Environmental Management Plan (Dredging)

Rosslyn Bay Boat Harbour 2016

By the State of Queensland acting through Queensland Department of Transport & Main Roads

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Document sign off

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Signature Date

Statement of Commitment

The Department of Transport and Main Roads and "CONTRACTOR" commits to achieving the environmental objectives outlined in this Environmental Management Plan, and ensuring the management actions herein are implemented.

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A COPY OF THIS ENVIRONMENTAL MANAGEMENT PLAN SHALL BE KEPT ON SITE AND BE AVAILABLE TO ALL STAFF ASSOCIATED WITH THIS PROJECT.

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APPENDICES

Preface

This Environmental Management Plan (EMP) details all elements of the Environmental Management Strategy to achieve best-practice environmental management for the maintenance of Rosslyn Bay Boat Harbour in 2016. This plan reflects the broader strategies outlined Long Term Management and Monitoring Plan (LTMMP) developed by TMR for the long term management of maintenance dredging in Rosslyn Bay Boat Harbour.

TMR has undertaken an assessment of dredge material management options given the proposed dredging need in 2012. This has resulted in a recommendation of continued use of the existing offshore disposal site (TMR (2012)). The outcomes of this investigation were further supported by an independent strategy investigation commissioned by the GBRMPA (SKM(2013)). In making this recommendation detailed plume and sediment redistribution modelling was carried out to assess the short and long-term fate of the dredging material and its potential for impact on sensitive ecosystems in the vicinity of the works area (BMT WBM (2012)). This modelling has been used along with historical monitoring and the extensive monitoring of 2012/13 in the development of the monitoring framework that is detailed in this document to ensure environmental risks are appropriately managed and mitigated. The monitoring framework will continue to evolve to support the maintenance works within the ten year planning period.

This EMP is to cover the dredging works for 2016 following harbour infilling from Tropical Cyclone Marcia in 2015. TMR have undertaken a significant volume of work to support long term permits for the maintenance of Rosslyn Bay Boat Harbour. Coastal processes understanding and modelling predictions have been validated via detailed monitoring for the past 3 dredging events. The outcomes of this work is that maintenance dredging at Rosslyn Bay Boat Harbour is a low risk activity.

The EMP is a living document that will be reviewed as required to ensure it continues to meet best-practice environmental management. Based on the recently approved 10 year permit TMR will formalise a Technical Advisory Consultative Committee (TACC) who will oversee the ongoing development of the management strategy based on monitoring outcomes. Details of the TACC requested membership and proposed meeting frequency are outlined in section 1.9.

1 Background and Purpose

1.1 Background

Rosslyn Bay Boat Harbour (RBBH) is one of 14 State Boat Harbours strategically positioned along the Queensland Coast to provide sheltered havens for recreational and commercial boating. It is located on the central Queensland coast, in the Rockhampton Regional LGA, approximately 8 km south of the township of Yeppoon. The harbour is within Keppel Bay and nearby the Mackay / Capricorn management area of the Great Barrier Reef Marine Park.

Department of Transport & Main Roads (TMR) manages Rosslyn Bay Boat Harbour on behalf of the State of Queensland, and is responsible for maintenance dredging of the entrance and internal navigation channels to the public boating facilities in the harbour and the public mooring area. Maintenance dredging of water leases and marina areas is the responsibility of harbour lessees.

TMR holds GBRMPA permit No. G16/38147.1, Sea dumping Act approval No. SD16/001, ERA Permit No. SPDE03383211, EA Permit No. EPPR03292815 and Tidal Works approval No. SPDC02622311 for dredging and spoil placement operations in Rosslyn Bay. This EMP and the permit conditions indicated in Appendix E make up the environmental management framework to guide TMR and its contractors in the best practice dredging of Rosslyn Bay Boat Harbour for this 2016 campaign. Figure 1 shows the location of the harbour, the offshore disposal site and the nearest identified sensitive sites (receptors) to dredging and disposal sites.

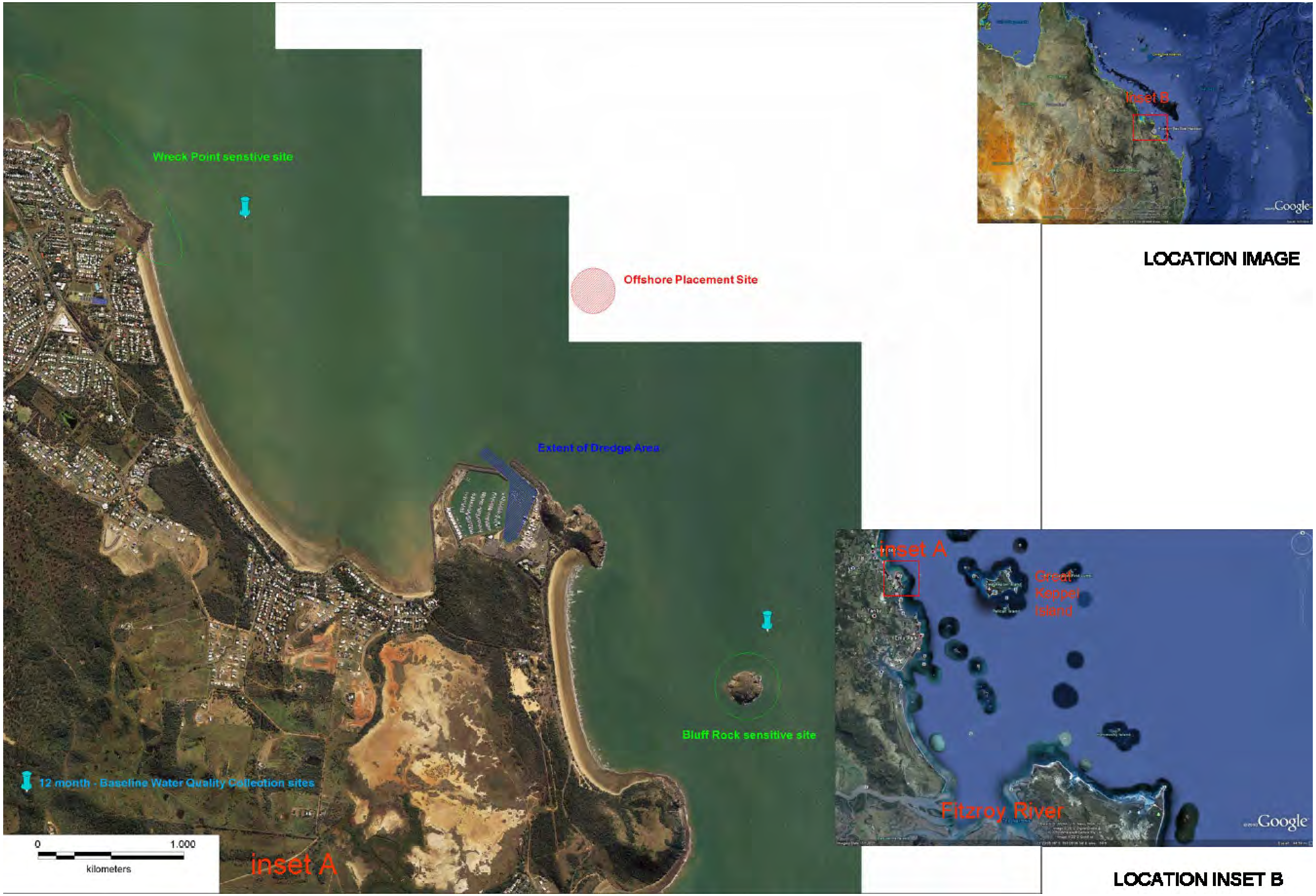

FIGURE 1 - LOCATION OF PROPOSED WORKS

1.2 Dredging Need

The harbour requires frequent maintenance dredging about every 3 to 5 years to maintain harbour access and internal public channels. The driver for frequent maintenance is the sediment escaping the Fitzroy River south of the harbour and its transport north via natural coastal processes. Historically maintenance dredging campaigns have been less than 40,000cu.m. The volumes of material extracted by previous dredging campaigns are summarized below.

Table 2-1 Historical dredged material volumes

Year	Total (m3)	Comments
1976	unknown	original harbour dredging
1977	unknown	harbour dredged again due to cyclone "David"
1983	approx. 10,000	maintenance dredging of access channels to the public jetty and public boat ramp
1987/1988	approx. 52,000	Combined capital and maintenance dredging of the channels and the mooring area. First time existing offshore disposal site used.
1991	unknown	Commercial Marina Capital Dredging – used for reclamation
1991/1992	approx. 26,000	maintenance dredging- pipeline to existing offshore disposal site
1997	31,137	maintenance dredging - pipeline to existing offshore disposal site
2002	29,153	maintenance dredging - bottom dumping barge to existing offshore disposal site
2006	31,000	Maintenance dredging – Trailing Suction Hopper Dredge
2009	24,000	Maintenance dredging – Trailing Suction Hopper Dredge
2012-13	78,000	Maintenance dredging – Cutter suction Dredge and Pipeline

10 Year Dredging Need

Given the current need for dredging TMR has conservatively calculated that a dredging need of up to 60,000cu.m may be require per campaign however likely to be less than 50,000cu.m (over potentially 4 campaigns over 10 years), in addition to this there is potential for cyclone infill above this (IE potentially immediately after dredging is complete). So a contingency allowance of 70,000cu.m has also been applied. Based on this the ten year dredging need is up to 280,000cu.m in total (Note: 'Contingency maintenance dredge spoil' means additional dredge spoil disposal other than regular maintenance disposal required to maintain existing facilities and navigable depths as a result of unexpected severe weather conditions)

Dredging Need for 2016

A Hydrographic Survey was undertaken in May 2015 following the crossing of Tropical Cyclone Marcia and based on this survey approximately 45,000cu.m requires dredging down to maximum dredge depth. Making an allowance for infill before dredging works commence approvals have been gained to dredge up to 60,000cu.m during the 2016 campaign.

1.3 Purpose

TMR has undertaken an assessment of dredge material management options given the proposed dredging need over the 10 year planning period. This assessment has resulted in a recommendation of continued use of the existing offshore disposal site (TMR (2012)). In making this recommendation detailed plume and sediment redistribution modelling has been carried out (BMT WBM (2012)) to assess the short and long-term fate of the dredge material and its potential for impact on potential sensitive receptors in the vicinity of the works area. This modelling has been used along with previous monitoring investigations in the development of a monitoring framework which contributes to the overall Long Term Environmental Management Strategy. This Environmental Management Plan (EMP) details all elements of the Environmental Management Strategy to achieve best-practice environmental management for the maintenance of Rosslyn Bay Boat Harbour.

Proper implementation of this EMP will minimise the risk of impact to the environment surrounding the dredging and disposal sites. Data from environmental monitoring will support continuous improvement in environmental performance through refinement of the EMP and LTMMP.

1.4 Management Plan Framework

The *National Assessment Guidelines for Dredging* (DEWHA 2009) details what EMP's should include and this has been used as the basis for this document;

1. ***Overall management framework** – describe how the EMP integrates with the overall management framework*
2. ***context** – put the proposal in the context of the local environment, including history of dredging and dredge material disposal at the site.*
3. ***description of the project** – provide information on dredging and disposal for the term of the plan or permit, including the location, staging, and timing of activities.*
4. ***information on approvals** – provide details of any approvals, relevant conditions and any other statutory requirements.*
5. ***description of the existing environment** – characterise the dredging and disposal sites and adjacent areas, including its water column, sediments, biota, resources and other uses (existing and potential) of the area.*
6. ***description of potential impacts** – address both potential short-term and long-term impacts and any uncertainties regarding the predicted impacts.*
7. ***management strategies and actions** – describe strategies and actions to mitigate impacts – including specific and auditable measures; performance indicators; monitoring requirements; corrective actions; and responsibilities and timing for management and monitoring activities.*
8. ***contingency arrangements** – identify corrective actions and contingency plans should undesirable or unforseen impacts occur.*
9. ***continuous improvement** – identify opportunities for continuous improvement to prevent, minimise or mitigate environmental impacts in the longer term.*
10. ***auditing requirements and reporting** – outline reporting and documentation standards, timing and responsibility of any auditing or reporting.*
11. ***review of management plan** – make provisions for a review of the management plan, including consultation with the TACC, to ensure it remains current.*

This EMP has been developed as a stand-alone operational document that ties together all aspects of maintenance dredging at Rosslyn Bay Boat Harbour. Because TMR may use different dredge contractors for individual dredging campaigns during the planning period it is important that the EMP comprehensively covers specific dredging equipment and methodologies for individual dredging campaigns. For this reason Appendix D includes a checklist of items within the EMP that need to be updated by the contractor when a contract is awarded. This checklist is included to ensure the EMP appropriately reflects the risks, procedures and actions for individual dredging campaigns and simplifies the review of the EMP with respect to project specific amendments.

1.5 Legislative Context

The Rosslyn Bay Boat Harbour dredging and placement of the resultant dredged material at sea within the Great Barrier Reef Marine Park requires approvals under both Commonwealth and State legislation. These are described below and copies of the approvals can be found in Appendix E.

1.5.1 Commonwealth Legislation

Environment Protection (Sea Dumping) Act 1981

The *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) was enacted to fulfil Australia's international responsibilities under the London Convention of 1972 and has been amended to implement the 1996 Protocol to the London Convention (which Australia ratified in 2001).

The Sea Dumping Act regulates the deliberate loading and dumping of wastes and other matter at sea. It applies to all vessels, aircraft or platforms in Australian waters and to all Australian vessels or aircraft in any part of the sea. The Act states that only uncontaminated dredged material may be disposed at sea. The then Dept of Environment, Water, Heritage and the Arts (DEWHA) has issued guidelines for sampling and testing sediment, which must be followed in order for a sea dumping permit to be issued.

The Sea Dumping Act applies in respect of all Australian waters (other than waters within the limits of a State or the Northern Territory inland waters), from the low water mark out to the limits of the Exclusive Economic Zone. The Act is currently administered by SEWPAC or the GBRMPA if dumping is to take place within the GBRMP.

In assessing any proposal under the Sea Dumping Act the proposal is also assessed under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

TMR's continued use of the existing ocean disposal site or alternative ocean disposal site necessitates the need for a sea dumping permit for the maximum period of 10 years.

Great Barrier Reef Marine Park Act 1975

The *Great Barrier Reef Marine Park Act 1975* (GBRMP Act) establishes a framework for the establishment, control, management and development of the GBRMP. The Act is administered by the GBRMPA. GBRMPA in deciding whether or not to grant a permission in relation to an application, and whether or not to impose any conditions on the permission must assess any proposal that has the potential to impact on the environment and on the social, cultural and heritage values of the Marine Park or a part of the Marine Park. The assessment is undertaken in accordance with the requirement of Regulations 88Q and 88R.

State marine park legislation is also assessed and a joint Marine Parks permit is considered where boundaries overlap.

TMR's continued use of the existing ocean disposal site or alternative ocean disposal site within the GBRMP necessitates the need for a permit under the GBRMP Act.

1.5.2 State Legislation

Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* (SPA) establishes the Integrated Development Assessment System (IDAS) which integrates a range of development approvals, including the *Coastal Management and Protection Act 1995, Environment Protection Act 1994* and *Transport Infrastructure Act 1994.*

The SPA also provides the framework for the regulation of land use and development within local government areas, in this instance Rockhampton Regional Council.

Coastal Protection and Management Act 1995

The *Coastal Protection and Management Act 1995* (CP&M Act) provides a framework for the development of regional plans which regulate development in coastal areas. The regulatory mechanisms are administered under the SPA. An assessment under the CP&M Act is triggered in relation to assessable development within tidal waters. This includes dredging and disposal of dredged material within tidal areas.

An IDAS application for operational works in relation to works within tidal waters and disposal of dredged material in tidal waters.

TMR has existing historical operational works approvals which last in perpetuity for dredging within the harbour (attachment A) and placement of this dredged material within the extends of the existing defined disposal facility (attachment B). Any change to the dredge area or footprint of the disposal area would require additional operational works approvals

Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides a framework for Environmentally Relevant Activities including dredging and disposal of dredged material. The regulatory mechanisms are administered under the SPA. An assessment under the EP Act is triggered in relation to a material change of use (MCU). The Act is triggered for any of the disposal options.

An IDAS application for an MCU which is an ERA16 (extraction) is required for dredging and disposal works.

TMR currently holds an ERA 16 (c) allowing the dredging and placement of up to 1,000,000t of dredge material a year. However TMR intends to hold an Environmental Authority to allow the dredging and placement of up to 100,000t given this is the extent of any dredging project proposed in the next 10 years.

Transport Infrastructure Act 1994, Transport Operations (Marine Safety) Act 1994, Transport Operations (Marine Safety) Regulation 2004

Maritime Safety Queensland (MSQ) is a Concurrence Agency for dredging and disposal works which may impact on maritime navigation. The Regional Harbour Master places conditions on any Development Approval to ensure Marine Safety is achieved.

TMR has conditions in its overall development approvals to cover Maritime Safety and is required to notify the RHM prior to the start of any works and seek advice and take direction from the RHM on any element of the project associated with navigational safety.

Aboriginal Cultural Heritage Act 2003

The *Aboriginal Cultural Heritage Act 2003* (ACH Act) and the *Torres Strait Islander Cultural Heritage Act 2003* came into force on 16 April 2004. Underpinning the Act is a "cultural heritage duty of care", which requires that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage.

The Act establishes a framework for the conduct and assessment of cultural heritage impact and processes to be undertaken in preparing Cultural Heritage Management Plans (CHMP) which will be followed by TMR during the course of any dredging campaign

1.6 Environmental Features

1.6.1 Regional Setting

Rosslyn Bay is a small embayment which forms part of the larger Keppel Bay. Keppel Bay is relatively shallow with water depth slowly increasing seaward. Its offshore extent is approximately 20 km and the distance between its southern end near the mouth of the Fitzroy Estuary to Great Keppel Island is approximately 40 km. Depths near the offshore boundary are approximately 15 m. The Fitzroy River is the major river discharging into Keppel Bay, with the tidal volume of the main channel estimated at 250 000 000 m3 at mid tide.

The catchment of the Fitzroy River is the largest catchment discharging to the Great Barrier Reef Lagoon. Sediments and nutrients together with anthropogenic pollutants originating upstream in the catchment are discharged from the Fitzroy River into the Fitzroy Estuary and ultimately into Keppel Bay and the Great Barrier Reef lagoon (figure 2; Webster et al. 2006).

It is clear from figure 2 that the impact on water quality from the natural discharge of the Fitzroy River is a very significant factor in the existing condition of the Keppel Bay area and is the primary driver of siltation within Rosslyn Bay Boat Harbour and the reason for its relatively frequent dredging requirement.

Figure 2

Landsat image of Fitzroy Estuary and Keppel Bay showing the plume of turbid water resulting from the 1989 flow event (Webster et al. 2006)

The Great Barrier Reef Marine Park Authority (GBRMPA) classifies the reef environments surrounding the broader Keppel Bay region as Coastal Southern Fringing Reefs. These systems are heavily influenced by episodic Fitzroy River flood plumes.

1.6.2 Sediment Deposition

The Rosslyn Bay Boat Harbour is in the Great Barrier Reef's High Nutrients Coastal Strip. This area is characterised by muddy sediments with elevated nutrient content introduced from the neighbouring Fitzroy River catchment.

Within Keppel Bay the concentration of total suspended solids is highly variable in both space and time. However, in general, the distribution of areas with high total suspended solids (TSS) tends to follow the distribution of bottom sediments with a high proportion of mud. These areas include the mouth of the Fitzroy Estuary, and the shallow foreshore along the western side of Keppel Bay extending north past Rosslyn Bay. The western side of Keppel Bay is relatively shallow and subject to waves from the east and south-east. These wave currents, combined with background tidal and wind currents, resuspend sediment into the water column. In addition, turbid water from the mouth of the Fitzroy Estuary is moved north-west to the western side of Keppel Bay by the prevailing currents (Webster et al 2006). Sediment transport modelling BMTWBM (2012) confirms these trends.

Fine sediments, or fine silts and clays with a particle size < 63 µm, are the greatest contributors to turbidity, as they are readily suspended by currents within the bay, and have relatively slow settling rates. Coarser sandy sediments (> 63 µm) are not easily suspended, settle relatively quickly, and consequently do not contribute so much to turbidity. Webster et al (2006) indicates that estimates of silt and clay delivery to Keppel bay from the Fitzroy River vary between 1.86 Mt year-1 and 10.47 Mt year-1. From historical sedimentation records it has been estimated that an average of 0.47 Mt year-1 of silt and clay have been deposited in Keppel Bay west of the Fitzroy River (Webster et al 2006).

This data confirms that the Fitzroy River plays a significant role in the existing Keppel Bay environment and is the primary source of sedimentation in Rosslyn Bay Boat Harbour given the harbour has no erodible catchment of its own. The shallow geography of Keppel Bay combined with significant sediment input from the Fitzroy River result in dominant wind, tide and wave conditions generating significant suspension of fine sediments into the water column. These typical conditions allow substantial volumes of fine sediment to enter the Harbour and the calm conditions within the harbour facilitate the siltation process that drives the ongoing need for maintenance dredging.

Given the above processes the most appropriate management measure is to return the uncontaminated sediment back to the coastal system from where it was sourced. This strategy does not increase the sediment load within the Keppel Bay system rather it maintains a condition consistent with Rosslyn Bay without a boat harbour that catches the sediment. Previous modelling and monitoring outcomes show that the dredging and placement activity does not impact on sensitive receptors. Modelling in 2012 showed that for the placement of 120,000cu.m of material to the offshore site, the resuspension process which occurs during high wind and wave events resulted in a very minor increase against background levels. Subsequent Monitoring in 2012-13 supported this prediction with it not being possible to quantify resuspension impacts against background levels. For the above reasons TMR’s strategy going forward is to focus on long term data collection to better understand the resuspension and redistribution processes from the placement ground in order to guide future dredging works.

The long term strategy going forward is to test the sediment to ensure it is clean, then place it back into the coastal system which it was sourced in the best way possible to minimise the impact of the redistribution process back to natural sediment flux levels.

The aim of the long-term strategy is to answer questions such as;

- What is the extent of change above background? Modelling and the 2012 monitoring confirm that the change is very small against background. During resuspension events high natural seabed resuspension occurs so the changes are occurring during naturally high turbidity periods. Because of this insufficient data exists to identify changes that can be attributed to Dredge Material Resuspension. For example, Modelling indicates more than a few hundred metres from the placement site, less than a 2% increase for peak events, which when the background is 300NTU is really not identifiable.

  (It must be noted that during calm conditions there is no resuspension so water quality is consistent with background.)

- What is the spatial extent of these changes? Use a control site and a series of impact sites over a long monitoring period.

- When the above two elements are better understood, can strategies be implemented to reduce these, consistent with the level of risk.

1.6.3 Aquatic Habitats in Rosslyn Bay

Although the boat harbour is excluded from the GBRMP, the surrounding waters are within the boundary and a range of marine habitats have been identified in the wider Keppel Bay Region.

The specific characteristics of these habitats surrounding the dredging and disposal areas have been described in detail by GHD (2005). Sub-tidal habitats near Rosslyn Bay Harbour and the disposal area consist primarily of soft sediments that provide habitat for benthic epifauna and infauna (GHD 2006). Epiflora and fauna at the spoil disposal area are characterised by soft coral communities and infaunal communities by annelid worms and arthropods (GHD 2006). In 2005, the infaunal community at the disposal ground was considered to be healthy and diverse, despite spoil having been disposed there since 1987 (GHD 2006).

Potential sensitive habitats near the boat harbour and existing spoil ground primarily include saltmarsh, mangrove and seagrass. Fringing reefs at Bluff Rock and Wreck Point, south and north of the harbour respectively, a couple of kilometres from the disposal site, have also been identified as receptors for consideration.

The previous monitoring campaigns in 2006 and 2009 and then modelling and monitoring in 2012 all concluded that the receptor sites of Bluff Rock and Wreck Point were too distant from the disposal site to be impacted by the dredging and placement works for dredging up to 120,000cu.m. The 2012 Modelling of re-distribution trends from the placement site indicated a minor increase above background conditions for turbidity and sedimentation. Monitoring in 2012 during the summer dredging campaign reflected the modelling predictions with the control site 11km south of the site reflecting the same turbidity trends as the receptor sites.

The 2012 model (BMTWBM (2012)) was calibrated against two monitoring datasets and included sediment and freshwater input from the Fitzroy River, providing a model that accurately reflects coastal processes that deliver sediment to Rosslyn Bay Boat Harbour and the background sediment transport processes in Keppel Bay. The model showed that the prevailing wind, tide, wave and freshwater input to Keppel Bay during the summer months result in significantly elevated background turbidity during this period (up to 200 NTU). This model prediction is supported by the field data collected by BMTWBM and CQU. The calibrated model also shows that the winter months as previously understood have lower background turbidity levels than in summer however these turbidity levels are still quite high in comparison to other parts of the GBR. These results indicate that the aquatic habitats in Rosslyn Bay are accustom to naturally high and variable turbidity levels and that winter/summer timing of dredging works is important in the assessment of impacts.

1.6.4 Saltmarsh

There are saltmarsh communities to the west of the harbour within an extensive low-lying area. The proposed dredging method and location of the spoil disposal ground will not impact these communities.

1.6.5 Mangroves

There are some scattered mangroves immediately adjacent to the harbour dominated by *Avicennia marina*, with the occasional individual *Rhizophora stylosa* trees. This western foreshore of the Bay is relatively high energy, and mangrove communities are restricted to more sheltered areas in the lee of Rosslyn Bay headland and associated outcrops. Mangroves along this foreshore grow in a narrow band in relatively marginal habitat that is restricted by the tidal range and prevailing sediment characteristics. The proposed dredging method and location of the spoil disposal ground will not impact upon these adjacent mangrove communities.

1.6.6 Seagrass

Although seagrass has been identified within the offshore waters surrounding the Islands of Keppel Bay, inshore waters provide poor conditions for the establishment of extensive seagrass beds. Benthic biota surveys completed by GHD (2006) have identified a small area of *Halophila ovalis* (~2m2) within the centre of the existing disposal area. Wider surveys of the disposal ground and adjacent reference sites failed to encounter additional seagrass.

1.6.7 Fringing Coral Reefs

There are 16 islands in Keppel Bay, and several prominent rocky outcrops. Many of these are surrounded by fringing coastal reefs, with most areas dominated by fast growing Acropora corals that extend into shallow waters. These species are particularly susceptible to thermal stress and bleaching (GBRMPA 2007). Reefs within the Keppel Bay region have been impacted by both flooding from the Fitzroy River 40 km to the south, and bleaching (GBRMPA 2007).

The rocky reef environments of Bluff Rock and Wreck Point have been identified as the most appropriate trigger points in managing the dredging works given their susceptibility to potential impacts.

1.6.8 Mobile Marine Fauna

In addition to these specific habitats there is potential for the dredging and disposal works to conflict with large marine fauna including dugongs, whales and turtles. Visual monitoring and operating procedures have been developed to mitigate potential impacts.

1.7 Description of Works

For the 2016 campaign it is estimated that TMR may need to dredge up to 60,000cu.m. The final dredge volume for the project will be assessed on the difference between pre and post hydrographic surveys. A map of the area to be dredged is provided in Appendix A.

It is proposed to dispose of dredged material at the previously approved off-shore disposal site located 1.1 km north east of the Rosslyn Bay Boat Harbour entry beacon at 23° 9.13" South, 150° 47.8" East (GDA94 - Zone 56). A map of the spoil ground is provided in Appendix B.

1.7.1 Proposed Dredging Methods

TMR has awarded a contract to Birdon (QLD) Pty Ltd to undertake the required scope of dredging works with a Cutter Suction Dredge (CSD) and Pipeline to the disposal site. This method and the proposed equipment is exactly the same used for the maintenance project in 2012-13 at Rosslyn Bay Boat Harbour.

Due to the distance from the dredge areas to the disposal area, a booster pump will be required to pump the material to the disposal site. Details of the dredge method are outline below.

1.7.2 Cutter suction dredge and pipeline

A cutter suction dredge is a non-propelled floating vessel. It consists of a combined pontoon structure of approximately 34m x 6.2m. The dredge contains a 10/8 high head gravel pump driven by an onboard diesel engine. Material is dredged by the use of a hydraulically driven cutter head, on the end of the dredge ladder, which is lowered to the seabed and while stirring/loosening the material it is sucked into the pipeline and transferred to the disposal area through the pipeline. The dredge is positioned and manoeuvred via a rear travelling spud system and front anchors. The travelling spud is a thick walled steel pipe which anchors the rear of the dredge and allows it to swing on an arc using the front anchors. The front anchors are set by the dredge using the anchor booms thereby enabling the dredge to operate without specialist support vessels. The travelling spud is attached to a longitudinal hydraulic ram which allows the dredge (and cutter) to be progressively moved into the cut face. Below is a photo of the dredge “Darwin” which did the 2012-13 campaign.

Figure 3 Cutter Suction Dredge “Darwin” (owned by Birdon (Qld) Pty Ltd)

Impacts

Dredge Area

The spud system allows for more accurate and efficient dredging while reducing the impact on other vessels using the harbour as anchors are placed close to the dredge area and all cables remain on the seabed. The material disturbance and turbidity created at the dredge area is minimal as compared to other dredging methods as the majority of the disturbed material is immediately sucked into the pipeline and transferred to the disposal area. However careful management is still required during spring ebb tides where turbid water may escape the harbour.

Disposal Site

The discharge pipeline will be positioned below the water surface to ensure sediment discharge as close as practical to the seafloor at the disposal site and moved periodically to spread the material to gain the required finish levels. Because the dredged material is placed down in the water column it will result in less turbidity in the upper parts of the water column.

The transfer of sediment from the dredge area to the disposal area will be via a continuously sealed pipeline. This removes any impact from the sediment in between the dredge and disposal areas.

1.7.3 Dredging Methodology

The dredge positioning will use a combination of DGPS and manual markings with depths manually checked to accurately dredge within the dredge area and monitor progress. Moored vessels in the dredge area will be removed as works proceed. In channel areas, the dredge will be positioned on one side of the channel and swing across the channel to dredge that area. This means that other vessels will be able to pass the dredge on each swing back to its side of the channel.

For most areas within the harbour, dredging will not be affected by the weather. Dredging of the entrance channel may be affected at times when prevailing winds or swells create conditions too rough for the dredge to operate. In most cases when this occurs, the dredge will be relocated to a more sheltered area so dredging can continue.

The dredge operates at a very slow swing speed and continually operates in the one area (does not traverse long runs like a trailer suction hopper dredge). The dredge crew will undertake visual monitoring for mobile marine fauna as detailed in Table 2.1. Due to the distance from the dredge areas to the disposal area, a booster pump will required. The booster will be located towards the end of the eastern breakwall. The booster consists of a diesel engine and fuel tank within a 6m modified shipping container with the pump direct coupled to the engine but immediately outside the container. The booster fuel tank shall be bunded to avoid hydrocarbon spills and a detailed refuelling procedure for the booster pump and dredge is provided in Appendix D to avoid spill events.

The discharge pipeline will be a combination of polyethylene and steel with flexible rubbers fitted as required. A floating pipeline of approx 80m will be attached to the rear of the dredge to provide manoeuvrability. The remaining pipeline will be submerged and rest on the seabed. The pipeline will be laid over the rock wall where it accesses the booster.

Dredging is to be undertaken 6 days per week (Mon to Sat).

The dredge, large workboat and onshore booster are equipped with emergency spill cleanup kits. Detailed procedures as to reporting and steps to control the discharge are included in the Oil Pollution Emergency Plans. See Appendix D.

The Emergency Strategy to be implemented by the contractor should a cyclone threaten the site are defined in Appendix D.

1.7.4 Disposal Methodology

The pipeline from the booster to the discharge area will be submerged and rest on the seabed. A flexible section near the end will allow for transition to a floating discharge and for manoeuvring of the discharge outlet.

The pipeline outlet shall be anchored and positioned using DGPS and moved intermittently to spread material evenly across the site. Periodic soundings or surveys will be undertaken to monitor the build up of material in the disposal area.

Periodic inspection of the pipeline will be undertaken and maintenance carried out to ensure its integrity between the dredge and the placement area.

1.8 Potential Dredging Risks

Given that the same areas will be dredged and used for disposal as have been historically used, the risks are well understood and the large dredging project undertaken in 2012-13 which used predictive modelling that was supported by the associated detailed monitoring program, further supported confidence in our understanding in the long term management of the site.

Based on this knowledge the long term management and monitoring strategy has been developed.

The primary risks associated with dredging of Rosslyn Bay Boat Harbour and offshore disposal relate to:

1. Seabed disturbance including:

a. the physical removal of the substrate and its associated flora and fauna from the dredge site; and

b. the smothering of the seabed at the dredge spoil placement site.

(Note: These impacts are unavoidable in order to carry out the approved works so are accepted impacts)

2. The suspension of fine sediment in the water column which can form plumes ‘down current’ of the harbour and the spoil disposal area, as a result of dredging and placement works, and the resulting blanketing and water quality impacts from the settling of sediment in the plume areas. (Modelling predictions have been validated by 3 monitoring events with placement up to 120,000cu.m, showing that impacts during the dredging and placement works do not impact sensitive receptors).
3. The re-suspension of fine sediment from the disposal site and the potential for blanketing and water quality impacts on sensitive areas.
4. The possibility of contaminants in some of the sediment to be released at the disposal site. While historical sediment sampling campaigns in 2001, 2005, 2009 and 2012 show that material dredged from Rosslyn Bay Boat Harbour is suitable for unconfined ocean disposal, there remains a risk that future material may not meet these requirements.
5. Translocation of marine pests on dredging plant / machinery. (TMR uses small local vessels that rarely travel outside of Australian waters so this risk is extremely low).

Marine incidents involving vessels, oil or fuel spills, collisions with large marine fauna, or spillage of material in transit to the disposal site.

1.9 Community Consultation

Consultation was undertaken with community representatives at the Capricorn Local Marine Advisory Council prior to the major dredging project in 2012-13. Once initial feedback is gained from approval authorities on our Long Term Management and Monitoring Strategy TMR intends to create a TACC in which to consult with appropriate stakeholders for the 10 year duration of our management strategy to ensure continuous improvement.

The TACC membership is intended to be made up of the following;

- GBRMPA Representative
- DEHP Representative
- DAFF Representative
- Representatives (two) from the Local Marine Advisory Council (LMAC)
- MSQ Harbour Master Representative
- TMR Representative

Because of the permit timing and the urgent need to undertake this current dredging campaign, there is insufficient time to formalise the TACC and meet prior to the start of this campaign. TMR has a long history of modelling and monitoring which shows this is a low risk maintenance project and the scope of monitoring defined in the EMP reflects that previously consulted in 2012-13 which included dredge volumes twice what proposed for the current project.

It is for this reason TMR will formalise the TACC and send them a copy of this EMP as soon as it is approved and organise a post dredge meeting to discuss the outcomes within 2 months of the conclusion of the dredging works.

For all future campaigns TMR will hold a TACC meeting a minimum of 2 months prior to any planned maintenance project (to outline the proposed scope of works and discuss and refine the monitoring strategy) and within 2 months of the conclusion of dredging works (to discuss the outcomes of the dredging works, volumes dredged and monitoring outcomes in which to drive continuous improvement).

The final EMP document will be placed on TMR's website when finalised for public information and contact details provided if the public wishes to provide feedback on the document.

2 EMP management strategies

This component of the EMP outlines mitigation strategies for the protection of specific environmental values that may be affected by dredging and disposal of dredged sediment.

Individual management strategies have been prepared for:

- Sediment characteristics;
- marine flora and fauna;
- water quality;
- waste management;
- spill response and emergency procedures; and
- air and noise.

The following parties have responsibilities under this EMP:

TMR	MSQ, Program Management and Delivery (The Principal)
Superintendent	TMR, Engineering and Technology
Contractor	Birdon (Qld) Pty Ltd
TMR environmental consultant	GHD and SeaResearch
ESS	Environmental Site Supervisor - GBRMPA

Management strategies may be revised and updated based on experience. Any changes will be approved by approval agencies. It is intended that specific work instructions be prepared for staff and contractors as the details of dredging methods and conditions of approval for each project are finalised. The following management measures will be implemented to minimise these impacts.

2.1 Sediment Characteristics

Addresses Primary Risk 4:

Objective

To ensure material proposed to be dredged and placed at the offshore disposal site has similar physical and chemical properties to the surrounding sediments in Rosslyn Bay.

Environmental Risk

Given Rosslyn Bay Boat Harbour has considerable boat traffic, boat maintenance facilities and a significant volume of hardstand parking area draining to the Harbour there is a risk although small that some of the sediment within the harbour could become contaminated. Some elevated TBT levels were identified 15 years ago and recently following Tropical Cyclone Marcia in 2015 (in an isolated area). Additional assessment was undertaken in accordance with NADG (2009) which concluded that the material was suitable for unconfined offshore placement. As detailed in Appendix C.

Table 2.1 Sediment Characteristics Assessment Strategies

Action	Responsibility
• TMR undertakes annual seabed monitoring surveys to assess the volume of siltation in the navigational channels in order to plan for dredging campaigns. When siltation rates reach a level that require dredging a consultant will be commissioned to develop a Sediment Sampling Analysis Plan (SAP) for the extent of the proposed dredging area in accordance with NAGD (2009).	TMR
• TMR will forward a copy of the SAP to GBRMPA and DEHP for review	TMR
• Subject to concurrence from GBRMPA and DEHP on the content of the SAP sediment sampling will be undertaken and a report drafted on sediment characteristics. This report will assess the sediment in accordance with the NAGD (2009). Dredge material cannot be placed to the offshore site unless it meets NAGD(2009) and the sediment analysis has been approved by GBRMPA.	TMR's consultant

Performance indicators

Sediments must be suitable for ocean disposal in accordance with NAGD (2009).

Monitoring and reporting

A final sediment sampling report shall be provided to GBRMPA and DEHP prior to the commencement of each dredging campaign. All samples must have contaminant concentrations at levels low enough to be suitable for unconfined offshore placement in accordance with the NADG(2009).

Corrective action/contingency plan

In situations where the performance criteria cannot be met alternative disposal options must be utilised.

2.2 Marine Flora and Fauna

Addresses Primary Risks 2, 3 and 5:

Objectives

To minimise direct and indirect disturbance to marine flora and fauna other than within the immediate works areas.

To ensure turbid plumes from the works and re-suspension of material from the disposal site do not impact the ecological character and integrity of the adjacent sensitive receptors.

Gain further knowledge on impact trends associated with the resuspension process from the disposal site.

Environmental Risk

The material dredged from Rosslyn Bay Boat Harbour is sourced from the adjacent coastal system in Rosslyn Bay and hence placement of this material back into the littoral system is not increasing the sediment within the system. For this reason the environmental risks of these works are broken down into the following.

1. Direct impacts on Marine Fauna from the dredging and disposal works.
2. Direct impacts at the dredge and disposal areas due to substrate removal and smothering.

3. The potential for short-term impacts of plume transport from dredging and disposal activities on sensitive receptors
4. The potential for short/medium-term impacts associated with the re-distribution of dredged sediment from the disposal site on sensitive areas,

GHD (2006) identified no sensitive environments in the immediate vicinity of the proposed dredging and disposal works. Their investigations identified the sensitive fringing rocky habitats of Wreck Point and Bluff Rock (Iron Pot) as of most significance in the general vicinity of the works. Their monitoring and the 2012-13 monitoring also concluded that benthic epiflora and infauna within and immediately adjacent to the placement site recovered rapidly between dredging events. Monitoring undertaken by TMR during the 2006, 2009 and 2012-13 dredging campaigns confirmed that these sites were not impacted by dredging and disposal works for dredging volumes up to 120,000cu.m and that the turbidity plume returned to background levels within 200m of the disposal site. Given the above findings, risk item 3 has been shown to be negligible for the extent of works previously undertaken.

Dredging in the Harbour

BMTWBM (2012) modelling indicates that for the worst case summer peak spring tides when turbidity is created by dredging (or excessive vessel movements) there is a potential for the associated plume to reach Bluff Rock at TSS levels between 5 and 10mg/l above background. The winter simulation indicates that such a plume would not reach Bluff Rock. Given summer conditions represent the period of highest natural turbidity and the time of exposure is very short, and because it takes the full extent of the tide to reach the site the extent of impact would be very small. The monitoring data from 2006 and 2009 indicated the model was generally overestimating the plume extent and the monitoring from 2012-13 did not show impacts at the Bluff Rock site logger as a result of plume release. However monitoring did show that a visible plume did escape the harbour and transported a significant distance towards Bluff Rock before the tide changed. Given the modelling indicated that for the worst case tidal conditions the plume could just reach Bluff Rock and monitoring supported this prediction then there is justification for further mitigation measures and monitoring to ensure this does not occur.

It is important to note that such a plume event that has potential to reach Bluff Rock only occurs in the worst case scenario and would be very short lived, because the ebb currents driving the plume in the direction of Bluff Rock only last for a couple of hours. As the natural variability of water quality in the Bluff Rock area is high the potential impacts from a short lived, relatively low concentration turbidity plume are likely to be minor.

The volumes proposed for any dredging campaign will not change the impacts from the dredging site other than increasing the number of spring ebb events where dredging may be occurring, due to the increased duration of the campaign.

However this outcome indicates the need to install mitigation measures to reduce the release of plumes during these tidal conditions and undertake compliance monitoring to ensure that any potential impacts are being appropriately mitigated.

Dredge Material Placement Site

BMTWBM (2012) modelling was undertaken to assess the impacts of a 40,000cu.m project, an 80,000cu.m project and a 120,000cu.m project starting in summer and winter at the disposal site. The modelling period extended for 12 months including the period for dredging works up to 120,000cu.m and the remaining period modelled the continued redistribution process from the disposal site. Previous monitoring in 2006 and 2009 indicated that for a dredged volume of up to 31,000cu.m, plume impacts (associated with the placement process) above background were contained within 100m of the disposal site. The 2012 modelling indicated for a summer commencement of the dredging campaign the material was redistributed faster than for the winter commencement. This resulted from the differing seasonal wave climate however, after the 12 month period the resulting disposal site condition was very similar for both simulations.

Both simulations showed that the sediment redistributed from the disposal site did not result in accumulation of sediment and associated smothering of areas outside the near vicinity of the disposal site (i.e., 1mm of sedimentation extended a maximum of 300m from the boundary of the disposal site for the worst case). The model trend was that the sediment when mobilised from the disposal site was dispersed rapidly by the dominant wave and current conditions returning to the littoral system at concentrations consistent with background fluxes. Once the material escaped the disposal site back into the coastal system it behaved largely as it had before entering the harbour, moving in response to the natural forcing mechanisms. Given this outcome the primary transport mechanism is away from Bluff Rock and hence no impacts are predicted for this site from disposal works. The redistribution process is north, north-west however the modelling indicates that the anthropogenic impacts of the placement at the disposal site and subsequent redistribution are not likely to impact Wreck Point. However Wreck Point is the sensitive receptor with the highest potential for impacts and hence should be a focus for monitoring.

Risks Identified from the Modelling and Monitoring

- The overall risks of dredging works of up to 120,000cu.m are that there is a small potential for Bluff Rock to be impacted by turbidity from the dredging works escaping during peak spring ebb tidal flow. This does not present a significant risk given the rarity of such an event, the small magnitude and the short time period it could occur for. However mitigating measures and monitoring are to be in place to best manage this.
- Other than that discussed above the dredging and placement works themselves have been shown by modelling and monitoring results to date to be contained very locally to the works area and do not represent a risk to the sensitive areas.
- Modelling did not predict significant impacts to the identified sensitive receptors resulting from the redistribution of dredged material from the disposal site and monitoring in 2012-13 confirmed this prediction. With the wind and wave events which apply sufficient forces to resuspend the placed material also resuspending the natural seabed as part of the natural sediment transport processes. This resulted in the potential impact sites showing the same turbidity/light trends as the control site. However insufficient data exists to understand the natural differences between these two sites in order to quantify resuspension impacts. (IE Wreck Point because of its location has naturally higher turbidity during high wind /wave events than the control site and Bluff Rock.). The outcome of the 2012-13 monitoring is that the impacts from redistribution are small as they cannot be clearly detected above background. However going forward TMR wishes to better quantify the redistribution impact in order to keep improving environmental management in our long term maintenance strategy.

Mobile marine fauna such as fish, dugong, turtles and cetaceans will generally avoid areas that are temporarily impacted by turbid plumes generated by dredging and spoil disposal activities. The dredging campaign will be relatively short, therefore the impacts of any localised reduction in water quality will be temporary. There is little likelihood for substantial numbers of turtles, crocodiles, dolphins, whales and dugong to be present within the vicinity of dredging and ocean disposal activities. However, should these fauna be present during dredging, there is the potential for injuries to occur through individuals being disturbed, struck or captured by the dredge head (namely turtles). In order to minimise the potential for capture of marine turtles a turtle deflecting device will be fitted to the dredge head where practical for dredge plant used and visual monitoring will be undertaken by the contractor for the duration of the campaign.

Operational risks of the dredging program to marine mammals and reptiles and their associated mitigation measures are summarised below. More detailed strategies are given to protect dolphin, dugong and turtles, as it is considered that whilst the risk is low, these are the most likely to be encountered. The risk management strategy is underpinned by a constant visual monitoring of the water area surrounding the dredge for the presence of marine mammals and turtles. Any damaged marine mammals or turtles will be reported immediately to the DEHP Hotline.

Reporting

The contractor is to record any observed cetaceans in the dredge log outlining date, time and general location.

Table 2.2 Marine Fauna and Flora Management Strategies

Taxa and Operation	Risk	Likelihood of Risk	Justification	Risk Mitigation Strategy	Responsibility
General				Maintain the extent of the turbidity plumes close to the dredging and disposal areas to minimise impacts on marine fauna habitat.	DTMR & Contractor
				Visually observe for large marine fauna such as dugong, whales, crocodiles or turtles in the works areas. Follow procedures below, and as directed by ESS.	Contractor
				In the event that a native animal is injured, adopt procedures outlined in Section 2.7.6.	Contractor
				If the death of a listed species is suspected to have occurred in or near the works area, adopt procedures outlined in Section 2.7.6.	Contractor
				Inspect dredge hull for marine pests prior to travelling to site if vessels from outside Australia are to be used.	
Cetaceans/Dolphins					Contractor
Dredging	Interaction between Cetaceans and dredge head	Very Low	Cetaceans likely to temporarily move away from dredge area at commencement of works	Stop dredging if Cetaceans are sighted within 300 m of dredge head. Cetaceans can be driven away from area by mechanical noise (e.g. banging iron pipe underwater). Dredging not to commence until 20 minutes after they have left the 300m boundary.	Contractor

Taxa and Operation	Risk	Likelihood of Risk	Justification	Risk Mitigation Strategy	Responsibility
Dredging	Noise associated impacts	Very Low	Noise associated with dredging activities is typically constant rather than intermittent. Noise generated by dredging is likely to be at low frequency due to the nature of the seabed and dredging equipment. Cetaceans are relatively robust to low frequency noise compared to high frequency noise.	None	Contractor
Dredge under steam to / from spoil ground	Physical injury of dolphins due to vessel strike	Very Low	Dolphins are highly mobile and are commonly observed bow riding marine vessels	None	Contractor
Dredge under steam to / from spoil ground	Separation of pod / younger animals	Very Low	Dolphins are highly mobile and are commonly observed bow riding marine vessels	None	Contractor
Dumping of dredge spoil	Physical injury of dolphins during disposal of dredge spoil	Very Low	Dolphins are highly mobile and are likely to move away during spoil disposal	Delay spoil disposal if dolphins are in the area. Dolphins can be driven away from area by mechanical noise (e.g. by banging an iron pipe underwater (McIwem 2006).	Contractor
Dredging / spoil disposal	Reduction in food availability	Very Low	Fish stocks are mobile and although they may move from the immediate works area, are expected to return upon cessation of works.	None	Contractor
Dredging / spoil disposal	Changes to water quality	Very Low	Turbidity-associated changes to water quality with dredging / disposal activities are likely to have little impact on dolphin populations. Increased turbidity may lead to increased predation on fish by dolphins	None	Contractor
Dugong					
Dredging	Interaction between dugong and dredge head	Very Low	Dugongs are unlikely to occur in the proposed dredging area due to sparse seagrass cover in this area	Stop dredging if dugongs are sighted with 300 m of the dredge. Deter dugong by mechanical noise (e.g. banging iron pipe underwater).	Contractor

Taxa and Operation	Risk	Likelihood of Risk	Justification	Risk Mitigation Strategy	Responsibility
Dredging	Noise associated impacts	Very Low	Dugongs are less acoustically sensitive than dolphins. Noise associated with dredging activities is typically constant rather than intermittent. Noise generated by dredging is likely to be at low frequency due to the nature of the seabed and dredging equipment.	Visual surveys for dugong prior to commencement of works to ensure no dugong are present. Stop dredging if dugongs are sighted with 300 m of the dredge. Mechanical noise (e.g. banging iron pipe underwater) may deter dugong from the area. Dredging not to commence until 20 minutes after they have left the 300m boundary.	Contractor
Dredge under steam to / from spoil ground	Physical injury to dugong due to vessel strike	Very Low	Dugong mobile and are likely to move away from vessel	Vessel to slow down if dugongs are sighted in transit to / from the spoil disposal site.	Contractor
Dredge under steam to / from spoil ground	Separation of mother and calf	Very Low	Few dugong are expected to occur in the area as seagrass cover is sparse across the dredging and disposal sites	Vessel to slow down if dugongs are sighted in transit to / from the spoil disposal site.	Contractor
Dredging / spoil disposal	Physical injury due to disposal operations	Very Low	Dugongs are unlikely to occur in the proposed disposal area, due to low abundance of seagrass. Dugong are mobile and are likely to move away from vessel	None	Contractor
Dredging / spoil disposal	Degradation of feeding grounds	Very Low	Seagrass cover is sparse within proposed dredging and spoil disposal area. *Halophila ovalis* (the dominant species of the study area) is a colonising species, and is expected to quickly re-colonise disturbed areas.	None	Contractor
Turtle					
Dredging	Interaction between turtle and dredge head	Moderate	Turtle are unlikely to occur in proposed dredging area due to lack of habitat and food sources in this area.	Stop dredging if turtle are sighted with 50 m of the dredge. Mechanical noise (e.g. banging iron pipe underwater) may deter turtle from the area.	Contractor
Dredging	Noise associated impacts	Very Low	Turtle are not acoustically sensitive.	None	Contractor

Taxa and Operation	Risk	Likelihood of Risk	Justification	Risk Mitigation Strategy	Responsibility
Dredge under steam to / from spoil ground	Physical injury to turtles due to vessel strike	Moderate	Turtles are susceptible to boat strike. However the dredge will be moving relatively slowly when compared to other boats in the area.	Vessel to slow down if turtle are sighted in transit to / from the spoil disposal site.	Contractor
Dredging / spoil disposal	Physical injury due to disposal operations	Low	Turtles are mobile and likely to move away from the area	None	Contractor

The sediment sampling reports completed by frc environmental (2009 and 2012), see Appendix C, indicated that all samples are below screening levels in the National Ocean Disposal Guidelines (2002) and NADG (2009) with the exception of Antimony and Nickel levels that were just above screening levels. Webster et al (2006) shows these higher levels of Antimony and Nickel are present within the Fitzroy River Catchment and subsequently not likely to cause adverse impacts. The sediment sampling results were consistent with the previous extensive sediment sampling completed by GHD (2005). For this reason environmental risk associated with sediment contamination at the dredging and disposal site is low. TMR's current campaign is supported by a sampling program completed in 2015, this identified some elevated TBT in an isolated area of the Harbour (Area F). Subsequently additional sampling and assessment was undertaken in accordance with NADG (2009) which concluded the elevated levels were very localised and did not present a risk to the receiving environment and hence in accordance with the NADG (2009) the material was found to be suitable for unconfined ocean disposal. (See reports Appendix C) Water chemistry is also part of the monitoring program, pre, during and post the dredging works.

Performance indicators

Physical disturbance to the substrate does not extend beyond the footprint of the dredging area shown on permit applications.

Physical disturbance (smothering) at the disposal site to be contained within the area predicted by the modelling.

No marine fauna incidents.

Sightings of rare, endangered and threatened animals likely to be impacted by the works are reported to the Superintendent and the ESS.

Monitoring and reporting

All sightings of rare, endangered and threatened animals including marine mammals, turtles and crocodiles, which could possibly have been impacted by the works, will be recorded and reported to the Superintendent, who will forward details to the DEHP and the ESS.

Pre and post Hydrographic surveys to be undertaken to confirm dredging area and extent of changes at disposal site and surrounding areas in accordance with modelling outcomes.

A program of benthic monitoring is to be undertaken in accordance with table 3.3 to assess potential impacts and extent of impacts from resuspension and recovery.

These reports shall be provided to GBRMPA or DEHP on request and provided within 60 days following the completion of the monitoring program.

Corrective action/contingency plan

All incidents involving flora or fauna are to be reported to the Superintendent and the ESS.

Dredging outside of approved areas is a breach of approval conditions and shall be reported to the Superintendent and the ESS and remediation works shall be undertaken to the satisfaction of approval agencies.

Disposal of material outside the designated disposal site is a breach of approval conditions and shall be reported to the Superintendent and the ESS and remediation works shall be undertaken to the satisfaction of approval agencies.

2.3 Water Quality

Addresses Primary Risks 2, 3 and 6:

The GBRMP Water Quality Guidelines (2010) indicate the need for the following framework:

1. Identify Environmental Values
2. Set Water Quality Objectives
3. Put in Place Monitoring and Assessment Programs
4. Management Response based on outcomes

TMR's previous long term dredge strategy identified the fringing rocky reefs of Wreck Point and Bluff Rock as Environmental Values of most concern and susceptibility in the vicinity of the dredging and disposal works. For this reason TMR has maintained the focus on these elements.

The GBRMP WQ guidelines specify the following measurement parameters; Water Clarity, Suspended Solids, Sedimentation and Contaminants.

Historical sediment sampling events (2000, 2005, 2009 and 2011) have indicated no contamination above screening levels specified in the NAGD (2009). For this reason no issues with contamination are expected to impact on water quality during the dredge works. Periodic water samples will however be collected prior to, during and following the dredging project and tested for heavy metals and nutrients to confirm this.

The remaining parameters of water clarity (LIGHT), suspended sediments and sedimentation will be the primary focus of the Water Quality monitoring program under this EMP and TMR's Long Term Strategy. The objective being to collect a long term dataset of water quality at Wreck Point (Potential Impact site) and Zilzie Point (Control site) in order to better quantify the impact associated with dredge material resuspension.

TMR has commissioned a 24 month monitoring program at Wreck Point and Zilzie Point in similar water depth to the Rosslyn Bay offshore disposal site. The intention of this program is two fold.

1. to capture background water clarity, suspended solids and sedimentation trends and measure the seasonal natural variability of water quality on which to sensibly consider impacts associated with resuspension from the placement site.
2. to capture water quality conditions during and following the 2015 dredging campaign. However given the results of the last 3 monitoring and modelling investigations, the dredging and placement works do not pose a risk to the sensitive sites and for this reason these loggers will not be used for real time compliance.

This methodology has been chosen to better quantify the impact of the resuspension process from the disposal site which is the main uncertainty in the management of Rosslyn Bay Boat Harbour. The results of this long term monitoring will be used to develop strategies for future campaigns to minimise any anthropogenic impacts associated with the redistribution process and the development of more refined monitoring strategies. This will benefit the management of Rosslyn Bay Boat Harbour but will also provide further knowledge of dredge material redistribution processes to feed into all maintenance dredging knowledge generally.

TMR plans to undertake 2 vessel based compliance monitoring campaigns during the 2015 dredging event in which to confirm past monitoring outcomes associated with the localised impacts from the dredging and placement. In the very unlikely event trigger values are exceeded at either of the sensitive sites as a result of the dredging or placement then more intensive monitoring works will be implemented as outlined in section 3.2 to ensure sensitive receptors are not impacted. The implementation of more intensive monitoring will occur in consultation with the ESS and DEHP.

Modelling and previous monitoring indicates that there is a potential for a plume to just reach Bluff Rock during peak spring ebb tides from dredging works however if it was to occur it would be very short lived. Although this presents a very low risk of environmental impact it could be perceived negatively by the community. For this reason to mitigate these risks, Entrance channel dredging works are NOT to occur during peak spring ebb tide flows to reduce the potential for plume transport from the harbour towards Bluff Rock.

In the event the plume associated with the dredging or placement extends (IE above background levels) beyond 500m from the source, dredging works are to be altered to reduce the plume extent. If the plume extends to the identified sensitive sites and creates turbidity levels above the 80th percentile for that season for four consecutive 3 hour readings, the dredging works are to cease until background conditions are returned. If this occurs then higher intensity monitoring works (as per section 3.2) will be undertaken for the remaining dredging project.

Using the available data in accordance with the Queensland Water Quality Guidelines the 80th percentile exceedance has been calculated which are being used for both sites for light, turbidity and sedimentation (see section 3.2). TMR intends to use TSS as the main compliance trigger for impacts at the two sensitive receptors. However as indicated, during the 3 past monitoring events no impacts have been identified and hence are very unlikely during this dredging campaign.

Objective

To provide protection to the biological integrity of waterways adjacent to the work site.

Environmental Risk

BMT WBM (2012) undertook a modelling investigation to assess the following potential impacts based on dredging projects of 40,000cu.m, 80,000cu.m and 120,000cu.m in summer and winter:

1. Extent of turbidity impacts from the dredging in the harbour;
2. Extent of turbidity impacts from the disposal of dredged material; and
3. Extent of re-suspension impacts of material from the disposal site.

The results of this investigation are detailed in BMT WBM (2012).

GHD (2006) identified no sensitive environments in the immediate vicinity of the proposed dredging and disposal works. Their investigations identified the rocky reefs of Wreck Point and Bluff Rock (Iron Pot) as of most significance in the general vicinity of the works. Monitoring undertaken by TMR during the 2006, 2009 and 2012-13 dredging campaigns confirmed that these sites were not impacted by dredging and placement works for dredging volumes up to 120,000cu.m and that the plume returned to background levels within 200m of the disposal site.

Dredging in the Harbour

BMT WBM (2012) modelling indicated that for the worst case summer peak spring tides there is a potential for the associated plume to reach Bluff Rock at TSS levels between 5 and 10mg/l above background. The winter simulation indicates that such a plume would not reach Bluff Rock. The monitoring data from 2006 and 2009 indicates the model is generally overestimating the plume extent so for this reason can be considered a worst case potential.

It is important to note that such a plume event that has potential to reach Bluff Rock only occurs in the worst case scenario and would be very short lived, as the ebb currents driving the plume in the direction of Bluff Rock only last for a couple of hours. As the natural variability of water quality in the Bluff Rock area is high the potential impacts from a short lived, relatively low concentration turbidity plume are likely to be minor, however monitoring is being undertaken to further confirm that impacts are not occurring.

From previous monitoring campaigns potential impacts can be further mitigated by avoiding dredging near the harbour entrance during peak ebb spring tidal flows.

Dredge Material Placement Site

BMT WBM (2012) modelling was undertaken to assess the impacts of a 40,000cu.m project, an 80,000cu.m project and a 120,000cu.m project starting in summer and in winter at the disposal site. The modelling period extended for 12 months including the period for dredging works up to 120,000cu.m and the remaining period modelled the continued redistribution process from the disposal site. Previous monitoring in 2006 and 2009 indicated that for a dredged volume of up to 31,000cu.m plume impacts above background were contained within 100m of the disposal site. The 2012-13 modelling indicated for a summer commencement of the dredging campaign the material was redistributed faster than for the winter commencement. This resulted from the differing seasonal wave climate however, after the 12 month period the resulting disposal site condition was very similar for both simulations.

Both simulations showed that the sediment redistributed from the disposal site did not result in accumulation of sediment and associated smothering of areas outside the near vicinity of the disposal site (that is, 1mm of sedimentation extended a maximum of 300m from the boundary of the disposal site for the worst case). The model trend was that the sediment when mobilised from the disposal site was dispersed rapidly by the dominant wave and current conditions returning to the littoral system at concentrations consistent with background fluxes. Once the material escaped the disposal site back into the coastal system it behaved largely as it had before entering the harbour, moving in response to the natural forcing mechanisms. Given this outcome the primary transport mechanism is away from Bluff Rock and hence no impacts are predicted for this site from resuspension from disposal site. The redistribution process is generally north, north-west however the modelling indicates that the anthropogenic impacts of the placement at the disposal site and subsequent redistribution are not likely to impact Wreck Point. However Wreck Point is the sensitive receptor with the highest potential for impacts and hence is the main focus of monitoring in the long term strategy.

Risks Identified from the Modelling

The overall risks of dredging works of up to 120,000cu.m are that there is a small potential for Bluff Rock to be impacted by turbidity from the dredging works for the worst case peak spring ebb tidal flow.

Within the near vicinity of the disposal site the redistribution process is predicted to elevate turbidity levels. So the extent of impact in this area needs to be assessed. Previous impact assessments indicate that areas in the near vicinity of the disposal ground were not significantly impacted by the redistribution process between dredging events. This is likely due to the impacts being short-term and temporary, with background turbidity levels likely returning soon after the completion of disposal.

Modelling does not predict significant impacts to water quality at sensitive receptors (Bluff Rock and Wreck Point) resulting from the placement and redistribution of dredged material at the disposal site however monitoring is required to further confirm this, with the majority of resources focused on redistribution processes.

Table 2.3 Water Quality Management Strategies

Action	Responsibility
Undertake monitoring as detailed in section 3.2.	TMR Consultant/Contractor
Not dredge near the harbour entrance during peak spring tide ebb flow events to reduce the escape of plumes from the harbour.	Contractor
Ensure safe and effective fuel, oil and chemical storage and handling.	Contractor
Contain any fuel, oil or chemical spills and clean up immediately.	Contractor
Ensure quick release of dredged sediment from the hopper/pipe to minimise the turbidity plume.	Contractor
Ensure no leakage from dredge/hopper barge/pipe during transit	Contractor
Ensure dredge material is placed within the disposal area via the positioning of the outlet via DGPS and checking the outlet location with GPS twice a week and immediately after significant weather events.	Contractor
Ensure dredge material is spread over the disposal area to avoid mounding.	Contractor

Performance indicators

- the requirements of Section 2.7 of this EMP have been satisfied
- compliance with the “Spill Response & Emergency Procedures” Strategy
- monitoring extent of plume impact does not extend to sensitive receptors
- satisfactory results of EMP implementation audits.

Monitoring and reporting

- The results of the monitoring program will be available to the contractor, ESS, TMR, DEHP and GBRMPA throughout the dredging campaign on request and the final monitoring report will be provided to DEHP and GBRMPA within 60 business days of the completion of any monitoring program.

Corrective action/contingency plan

- In the event of non-compliance the response will be as per section 3.2
- Adopt procedures outlined in Section 2.7.6 Incident and Non Conformance Reporting.

2.4 Waste Management

Addresses Primary Risk 6:

Objective

To minimise the production of waste, and ensure waste that is produced is stored and disposed of lawfully.

Environmental Risk

All TMR contractors are required to manage waste in accordance with Environmental Protection Policy (Waste) and for this reason environmental risk associated with waste management is low.

Table 2.4 Waste Management Strategies

Action	Responsibility
On vessels, allocate areas for solid and liquid waste storage. Waste will not be stored outside these areas. Any waste fuels, oils or other chemicals shall be collected in separate drums and transported to an approved facility for disposal	Contractor
If wastes listed as ‘trackable wastes’ are handled or transferred, documentation in accordance with Environmental Protection Policy (Waste) will apply (refer EPP Waste).	Contractor
Waste will be removed from vessels and disposed of at an approved facility.	Contractor
Housekeeping procedures, including spillage control, will be implemented to minimise the generation of waste.	Contractor
All waste awaiting disposal will be stored appropriately	Contractor

Performance indicators

- Appropriate waste receptacles are on board.
- All waste is disposed of lawfully.

Monitoring and reporting

- A record/manifest will be maintained for general and regulated waste disposal. The manifest shall record the type of waste, and the point and date of disposal.

Corrective action/contingency plan

- Failure to meet the performance criteria shall be recorded as a non-conformance incident and be dealt with in accordance with Section 2.7.6.

2.5 Spill Response and Emergency Procedures

Addresses Primary Risk 6:

Objective

- To minimise the risk of spills or unplanned situations that might cause environmental harm.
- To ensure that contingency measures are in place and implemented in the event of such spills or unplanned situations.

Environmental Risk

All TMR contractors are required to confirm Emergency Response Procedures, via training prior to the commencement of works and for this reason environmental risk associated with spill response and emergency procedures is low.

The Contractors vessels shall be equipped with suitable spill kits and will be operated in accordance with the Maritime Safety Queensland (MSQ) approved Oil Pollution Emergency Plan (see Appendix D).

In addition, MSQ have in store at the harbour comprehensive oil spillage equipment. This includes 195m of 300mm high fence boom, 250m of absorbent boom, one mini skimmer with pump, anchor kit for boom, 10,000 litre portable tank and absorbent pads.

Table 2.5 Spill Response and Emergency Procedure Management Strategies

Action	Responsibility
All refuelling is to be done by licensed fuel suppliers in accordance with their Standard Operating Procedures.	Contractor
Refuelling will take place at wharves suited to tanker access. In the event that it is necessary for the contractor to refuel vessels or plant in the works area operations will be in accordance with industry standards.	Contractor
Provide a Construction Workplace Plan, prior to the commencement of any works.	Contractor
Maintain an Emergency Contact List with an up to date copy retained.	Contractor
Minimise the stored volumes of fuel, lubricants and oil in discrete containers on board vessels. When required they will be stored in a secure area and any spills will be cleaned immediately. Any visible or reasonably suspected fuel, lubricant or hydraulic fluid loss will be treated as an 'incident' and handled in accordance with Section 2.7.6.	Contractor
Vessel crew are to regularly check equipment for evidence of leaks and fitness of hydraulic hoses and seals, and conduct maintenance or repairs as necessary to prevent drips, leaks or likely equipment failures.	Contractor
For minor spills, provide spill kit including; bilge socks, heavy duty absorbent polypropylene pads, floating booms and blowback refuelling collars on vessels for use in the event a substance is spilled either on deck or to waters to handle a spill of up to 160 litres.	Contractor
For major spills, undertake actions as specified in the MSQ	Contractor

Action	Responsibility
approved Shipboard Oil Pollution Emergency Plan. (See Appendix D) Contact Harbour Controller (phone 49336182 or mobile 0417728354 seven days per week) to access shore based oil spill equipment.	
A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances on board, will be maintained	Contractor

Performance indicators

- Documented procedures for emergency response are available and up to date.
- All vessels carry response equipment appropriate to the level of risk. The kits are restocked and accessible.
- Staff has been trained in the use of the kits and in emergency response.
- Contractor's Standard Operating Procedures for Refuelling available and implemented.
- No spills—if any spills do occur they are effectively contained and cleaned up.
- Incident reports accurately describe any spills and response actions.
- A register of MSDS for each chemical used on site is available.

Monitoring and reporting

- The contractor will undertake audits which include:
  - ensuring that emergency response plans and equipment and materials are available, working and unobstructed;
  - ensuring fire fighting equipment has been serviced when required;
  - updating the emergency response contacts list when required;
  - hazardous materials are appropriately stored; and
  - MSDS are appropriate to the material stored.
- If emergency response procedures are initiated, or any spills of hazardous materials occur, the action will be regarded as an incident and reported as described in Section 2.7.6.
- Equipment that uses fuel, lubricants, and/or hydraulic fluid, will be inspected during scheduled maintenance for the condition of hoses, valves, seals and reservoirs.
- Storage areas, containers, transfer hoses and valves for fuel/lubricants/hydraulic fluids will be inspected during maintenance.

Corrective action/contingency plan

- Failure to meet the performance criteria shall be recorded as a non conformance incident and be dealt with in accordance with Section 2.7.6.
- In the event of a spill, the spill source will be immediately isolated, stopped and contained.

2.6 Noise and Air Quality

Objectives

- To minimise the impact of dredging and disposal of dredged material on noise-sensitive receptors.
- To minimise the impacts of the proposed dredging works on air quality.

Environmental Risk

Low provided management strategies are followed

Table 2.6 Noise and Air Quality Management Strategies

Action	Responsibility
Conduct all works during hours agreed by GBRMPA and DEHP prior to start of dredging project No audible noise on Sundays or public holidays	Contractor
Notify all nearby businesses and residences of the work hours, and give a point of contact for any questions or problems.	TMR
Equipment will be maintained and operated to ensure that unnecessary noise or air emissions will be prevented. In accordance with approvals Attachment E.	Contractor
In the event that a complaint is received, the relevant details will be recorded on the Complaints/Query Report Form - Appendix D.	Contractor
All vessels are to be suitably maintained and fit for the work to be undertaken.	Contractor

Performance indicators

- All nearby businesses are notified prior to commencement of the works.
- Response to all complaints about noise or air quality issues initiated within 24 hours of receipt.
- Machinery is operating in a fit-for-purpose manner.

Monitoring and reporting

- All complaints will be recorded on the Complaints/Query Report Form (Appendix D) and referred to TMR.

Corrective action/contingency plan

- Failure to meet the performance indicators shall be recorded as a non-conformance and will be dealt with in accordance with Section 2.7.6.
- All complaints received will be investigated immediately, taking note of prevailing wind conditions and noting any evidence that relates to the complaint.
- Defective vessels are to be repaired prior to continuing work.
- Changes to hours of work or dredging procedures should be considered if practical and potentially beneficial.

2.7 Environmental Management Plan Procedures

This component of the EMP establishes the procedures for implementation of the environmental management plan.

2.7.1 Responsibility and Implementation

No.	Procedure/Action	Responsibility
1.1	Amend/revise EMP document when required, gain GBRMPA and DEHP sign off and supply a copy to any contractors to whom it is relevant and publish on TMR website.	TMR
1.2	Ensure satisfaction with the EMP and all conditions contained in all permits (Attachment E) that relate to the works.	Contractor
1.3	Oversee dredging and ensure compliance with the monitoring program.	TMR / Superintendent
1.4	Conduct hydrographic surveys as needed.	Superintendent

2.7.2 Communication and Reporting

No.	Procedure/Action	Responsibility
2.0	Notifications to DEHP, GBRMPA and MSQ are to be made as required prior to commencement and following the completion of works in accordance with approvals Appendix E	Superintendent/TMR
2.1	All project staff will heed any lawful direction by the Environmental Site Supervisor or any duly Authorised Officer of the State or Commonwealth. (The ESS can instruct the contractor to cease works and provide permission to restart works on environmental grounds).	Contractor/ Superintendent / TMR
2.2	Any actions required under the EMP procedures shall be duly documented.	Contractor/ Superintendent / TMR
2.3	Copies of dredge logs, dredge and placement locations, wind conditions and a summary of dredging progress shall be provided to the ESS on request.	Contractor
2.4	Copies of the field notes from the water quality monitoring will be provided to the ESS on request.	TMR
2.5	A final report following completion of the works will be forwarded within 60 business days to DEHP and GBRMPA. This report will include the items in Appendix F.	Contractor/TMR /Superintendent

2.7.3 Documentation and Record Keeping

No.	Procedure/Action	Responsibility
3.1	Primary control of EMP document.	TMR
3.2	Ensure the EMP and associated specific project instructions	Contractor

	are readily accessible to personnel carrying out activities associated with dredging.	
3.3	Ensure records are maintained with respect to, non-conformance and incidents, environmental training, complaints and results of any audits.	Contractor
3.4	Plant maintenance records are kept and used to program repairs and vessel/plant maintenance as required	Contractor

2.7.4 Environmental Awareness Training

No.	Procedure/Action	Responsibility
4.1	Ensure all personnel performing activities related to environmental management of dredging are trained, qualified and competent.	Contractor
4.2	Ensure all personnel performing activities are aware of their responsibilities under the EMP and all associated permits.	Contractor
4.3	Ensure all personal performing activities have PPE and are trained in spill response and emergency procedure management strategies.	Contractor

2.7.5 Complaint Handling Procedures

No.	Procedure/Action	Responsibility
5.1	Main point of contact for complaints, provide a contact number to Contractor to refer complaints.	Superintendent
5.2	Ensure complaints are forwarded to TMR representative.	Contractor
5.3	Upon receipt of a complaint, all relevant details will be obtained and documented on the Complaints/Queries Report Form (Appendix D).	Superintendent
5.4	All complaints responded to within 24 hours.	Superintendent

2.7.6 Incident and Non-Conformance Reporting

No.	Procedure/Action	Responsibility
6.1	In the event of an environmental incident, take immediate action to secure safe conditions and prevent further environmental harm, and then immediately notify the Superintendent, the Harbour Master and the ESS of the type and extent of the incident. Details of the incident will be taken and provided to the ESS in accordance with Condition 16, permit No. G16/38147.1 (see Appendix E)	Contractor
6.2	In the event of an environmental incident, details of the incident shall be recorded on the Environmental Incident/Non-conformance Report Form (Appendix D).	Contractor
6.3	Notify DEHP and GBRMPA representatives of the incident within 24 hours of the incident.	TMR / Superintendent
6.4	Cases of non-conformance with the EMP will be recorded on the Environmental Incident/Non-conformance Report form (Appendix D) and reported to TMR within 24 hours of the incident.	Contractor

3 Environmental monitoring program

3.1 Monitoring Programs

An environmental monitoring program has been established to support this EMP. The implementation of the monitoring program will ensure that the requirements of the EMP are being met. All monitoring will be undertaken by suitably qualified persons in accordance with the monitoring requirements. TMR will submit a summary report of the monitoring outcomes at the conclusion of the dredging campaign or at the conclusion of the specified monitoring period to GBRMPA and DEHP.

There are a number of components for which environmental monitoring is required, including:

- sediment characteristics
- water quality
- flora and fauna
- access arrangements
- noise
- air quality
- waste management
- hazardous substances
- community consultation.

Table 3.1 Environmental Monitoring Program – Rosslyn Bay Boat Harbour Dredging

Issue	Monitoring	Frequency / timing	Performance criteria	Responsibility
Sediment Characteristics	Prior to each dredging event undertake sampling in accordance with NAGD (2009) see details table 2.1	Prior to each dredging event	Sediments must be suitable for ocean disposal in accordance with NAGD (2009)	TMR
Water Quality 1	Visual Inspection of turbid plume from the dredge and placement area	during works	Visual plume to be kept within 500m of the source.	Contractor

Issue	Monitoring	Frequency / timing	Performance criteria	Responsibility
Water Quality 2	Refer to table 3.1a and section 3.2 for the detailed water quality monitoring strategy	Refer to table 3.1a and section 3.2	No impact on surrounding ecological features, develop further understanding of redistribution processes	TMR Consultant
Fauna and Flora	Visual inspection for any sign of marine flora and fauna (turtles, dolphins, dugongs, crocodiles and whales) in accordance with table 2.2.	Refer to table 3.1a and section 3.3	No deaths/injuries attributable to works. Report any observations in the dredge logs in accordance with section 2.2	Contractor
	Undertake benthic monitoring in accordance with table 3.1a and section 3.3		No long term impact on surrounding ecological features	TMR consultant
	Undertake seabed monitoring in accordance with table 3.1a and section 3.4		No long term impact on surrounding ecological features	TMR
Access arrangements	Visual inspection to ensure harbour navigation is not restricted	Daily (during dredging works)	Minimal restriction to access	Contractor / TMR
Noise	Investigation of noise complaints	As required in response to any noise complaints. (during dredging works)	Complaint responded to within 24 hours and all complaints resolved	Contractor and Superintendent
	Aural inspection of equipment for excessive noise	Weekly (during dredging works)	Noise levels in accordance with equipment specification	Contractor

Issue	Monitoring	Frequency / timing	Performance criteria	Responsibility
Waste management	Visual inspection of disposal area for litter	Daily (during dredging works)	No uncontained litter /waste	Contractor
Hazardous substances	Visual inspection of the vessel, disposal area and immediate vicinity of dredge for evidence of spills	Daily (during dredging works)	No spills.	Contractor
Hazardous substances	Visual inspection of chemical storage areas	Weekly and following substantial rainfall events (during dredging works)	Storage capacity sufficient to contain spills and no breach of storage area. Materials stored as per relevant standards.	Contractor
Community consultation	Review of complaints records for any increasing trend in number of complaints Outcomes of specific dredging events to be discussed with TACC	Weekly (during dredging works) Each Campaign	No increasing trend in number of complaints. All complaints addressed within 24 hours. Gain feedback for ongoing improved strategy development	Superintendent / Contractor

Table 3.1a Campaign Specific Monitoring Strategy

Campaign	Water Quality Monitoring	Benthic Monitoring	Disposal site seabed Monitoring
2015/16	**WQA**– logger monitoring (24 month period) **WQB**– vessel based plume and compliance monitoring (x2)	**BMA, BMB, BMC** and **BMD** – Pre, During, Post and 12 month Post	**SM** – pre, post and annually between dredge events **LB_PSD** – monitoring sediment distribution changes on Lammermoor beach **A_PSD** – collect PSD data along benthic

	WQT –testing for metals and nutrients		transects

3.2 Water Quality Monitoring

BMT WBM (2012) modelling did not predict that the identified sensitive receptors of Wreck Point and Bluff Rock will be impacted significantly by the dredging and placement of 120,000cu.m of dredge material at the existing disposal site. The 2012 monitoring event supported this prediction and hence for this much smaller dredging campaign. A targeted monitoring program has been developed to ensure potential impacts are measured, assessed and mitigated. This program is designed to also build on existing knowledge for the effective long term management of Rosslyn Bay Boat Harbour.

The two primary objectives of the program are:

1. to monitor water quality over 24 months at the main potential impact site from resuspension (Wreck Point) and the control site (Zilzie Point), to provide further background data and dredge campaign data to develop a better understanding of the resuspension processes from the disposal site **(WQA)**
2. to undertake vessel based compliance monitoring to further confirm that plumes generated from the dredging and disposal works do not impact on sensitive receptors **(WQB)**
3. to collect and assess water chemistry changes prior to, during , post and 12 months following dredging works to continue to build a dataset of trends associated with the dredging works **(WQT)**

Description WQA

Two Water Quality loggers will be placed adjacent to the sensitive receptor at Wreck Point (WP) and a control site at Zilzie Point (ZP) both previously monitored in 2012-13. These dumb loggers will capture sedimentation, suspended solids and light levels for a 24 month period prior to during and following the 2016 dredging works creating a critical dataset to assess potential resuspension processes from the placement site. This data will be used along with past and current monitoring and modelling data to refine the future monitoring strategy (with TACC consultation) for future maintenance campaigns.

Description WQB

Compliance Monitoring

Monitoring in 2006 and 2009 showed that plumes (from dredging and placement works) were contained locally and remote from sensitive sites. The 2012 Modelling supported this monitoring and then the dredging and placement of 120,000cu.m and associated monitoring further supported this outcome. It can be confidently concluded that with the exception of entrance channel dredging during extreme spring ebb tidal flows that plumes from the actual dredging and placement works are kept local and do not present a risk to sensitive receptors. For this reason the compliance monitoring proposed is two vessel based events (of 4 days each, total 8 days) focusing on spring tides. In the very unlikely event compliance triggers are breached as a result of dredging or placement then this compliance monitoring element will be extended for the remainder of the works.

The 4 day vessel based monitoring campaigns will be undertaken at the start and then again towards the middle of the dredging campaign to assess and map the plume impacts from dredging and disposal area.

The vessel based monitoring campaigns will focus on mapping the extent of plumes and performing a compliance check on previous understanding;

- escaping the harbour during peak spring ebb tides from D1
- migrating from the disposal site (From DS1 to the extent of the plume above background)

(Both mapping exercises will utilise an up drift control site as a background)

Both these assessments will be undertaken via transects (at minimum 40m intervals) as indicated in figure 4 and detailed in table 3.2.

At each sample site 3 replicates will be taken at depths of 1m (surface), mid water column (middle) and within 1m of the seabed (bottom). The following parameters will be recorded at each site:

- GPS location
- Turbidity
- Suspended Solids
- pH
- Salinity
- Conductivity
- Temperature

Weather and sea conditions, and other observations, will also be recorded at each site.

This compliance monitoring will be applied as follows;

1. Undertake transects from the harbour entrance D1 (for spring ebb tide events) and the disposal site DS1 (both ebb and flood flow events) mapping the plume extent against up-current background levels.
2. If the plume extends 500m from the source site, notify the dredge operator, to amend operations to reduce plume extents and continue to monitor plume extents and every 3 hours sample at the sensitive site in the direction of the plume (either WP or BR).
3. In the event the water quality (TSS) is above the identified 80th percentile trigger for the sensitive receptor and is above background levels (i.e. the increase is a result of the dredging or placement works) for four consecutive 3 hourly readings then dredging and placement works will cease until background TSS is returned.
4. In the event trigger item 3 occurs a real time logger will be installed for this sensitive site and the control site for the remainder of the dredging campaign.
5. If action item 4 is applied, hourly monitoring of both sites will occur. In the event trigger levels are exceeded for 6 hourly readings above the 80th percentile, the control site data will be reviewed to assess if the impact is a natural trend or associated with the dredging or placement works. If the impact is associated with dredging, works will be amended to mitigate the impact to reduce the TSS to below the 80th percentile or to background levels consistent with CS1.

6. In the event levels are not reduced to below trigger conditions 24 hours after changes to dredging works have been implemented (attributed to dredging works), dredging works are to cease until levels fall below trigger levels or to levels consistent with CS1.

Possible actions should item 2 or 5 be instigated (this list is not exhaustive but is intended as a starting point for guiding actions, depending on the source and extent of impact)

- Relocate the dredge to minimise plume transport during certain phases of the tide.
- Plan timing of dredging works for certain phases of the tide to minimise plume transport.
- Relocate the pipeline outlet where possible during spring tide flows to minimise plume transport impacts.
- Minimise the use of the dredge cutter head where practical to minimise plume generation.
- Slow the production rate of dredging to minimise plume distribution.

TMR plans to continue to build its water quality monitoring dataset at Rosslyn Bay through this campaign and item WQA is designed to further quantify seasonal trends in order to have the most effective understanding of the system and the influence the dredging works have. Bluff Rock was not impacted by dredging works or redistribution processes in 2012-13 and for this reason the existing logger dataset for Bluff Rock has been used to define an 80th percentile exceedance of Total Suspended Solids for summer and winter conditions. (Summer data period 24/9/12 to 31/3/2013 and winter data being 1/4/2013 to 9/7/2013).

Bluff Rock triggers: Winter = 121.7mg/l and Summer = 107.0mg/l

Wreck Point: The data losses during the previous baseline monitoring at Wreck Point didn't provide a representative dataset. But the proposed WQA monitoring will rectify this, however for the next dredging project to be conservative we propose to use the Zilizie Point (Control 11km south) summer (1/11/2012 to 31/3/2013) and winter data (1/4/2013 to 9/7/2013) (even though the turbidity trends indicate Wreck Point is naturally higher). This is considered to be the most appropriate strategy given the influence of the redistribution from the disposal site on Wreck Point is the primary goal of the monitoring strategy. As we gain more data these values will be reviewed and updated. Because the JCU background data (WQA) commenced in October 2015 and has only captured summer data and dredging works for this campaign are planned for winter the previously calculated 80th percentile figures will be used as the triggers for the 2016 dredging campaign.

Wreck Point triggers: Winter = 145.5mg/l and Summer = 319.4 mg/l

Water Quality Testing (WQT) - Disposal Site, Wreck Point and Bluff Rock

- Water samples will be collected in accordance with the Queensland Water Quality Guidelines and tested for the following analytes to assess any water chemistry changes from the dredging and placement works;
    - 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn)
    - Total Nitrogen
    - Total Phosphorus

- **Frequency:** Pre-dredge, 2 times during the dredging campaign, post-dredge and 12 months following the completion of works.

The water quality monitoring program will be in accordance with table 3.2.

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Figure 4: Monitoring Locations

Table 3.2 Proposed Water Quality Monitoring

WQA					
Site	**Description**	**Compliance Trigger**	**Depth**	**Replicates**	**Frequency**
WP1	Background Wreck Point	N/A	-5m LAT	continuous	Monitoring to occur for 24 months with 30minute readings
ZP11	Background Zilzie Point	N/A	-5m LAT	continuous	
WQB					
Site	**Description**	**Transect Distance/Interval**	**Depth**	**Replicates**	**Frequency**
D1 (transect from harbour entrance south)	Extent of plume from dredging ensure compliance met	Interval distance shall be no less than 40m however shall be chosen by the consultant to appropriately map the plume extent in the direction of plume until background conditions are reached	Surface, Middle, Bottom	3	Capture at least 4 spring peak ebb flow events during the dredging works
DS1 (Transect from Dump point)	Extent of plume from disposal site and ensure compliance is met	Interval distance shall be no less than 40m however shall be chosen by the consultant to appropriately map the plume extent in the direction of plume until background conditions are reached	Surface, Middle, Bottom	3	Capture at least 4 ebb and 4 flood flow conditions during the dredging works
WQT					
Site	**Description**		**Depth**		**Frequency**
Disposal site (D1)	Water Sample test for; • 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn) • Total Nitrogen • Total Phosphorus		1 metre below the surface		Pre, 2 times during the dredging campaign, post and 12 months after
Bluff Rock (BR1)	Water Sample test for; • 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn)		1 metre below the surface		Pre, 2 times during the dredging

	• Total Nitrogen • Total Phosphorus		campaign, post and 12 months after
Wreck Point (WP1)	Water Sample test for; • 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn) • Total Nitrogen • Total Phosphorus	1 metre below the surface	Pre, 2 times during the dredging campaign, post and 12 months after
Zilzie Point (ZP1)	Water Sample test for; • 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn) • Total Nitrogen Total Phosphorus	1 metre below the surface	Pre, 2 times during the dredging campaign, post and 12 months after
2km North Wreck Point (NWP1)	Water Sample test for; • 8 Heavy Metal Suite (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn) • Total Nitrogen Total Phosphorus	1 metre below the surface	Pre, 2 times during the dredging campaign, post and 12 months after

3.3 Benthic Monitoring

Benthic monitoring will focus on the following elements:

- **BMA:**
  Monitoring of the condition of the fringing reef community at representative sites at Wreck Point and Bluff Rock (the two nearest sensitive receptors to the dredging and spoil disposal sites) against a Control site in the vicinity of Zilzie Point approximately 10km south of the harbour;
- **BMB**:
  Monitoring of benthic infaunal assemblages and sediment particle size distribution adjacent to the spoil disposal site, within areas that will be potentially impacted by sediment re-suspension from the spoil ground and areas that will be unaffected.

BMA - Reef Monitoring at Wreck Point and Bluff Rock

Wreck Point (WP) and Bluff Rock (BR) are the nearest sensitive receptors to the dredging and spoil disposal sites. Hydrodynamic modelling and the results of water quality monitoring from previous dredging campaigns at Rosslyn Bay suggest that WP or BR are unlikely to be impacted by turbidity from dredging and spoil disposal, or impacts from any ongoing re-suspension of material from the spoil ground. To confirm this, monitoring of the condition of the fringing coral reef community will be undertaken at representative sites at WP and BR and at a control site in the vicinity of Zilzie Point (ZP). Monitoring will be conducted pre and post the dredging campaign and again 12 months after the conclusion of the dredging campaign.

At each monitoring site at WP, BR and ZP, fringing reefs will be documented using two strata of four line transects in each location; The first on the shallow landward part of the fringing reef and the second on the deeper seaward edge of the reef. Each of the transects will be 25m long and will be permanently marked using metre long sections of 12mm reinforcing rod driven into the bottom. Permanent transects give a much more powerful measure of change in the benthic community due to the same individual corals being monitored.

A fibreglass survey tape will be stretched tightly between the marker stakes on each transect positioned as close to the bottom as possible and high resolution digital images will be recorded every 50cm along the shoreward side of each transect, for archive records.

In addition the length of intercept in centimetres with each benthic feature immediately beneath the tape will be recorded. Intercept lengths along each transect will be totalled for each benthic category and converted to a measure of percentage cover. A range of statistical analysis will be applied to the data as described below to describe the benthic community at each site and to identify any changes in the benthic community between the pre, post and 12 month post dredging monitoring events.

Sediment depth will also be measured on a random selection of 25 corals along each transect. If sediment is present on a surface of a selected colony then the maximum depth of sediment will be measured to the nearest millimetre (mm). Health of hard coral colonies shall also be categorised that exist within a one metre strip centred on the transect Categories; healthy; bleached; partially bleached; disease present; sediment mortality present; recent partial mortality; recent total mortality.

BMB - Monitoring of Benthic Infaunal Assemblages and Sediment Particle Size Distribution Adjacent to the Spoil Disposal Site

The results of hydrographic modelling suggest that resuspension of material from the spoil ground will occur for some time after material placement has concluded, but that detectable impacts to the seafloor will extend only a short distance from the boundary of the spoil ground, primarily in the northwest and southeast directions. To identify the nature and extent of any impacts to the benthic habitats adjacent to the spoil ground, monitoring of the benthic infaunal assemblages and particle size distribution of the substrate will be conducted pre and post the first dredging campaign and again 12 months after the conclusion of the dredging campaign. Results of this monitoring will inform consideration of the requirement for continuation of this monitoring as part of future dredging campaigns.

Sampling will be conducted along three transects radiating perpendicular to the outer boundary of the spoil ground. Two of the transects will be aligned in the directions of the primary resuspension pathways, predicted by the hydrodynamic modelling (that is, northwest and southeast), and the third in the direction predicted to be subject to least resuspension impacts (i.e. northeast). The third transect will act as a surrogate reference if found to be unaffected by the influence of the sediment resuspension, otherwise it will provide an indication of impacts to the northeast of the spoil ground.

In addition a transect offshore of at Zilzie Point (ZP1), Wreck Point (WP1) and 2km north of Wreck Point (NWP1) will be undertaken starting at approximately the -5m LAT contour going onshore. So a total of 6 transects shall be captured in total.

Along each transect five locations will be sampled. For the first three transects the sampling will be taken from the boundary of the spoil ground 50m, 125m, 250m, 500m, 1000m, for the later three transects a sample will be collected every 20m (0m, 20m, 40m, 60m, 80m perpendicular to the shoreline with 0m approximately on the -5m LAT contour). At each sampling site, 4 replicate sediment samples will be collected for macrobenthic infauna assessment and one sample will be collected for analysis of particle size distribution. Samples will be collected with a Van Veen grab.

Samples for infauna analysis will be sieved using a 0.5mm mesh sieve. Infauna will be extracted, identified to morphospecies and counted. A range of analysis will be applied to the data to determine abundance, species (taxa) richness, species (taxa) diversity and evenness at each site as detailed below. Infauna assemblages at each sampling site will be compared between the pre, post and 12 month post dredging monitoring events, to identify changes.

Assessment of particle size distribution will be undertaken by wet sieving of the coarse fraction through a series of Australian standard sieves, with hydrometer analysis of the fine fraction. Particle size distribution will be compared between monitoring events to identify changes over time.

Results of the benthic infauna and particle size distribution monitoring will be assessed to identify the nature and extent of changes in benthic habitats from the control site 11km south of the works area, nearby the disposal site and approximately 5km north of the site to assess the extent of impacts to benthic habitats.

Statistical Analysis – Infauna and Sediments

To evaluate changes in the fringing reef and benthic infauna communities, data collected will be statistically analysed using uni-variate and multivariate techniques. Ecological analysis will include One-way ANOVA, Multidimensional Scaling, Cluster Plots, ANOSIM and SIMPAR. The statistical software packages Primer-e version 6 (Clarke, 2001) and PAST (Hammer et al, 2001) will be used to assess statistically significant changes in community and habitat structure.

Table 3.3 Benthic Monitoring 2012 Dredging Campaign

Description	Sites	Monitoring	Frequency	Performance Criteria
BMA Reef Monitoring	WP2, BR2 and ZP2	Underwater Dive Transect (as described above)	Pre and post dredging and 12 months after conclusion of dredging	No impact attributed to dredging works
BMB Benthic Infauna and Particle Size Distribution Monitoring	5 sites on six transects radiating to the Northwest, Southeast and Northeast (of the	Benthic infauna and particle size distribution as described above	Pre and post dredging 12 months after conclusion of dredging	Identify any impact to benthic Infauna and substrate particle size distribution outside boundary of spoil ground attributed to spoil disposal.

	disposal site) plus at ZP1, WP1 and NWP1			

3.4 Hydrographic Survey Monitoring

Modelling indicates that the Rosslyn Bay placement area is dispersive and for this reason there is a significant need to monitor the placement site to assess how much material has redistributed in order to effectively understand and interpret the water quality and benthic data.

In order to achieve this, the following monitoring is proposed:

- Undertake pre and post dredge bathymetric surveys of the disposal site and map the seabed in the vicinity of the disposal site as indicated in Figure 4.
- Undertake annual surveys of the monitoring area as indicate in Figure 4.

Table 3.4: Disposal site monitoring

Location/Aspect	Sites	Monitoring	Frequency	Performance Criteria
Survey	Area shaded in Figure 4	Bed level	Pre and post dredge + annual	Assess redistribution

3.5 Additional Monitoring - Lammermoor Beach

Particle Size Distribution changes - Lammermoor Beach

Monitoring of sediment particle size distribution (PSD) will be undertaken for three transects on Lammermoor Beach as was completed in 2012-13, to assess any changes that could be associated with dredging and placement works.

Assessment of particle size distribution will be undertaken by wet sieving of the coarse fraction through a series of Australian standard sieves, with hydrometer analysis of the fine fraction.

Particle size distribution will be compared between monitoring events to identify changes over time.

Visual observations of surface sediment characteristics will also be noted.

- **Frequency**: Pre-dredging, Post-dredging and 12 months after dredging works
- **Extent**: samples at high water line, mid water line and low water line will be collected at each transect for each event (9 samples per event)

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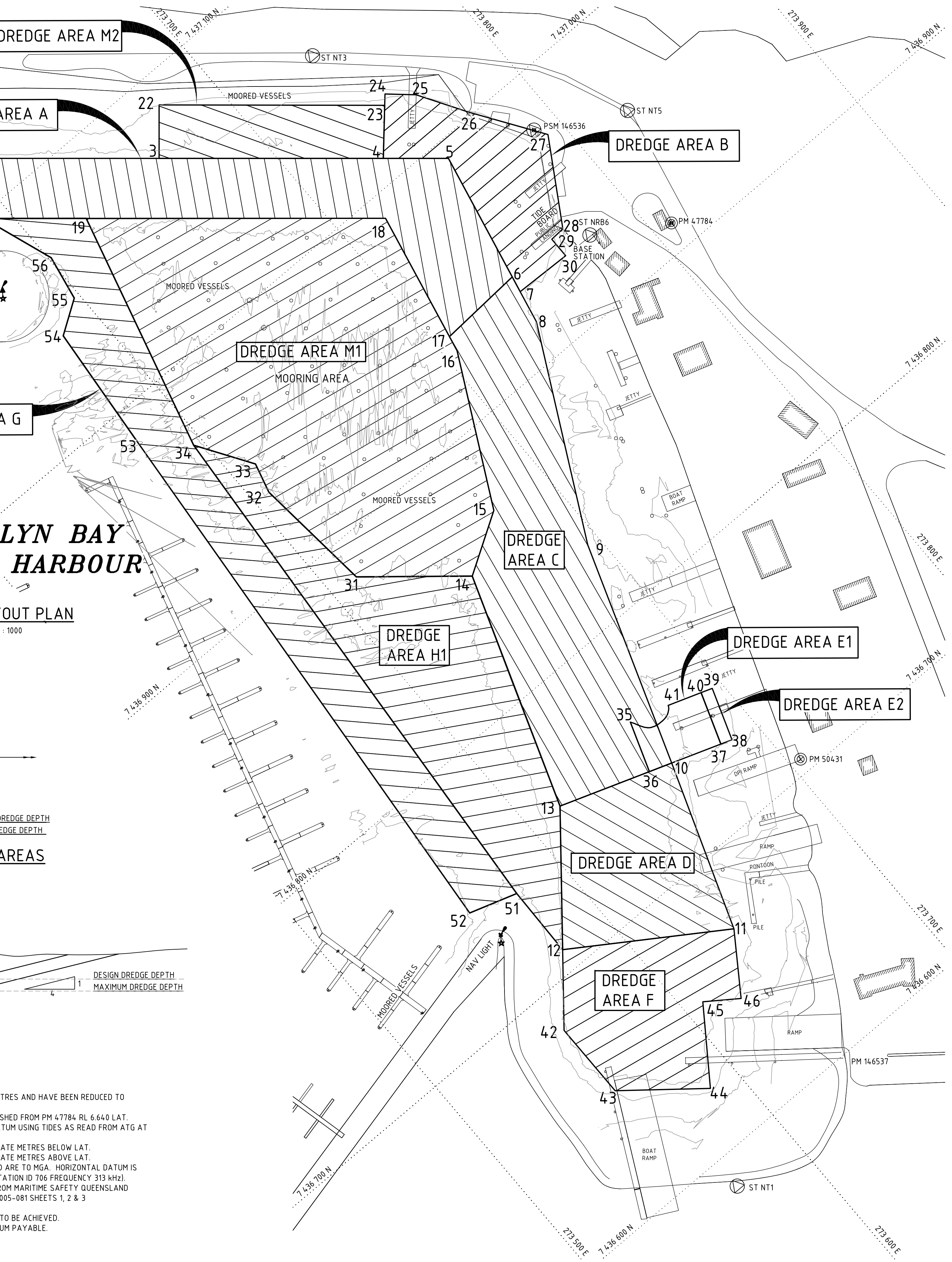
Appendix A – drawing of dredge areas



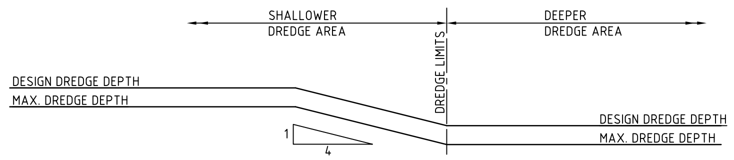
DREDGE LIMIT CO-ORDINATES

STATION	EASTING	NORTHING	STATION	EASTING	NORTHING
1	273 427.091	7 437 269.332	29	273 765.654	7 436 938.615
2	273 601.727	7 437 121.563	30	273 765.654	7 436 929.635
3	273 662.266	7 437 070.334	31	273 612.286	7 436 883.714
4	273 733.755	7 437 009.844	32	273 607.256	7 436 934.374
5	273 754.504	7 436 992.284	33	273 610.596	7 436 946.934
6	273 742.914	7 436 937.295	34	273 595.926	7 436 969.604
7	273741.464	7 436 930.425	35	273 660.594	7 436 763.405
8	273 738.524	7 436 916.475	36	273 653.224	7 436 742.615
9	273 694.704	7 436 831.485	37	273 683.453	7 436 732.115
10	273 662.674	7 436 739.335	38	273 688.173	7 436 730.475
11	273 637.804	7 436 669.725	39	273 695.723	7 436 752.195
12	273 577.535	7 436 709.285	40	273 691.003	7 436 753.835
13	273 615.435	7 436 755.755	41	273 677.064	7 436 758.685
14	273 649.475	7 436 852.715	42	273 556.255	7 436 683.195
15	273 674.074	7 436 867.855	43	273 556.255	7 436 650.195
16	273 705.434	7 436 928.684	44	273 587.254	7 436 625.195
17	273 706.794	7 436 935.204	45	273 608.204	7 436 654.865
18	273 718.285	7 436 990.174	46	273 621.304	7 436 645.615
19	273 622.827	7 437 070.874	47	273 653.950	7 436 715.090
20	273 590.137	7 437 098.504	48	273 685.560	7 436 696.420
21	273 397.942	7 437 260.982	49	273 648.490	7 436 639.660
22	273 676.706	7 437 087.384	50	273 626.470	7 436 653.000
23	273 748.524	7 437 026.384	51	273 578.042	7 436 739.578
24	273 751.674	7 437 029.924	52	273 557.814	7 436 746.067
25	273 761.374	7 437 021.264	53	273 578.920	7 436 985.845
26	273 773.344	7 437 001.684	54	273 583.833	7 437 039.682
27	273 792.663	7 436 973.025	55	273 597.520	7 437 048.717
28	273 772.054	7 436 938.995	56	273 601.072	7 437 067.803

DREDGE AREAS

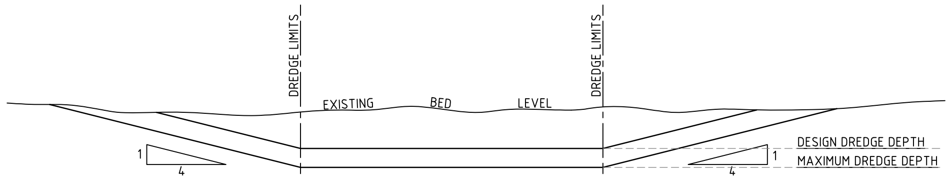
DREDGE DEPTHS (METRES BELOW L.A.T.)

DREDGE AREA	STATION	DREDGE DEPTH	
		DESIGN	MAXIMUM
A1	1, 2, 20, 21	2.40 m	2.90 m
A	2,3,4,5,6,17,18,19,20	2.40 m	2.90 m
B	25,26,27,28,29,30,7,6,5,4,24	1.70 m	2.00 m
C	6, 7, 8, 9, 10, 13, 14, 15, 16, 17	1.90 m	2.20 m
D	10,11,12,13	1.40 m	1.70 m
F	11,46,45,44,43,42,12	1.40 m	1.70 m
M1	18,17,16,15,14,31,32,33,34,19	1.40 m	1.70 m
M2	23,4,3,22	1.40 m	1.70 m
E1	35,41,40,37,10,36	2.00 m	2.30 m
E2	40,39,38,37	1.00 m	1.30 m
F	12,11,46,45,44,43,42	1.40 m	1.70 m
H1	34,33,32,31,14,13,12,51,52	2.40 m	2.90 m
G	20,19,34,51,52,53,54,55,56	2.40 m	2.90 m



TYPICAL DREDGE SECTION BETWEEN ADJACENT DREDGE AREAS

NOT TO SCALE

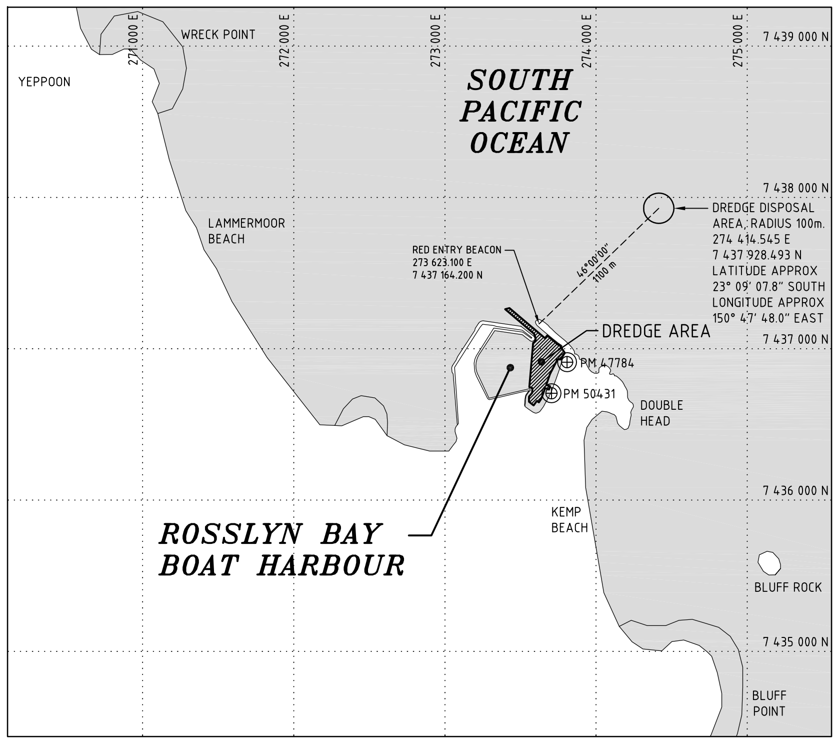


TYPICAL DREDGE SECTION

NOT TO SCALE

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. ALL LEVELS AND SOUNDINGS ARE IN METRES AND HAVE BEEN REDUCED TO LOWEST ASTRONOMICAL TIDE (LAT).
3. VERTICAL DATUM FOR LEVELS ESTABLISHED FROM PM 47784 RL 6.640 LAT. SOUNDINGS HAVE BEEN REDUCED TO DATUM USING TIDES AS READ FROM ATG AT ROSSLYN BAY.
4. SOUNDINGS SHOWN THUS e.g. 2_4 INDICATE METRES BELOW LAT.
5. SOUNDINGS SHOWN THUS e.g. $\underline{1}_9$ INDICATE METRES ABOVE LAT.
6. ALL CO-ORDINATES ARE IN METRES AND ARE TO MGA. HORIZONTAL DATUM IS GDA94 ZONE 56. AMSA GLADSTONE (STATION ID 706 FREQUENCY 313 kHz).
7. SURVEY INFORMATION WAS DERIVED FROM MARITIME SAFETY QUEENSLAND HYDROGRAPHIC SERVICES PLAN No.'s G005-081 SHEETS 1, 2 & 3 DATE OF SURVEY: 26 OCTOBER 2011.
8. DESIGN DREDGE DEPTH IS THE MINIMUM TO BE ACHIEVED.
9. MAXIMUM DREDGE DEPTH IS THE MAXIMUM PAYABLE.



LOCALITY PLAN

SCALE 1 : 25 000

Drawing No.	Associated Drawings	Amend.	Description	Date	Initials

File No 467/00222

Contract No QT12-132

Ratio Scales 1:1, 1:2, 1:2.5, 1:5 (mm)

JAS-ANZ QUALITY SYSTEM CERTIFIED TO AS/NZS ISO 9001 REGN. NO. 088

Drafting J.W.RICHARDS	Drafting Ckd	Examined
Design	Design Ckd	Approved
Date	R.P.E.Q. No.	Certified

Queensland Government

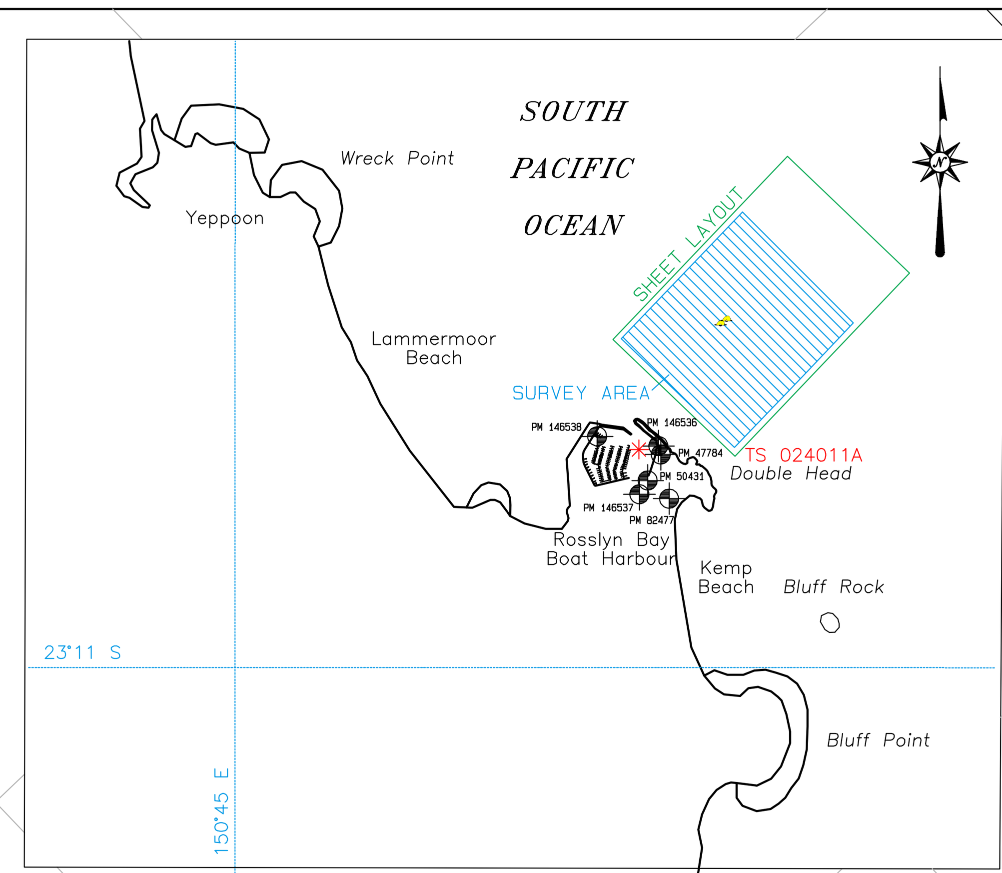
ROSSLYN BAY BOAT HARBOUR
MAINTENAANCE DREDGING (LV70) - 2012
DREDGE AREA LAYOUT

SKETCH 1 (Drawing Number)

A1 (Sheet Size) — Amendment

Appendix B – drawing of disposal area

Unknown object
Approx 1m proud
of seabed



LOCALITY DIAGRAM

SCALE 1: 50000

Offshore Material Relocation Site
Centre 274414.6E, 7437928.5N
Radius 100m

PIPELINE MARKER BUOYS COORDINATE TABLE - MGA ZONE 56 (GDA94)			
MARKER BUOY	EASTING	NORTHING	COMMENTS
Small Buoy	274281	7437937	Small line bouy
Small Buoy	274327	7437971	Small line bouy

SURVEY CONTROL - MGA ZONE 56 (GDA94)			
STATION	EASTING	NORTHING	REMARKS
PM 47784	273808.225	7436911.525	TGBM RL 6.64m LAT
PM 50431	273704.806	7436705.795	-
PM 82477	273874.350	7436562.254	1st Order Class A Horizontal
PM 146536	273789.396	7436978.220	4th Order Class D Horizontal

NOTES:

1) This survey meets the mandatory class requirments as outlined in the MSQ document "Standards for for Hydrographic Surveys within Queensland Waters v1.3".
2) Contours are computer generated to Hydrographic Standard (inclusive)
3) Soundings coloured for clearance purposes.
4) Coastline digitised from aerial photography is approximate only
5) The Marinestar differential position was shifted E= -0.33m and N= -1.14m based on observations at PM 82477
6) Soundings were derived from CARIS HIPS & SIPS v8.1.7 1m CUBE surface. Soundings reduced to datum in Caris HIPS&SIPS using tides as read from Rosslyn Bay Storm Surge tide gauge.
7) Dredge limits updated from plan RS-1-38-1 A. Contract No. QT12-132 (2012)
8) Multibeam data was collected using Kongsberg SIS *.all file format.

Horizontal Datum MGA Zone 56 (GDA94)
Base Station Easting Northing
Marinestar DGPS (Differential corrections)
Vertical Datum LAT **based on** PM 47784 RL 6.640m
Tide Notes
Soundings reduced to datum using tides as read at the Rosslyn Bay Storm Surge tide gauge.
Depth Tolerance 0.2m **Horizontal Tolerance** 1.5m **Weather** 15 kts SE

Vessel	QG Norfolk
Echo Sounder	Kongsberg EM3002D PU version 2.0.63
Heavemeter	Applanix POS MV v4 FW: 5.08 SW: 5.80
Horizontal Positioning	Applanix POS MV v4 FW: 5.08 SW: 5.80
Data Collection/Processing	Qinsy v8.1 / Caris v8.1.7 Terramodel v10.61J/SIS v3.9.3
Tidal Reference Station	ATG 024011A

SOUNDINGS (m)
2_5 below datum
$\underline{0}_7$ above datum
LEVELS (m)
0.99 above datum
-1.23 below datum

SCALE 1 : 2500 AT A1
0 25 125 250

CLASS A
*SEE NOTES

CLIENT SPO

Signature Hydrographic Surveyor	
Surveyor	R Penington
Checked	T Reise

Queensland Government
HYDROGRAPHIC SERVICES
Ph: (07) 3066 3500
Email: hydro@msq.qld.gov.au

ROSSLYN BAY
MATERIAL RELOCATION SITE
HYDROGRAPHIC SURVEY
19 MAY 2014

Plot File. G005092.PDF
Job No. RK040033
Plan No. G005-092

Appendix C – sediment sampling reports

Rosslyn Bay Boat Harbour

Sediment Sampling & Analysis

Prepared for:

Queensland Transport

frc environmental

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frc Ref: 081201

Document Control Summary

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Project Manager:	Lauren Thorburn
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Contents

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Summary

The results of the sediment sampling and analysis program undertaken at Rosslyn Bay Boat Harbour by frc environmental on behalf of Queensland Transport are presented in this report. The sediment sampling and analysis was done in accordance with the sediment sampling and analysis plan (SAP), prepared by frc environmental in December 2008, and approved by the relevant Government agencies in January 2009.

Sediments in the outer channel were sandy, whilst those within the harbour were sandy-clay. Sediment settling rate analysis showed that 90% of the sediments had settled within 16 minutes.

Most parameters analysed did not exceed the NOD guideline levels, with the exception of antimony. Mean levels of antimony exceeded the NOD Guideline screening level by 0.6 and 0.5 mg/kg for subsample A and B samples, respectively.

Net acidity for one subsample exceeded the *State Planning Policy 2/02* (SPP 2/02) Texture-based Action Criteria for treatment of acid sulfate soils (ASS) or potential acid sulfate soils (PASS). As the spoil will be disposed of at sea, and as sediments are likely to be mixed during dredging and disposal, the acid sulfate soils detected in this sediment will be diluted with the soils of low acidity found throughout the dredge area. Therefore, acid sulfate soils are not considered to be a risk to aquatic ecology.

The results of quality assurance / quality control analyses were generally acceptable.

1 Introduction

The results of the sediment sampling and analysis program undertaken at Rosslyn Bay Boat Harbour by frc environmental on behalf of Queensland Transport are presented in this report. The sediment sampling and analysis was done in accordance with the sediment sampling and analysis plan (SAP), prepared by frc environmental in December 2008, and approved by the relevant Government agencies in January 2009.

Advanced Analytical (and subcontracted NATA-registered laboratories Golder Associates and Envirolab Services) and Dr. Massimo Gasparon from the University of Queensland did the laboratory analysis of the sediment.

1.1 Background

Queensland Transport (QT) plans to undertake maintenance dredging of accumulated silt in Rosslyn Bay Boat Harbour in the entrance and internal navigation channels of the public boating facilities in the harbour and public mooring area. The harbour requires dredging every 3 to 4 years and was last dredged in November 2006 when approximately 31,000 cubic metres of material was dredged from the harbour. For the last five dredging events, spoil material has been deposited to an offshore area 1.1 kilometres north east of the harbour entrance. The disposal site is within the Farnborough section of the Great Barrier Reef Marine Park. QT currently holds a Marine Park permit for spoil disposal in this area, which is current until June 2011.

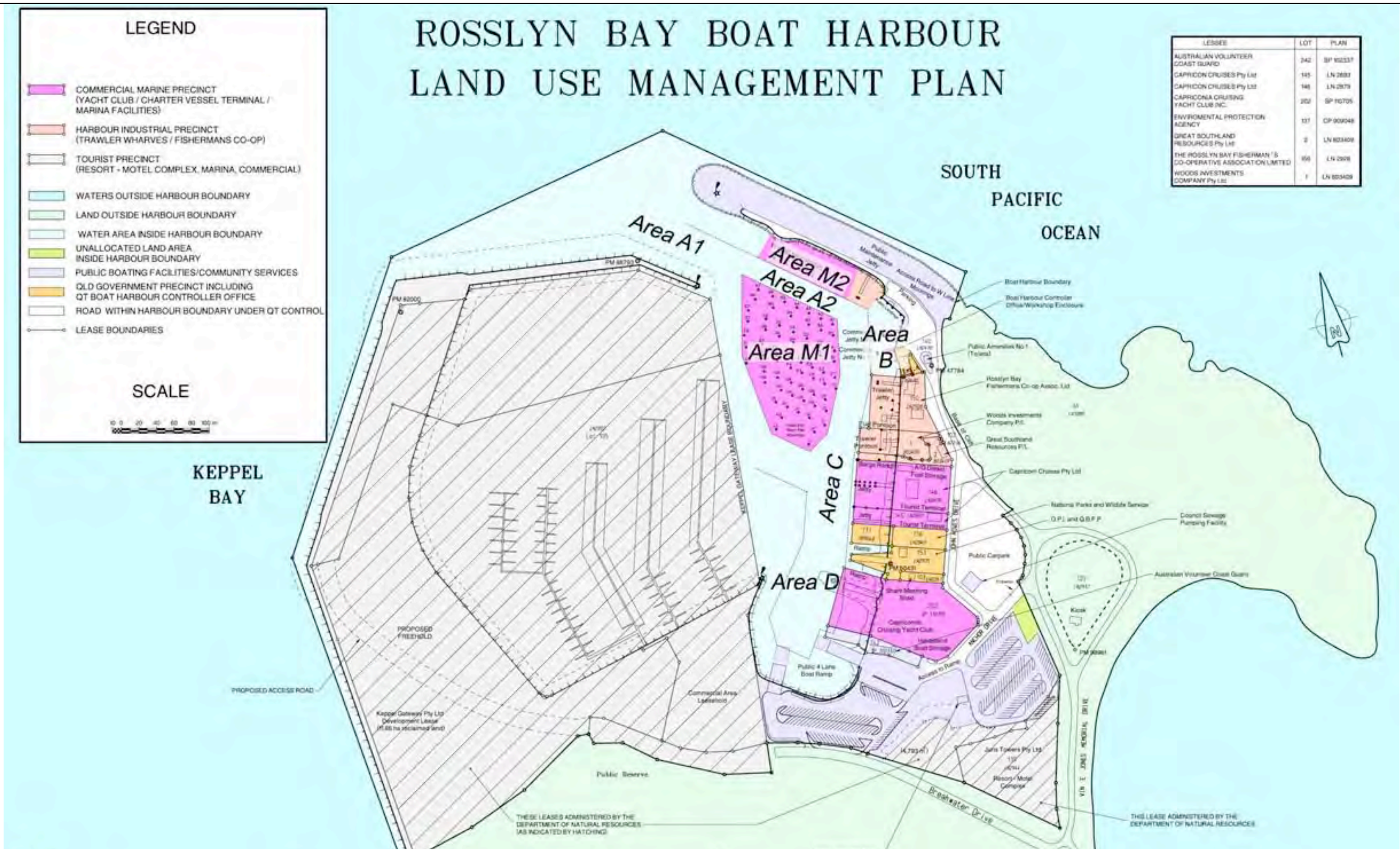
Dredging is required in March/April 2009, and is expected to generate up to 28,260 m^3 of dredge spoil. Seven areas of the harbour will be dredged, to a maximum depth of between 1.7 and 2.9 metres below lowest astronomical tide (– m LAT) (Figure 1.1; Table 1.1).

Table 1.1 Description of dredge areas and estimated dredge depths and dredge volumes (provided by QT).

Dredge Area	Description	Minimum Dredge Depth (m below LAT)	Maximum Dredge Depth (m below LAT)[A]	Area (m^2)	Estimated Dredge Volume (m^3 in-situ)[B]
A1	Outer entrance channel	2.4	2.9	6,040	6,900
A	Inner entrance channel	2.4	2.9	6,570	6,500
B	Public access area	1.7	2.0	2,790	840
C	Inner access channel	1.9	2.2	4,740	5,900
D	Inner access channel	1.4	1.7	4,000	1,860
M1	Pile mooring area	1.4	1.7	16,480	5,700
M2	Pile mooring area	1.4	1.7	2,090	560

A Maximum dredge depth = design dredge depth + dredge tolerance (0.3 to 0.5 m)

B If maintenance dredging is done in March/April 2009. Assumes all dredging is to the maximum dredge depth, and allows for 25% infilling from the January 2008 survey.



SAP: Rosslyn Bay Boat Harbour	
Figure 1.1 Plan showing areas to be dredged (areas A1, B, M1 and C).	
Adapted from figure provided by QT	March 2009

2 Methodology

Except where varied in the SAP, all sediment sampling and analysis was in accordance with the latest version of the *National Ocean Disposal Guidelines for Dredged Material* (Environment Australia 2002) (NOD Guidelines). Acid sulfate soil sampling was in accordance with the *Sampling and Analysis Procedure for Lowland Acid Sulfate Soils in Queensland* (Ahern et al. 1998) and the *Acid Sulfate Soils Laboratory Method Guidelines* (Ahern et al. 2004).

2.1 Collection of Samples

Sediment cores were collected from a total of five sites. The GPS position of each of site is listed in Table 2.1. The position of site A1 was south east of the site originally specified in the SAP, due to sea-state conditions during sampling.

Table 2.1 GPS position of each site (UTM WGS 84 Zone 56; GPS positioning to within 4 m accuracy).

Site	Easting	Northing
A1	273,565	7,437,103
2	273,769	7,436,976
3	273,696	7,436,979
4	273,697	7,436,906
5	273,654	7,436,787

frc environmental deep thinking. science.	Rosslyn Bay Sediment Sampling & Analysis
	Figure 2.1 Core collection sites within Rosslyn Bay Boat Harbour.
	Source: Google Earth / March 2009

Cores were collected using a 50 mm stainless steel piston corer at all sites except site A1, where a 50 mm stainless steel push corer was used due to constraints on the length of core that can be taken with the piston corer. The corer was cleaned of all traces of sediment and rinsed with ambient seawater between cores. Collected cores were drawn off into poly-sleeves. At least two cores were taken at each site to ensure an adequate quantity of sediment was collected. At each site cores were taken immediately adjacent to each other. The sediments from each core were thoroughly mixed, so that each subsample sent to the laboratory was a homogenous mix of each core taken at that site.

Cores at all sites were taken to a depth as close as practical to 0.5 m below the proposed maximum dredge depth in each area. However, the core at site A1 was only taken to 0.2 m below the maximum dredge depth, due to sampling constraints caused by the length of the push corer relative to the water depth at this site on low tide, and the sandy nature of the substrate. Water depths and required core lengths were checked at several locations in the area; the location sampled enabled us to achieve the greatest core depth relative to LAT.

To fully comply with the National Ocean Disposal (NOD) guidelines, we included field quality assurance / quality control (QA/QC) samples in our sampling protocol. Field triplicates were collected at site 3 (Cores 3, 3QC1 and 3QC2) to determine between-core variability within a site (that is, sediments from each triplicate core were not mixed with each other when collecting subsamples). Further, the bottom half of core 2 was mixed and divided into two homogenous subsamples (subsamples 2A and 2QC3A), to assess within core variation and laboratory handling.

Each core (including the field triplicate cores) was divided into two sections: the upper 0.5 m of the sediment core (subsample A), and the remainder of the sediment core (subsample B). Each subsample of the duplicate cores was mixed and a single composite sample taken from each section.

Samples were chilled and forwarded to the analytical laboratories within 48 hours of collection.

At the time of sampling, a core log was recorded for each site, including:

- GPS position of sampling point
- time and date of coring
- the name of the sample collector
- weather conditions at the time of coring
- sea state at the time of coring
- general comments (e.g. on wind speed, level of shipping traffic, etc)

- water depth at core location
- the height of the top and bottom of each core, relative to LAT
- core length, and
- type of corer used (aluminium, PVC, stainless steel etc.).

And every 0.25 m or before and after any discontinuities, we recorded:

- the distance from the top of the core
- colour
- approximate particle size
- field texture
- plasticity
- odour, and
- presence of shell or carbonate material, along with a measure or estimate of their abundance and size distribution.

Acid Sulfate Soil Testing

Field pH and field pH after oxidation with 30% peroxide was measured every 0.25 m along the core profile at each site (this encompassed measuring any horizons present). Methodology was as per Section H of the *Acid Sulfate Soils Laboratory Method Guidelines* (Ahern et al. 2004), produced by the Queensland Acid Sulfate Soils Investigation Team (QASSIT). Briefly, a small amount of soil (1 tsp) was taken from each interval for each of the tests. One sample was mixed with de-ionised water and the pH (pH_F) was measured using a pH meter and electrode. The other sample was oxidised with 30% hydrogen peroxide, which had been buffered with sodium hydroxide to a pH of approximately 5 – 6. The reaction speed was noted, and once the reaction had ceased, the pH of the solution was measured (pH_{FOX}).

2.2 Laboratory Analysis of Samples

All subsamples were analysed for the following parameters:

i. particle size distribution (including hydrometer)

ii. sediment settling rate

ii. moisture content

iii. total organic carbon

iv. nutrients (total nitrogen, total ammonia and total phosphorus)

v. total petroleum hydrocarbons (TPH),

vi. Phenols (speciated)

vii. Volatile chlorinated hydrocarbons (VCHs)

viii. Chlorobenzenes

ix. Organochlorines including: total chlordane@, oxychlordane, dieldrin, heptachlor, heptachlor epoxide, methoxychlor, endrin, DDD, DDE, DDT, alpha and beta BHC, endosulfan (total alpha, beta and sulphate), hexachlorobenzene, lindane, aldrin

x. total Polychlorinated Biphenyls (PCBs)

xi. Polynuclear Aromatic Hydrocarbons (PAHs) including:Napthalene, acenapthalene, acenapthene, fluorine, Phenanthene total, benz[b]fluoranthene, fluoranthene total, indeno[1,2,3-cd]pyrene, benzo[k]fluoranthene, chrysene, coronene, dibenz[ah]anthracene, benzo[e]pyrene, benzo[a]pyrene, perylene, pyrene and total PAHs

xii. Benzene, toluene, ethylbenzene, xylene (BTEX)

xiii. Non-organochlorine pesticides, including: Organophosphates, carbamates, synthetic pyrethroids, trazine and phenoxy acid herbicides

xiv. Organotin compounds (monobutlytin, dibutlytin, tributyltin)

xv. Metals and metalloids (Cu, Pb, Zn, Cr, Ni, Cd, Hg, As, Ag, Mn, Al, Co, Fe, V, Se, Sb)

xvi. total cyanide, and

xvii. acid sulfate soils.

All acid sulfate soil samples were analysed for potential acid sulfate soils using the SPOCAS method, as described in the latest version of the *Acid Sulfate Soils Laboratory Method Guidelines* (Ahern et al. 2004).

2.3 Assessment of Sediment Settling Rates

Sediment settling rates were measured by Dr Massimo Gasparon at the University of Queensland. “Settling rates” were measured using conventional Imhoff cones, to determine the rates of settlement after 50% and 90% of settlement, in seawater, as per the NOD Guidelines. The NOD guidelines do not provide specific information on the exact procedure to be used to carry out the analysis. The following protocol was adopted:

- 100 grams of sediment sample (wet weight) was thoroughly mixed with 1 litre of clean seawater
- the sludge was placed into a standard 1-litre Imhoff cone, and volumes of sediment settled were recorded at regular time intervals
- the final volume of the sediment was recorded at the end of settling. This volume was used to calculate proportions of sediment volume deposited after 50% and 90% settling.

At the end of the testing, samples were left in the Imhoff cones overnight, and sediment volumes were noted the following morning.

2.4 Assessment of Sediment Quality

The assessment of sediment quality followed the approach outlined in Section 3.10.2 of the *National Ocean Disposal Guidelines for Dredged Material*.

Any results less than the Practical Quantification Limit (PQL) were entered as half the PQL, for statistical and analytical purposes (Environment Australia 2002). The concentration of detected organic compounds was normalised to total organic carbon (TOC) content, as outlined in Section 3.10.2 of the NOD Guidelines.

3 Results and Discussion

The sediments were sampled on the 17th and 18th of January 2009. The weather was fine and the water was mostly calm throughout sampling (Appendix A). No litter was seen in the dredge area or collected in the cores, except for a piece of fishing line that was found in the core at site 2.

3.1 Particle Size Distribution

Sediments in the outer channel were sandy, and those within the harbour were sandy-clay: whilst sands comprised the greatest proportion of the sediments, the proportion of clay, and to a lesser extent silt, was also high. A very small amount of gravel was recorded at site 2, no other cores contained gravel.

3.2 Settling Rate in Seawater

Sediment settling rates in seawater were very similar between subsample A samples and subsample B samples (Table 3.1, Table 3.2). Fifty percent of the volume of sediment settled within a mean time of less than 10 minutes for both subsample A and subsample B samples. Ninety percent the volume of sediment settled within a mean time of less than 16 minutes for both subsamples.

Table 3.1 Summary of settling rate analysis for subsample A samples (the top 0.5 m of sediment).

Settling rate	Units	Mean	SD	95% UCL[1]
Time required to settle 50% (volume) of the total sediment	Minutes	9.92	5.59	14.81
Time required to settle 90% (volume) of the total sediment	Minutes	14.60	2.71	16.97

1 95% UCL - upper 95% confidence limit of the mean

Table 3.2 Summary of settling rate analysis for subsample B samples (the sediment below 0.5 m).

Settling rate	Units	Mean	SD	95% UCL1
Time required to settle 50% (volume) of the total sediment	Minutes	9.56	5.83	14.67
Time required to settle 90% (volume) of the total sediment	Minutes	15.43	3.06	18.12

1 95% UCL - upper 95% confidence limit of the mean

3.3 Soil Nutrient Concentrations

There are no NOD Guidelines for sediment nutrient concentrations.

Organic Carbon

Mean total organic carbon concentrations were 1.01% for subsample A samples, and 1.33% for subsample B samples (Table 3.3 & Table 3.4).

Nitrogen

Mean total nitrogen (TN) concentrations were 410 mg/kg for subsample A samples, and 360 mg/kg for subsample B samples (Table 3.3 & Table 3.4). This is similar to nutrient concentrations in the sediment at other boat harbours along the central Queensland coast (such as Bowen Boat Harbour, frc environmental 2004), and lower than concentrations recorded in sediments from Moreton Bay in south-east Queensland (frc environmental 2006, 2007a, 2007b). Ammonia concentrations were relatively low, and oxidized nitrogen concentrations were below laboratory detection limits. Nitrogen concentrations varied among sites, with the lowest concentrations recorded at site 1, which was characterised by sandy sediments.

Phosphorus

Mean total phosphorus (TP) concentrations were 331.67 mg/kg for subsample A samples and 324.00 mg/kg for subsample B samples. TP concentrations did not vary greatly

(≤40 mg/kg) among sites, and were similar to concentrations recorded in Bowen Boat Harbour and Moreton Bay (frc environmental 2004, 2006, 2007a, 2007b).

3.4 Soil Contaminants

Metals

The concentrations of all metals except for antimony were below National Ocean Disposal Guidelines screening levels. Levels of antimony in the sediment exceeded the screening level at all sites apart from site A1. Mean levels of antimony exceeded the NOD Guideline screening level by 0.6 and 0.5 mg/kg for subsample A and B samples, respectively. The 95% upper confidence limit of the mean was 1.1 mg/kg above the screening level for both subsample A and B samples (Table 3.3 & Table 3.4).

Hydrocarbons

There are no guidelines for TPH / BTEX levels in sediments. However, total petroleum hydrocarbon (TPH) and BTEX (benzene, toluene, ethylene & xylene) levels were low in all the samples that were analysed, and were all below guideline practical quantification limits or laboratory detection limits (Table 3.3 & Table 3.4).

Concentrations of most polynuclear aromatic hydrocarbons (PAHs) were below guideline practical quantification limits and laboratory detection limits for most parameters. Fluoranthene and Pyrene concentrations at site 4 (subsample A) and Fluoranthene, Pyrene and Benzo (a) pyrene concentrations at site 5 (subsample B) were above laboratory detection limits and therefore an adjustment was made relative to total organic carbon content, as per the NOD guidelines. Original and adjusted values were below the National Ocean Disposal Guidelines screening levels.

Herbicides and Pesticides

Concentrations of herbicides and pesticides were all below guideline practical quantification limits and laboratory detection limits for all sites (Table 3.3 & Table 3.4).

Organotin

Levels of monobutyltin (MBT) were below guideline practical quantification limits and laboratory detection limits for all sites. Dibutyltin (DBT) concentrations were above laboratory detection limits at site 2 (subsample A), while tributyltin (TBT) concentrations were above laboratory detection limits at site 2 (subsample A and B), site 3 (subsample A and B) and site 5 (subsample A and B). Levels at these sites were adjusted to account for total organic carbon, and were below the NOD Guidelines screening level both before and after adjustments were made (Table 3.3 & Table 3.4).

Poly-chlorinated Biphenyls

Total poly-chlorinated biphenyl (PCB) concentrations were below the laboratory detection limits for all sites sampled (Table 3.3 & Table 3.4).

Table 3.3 Summary of analyses for subsample A samples (the top 0.5 m of sediment). Shading indicates where parameters exceeded the screening level (SL).

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Moisture Content	**%**	-	-	44.06	8.65	51.64
Particle Size Analysis						
Gravel (+2 mm)	%	-	-	0.40	0.89	1.18
Sand (2 mm – 0.06 mm)	%	-	-	36.20	22.03	55.51
Silt (0.06 mm – 0.002 mm)	%	-	-	27.00	7.84	33.87
Clay (<0.002 mm)	%	-	-	36.40	14.35	48.97
Nutrients						
Total Organic Carbon	%	-	-	1.01	0.15	1.15
Ammonia	mg/kg	-	-	9.80	5.12	14.29
Total Nitrogen	mg/kg	-	-	410	126.29	520.70
Phosphorus	mg/kg	-	-	336.00	15.17	349.29
Nitrate as N	mg/kg	-	-	0.25	0.00	0.25
Nitrite as N	mg/kg	-	-	0.25	0.00	0.25
Total Kjeldahl Nitrogen	mg/kg	-	-	410.00	126.29	520.70
Cyanides						
Cyanide - Total	mg/kg	-	-	0.05	0.00	0.05
Metals						
Selenium	mg/kg	-	-	0.47	0.30	0.74
Silver	mg/kg	1.00	3.70	0.05	0.00	0.05
Aluminium	mg/kg	-	-	8426.60	2657.94	10756.34
Antimony	mg/kg	2.00	25.00	2.60	0.62	3.14
Arsenic	mg/kg	20.00	70.00	10.40	0.55	10.88
Cadmium	mg/kg	1.50	10.00	0.05	0.00	0.05
Cobalt	mg/kg	-	-	8.56	0.61	9.09
Chromium	mg/kg	80.00	370.00	21.40	5.50	26.22
Copper	mg/kg	65.00	270.00	12.36	4.80	16.57
Iron	mg/kg	-	-	16800.00	3271.09	19667.18
Lead	mg/kg	50.00	220.00	6.12	2.93	8.69
Mercury	mg/kg	0.15	1.00	0.01	0.01	0.02
Manganese	mg/kg	-	-	428.00	65.35	485.28
Nickel	mg/kg	21.00	52.00	15.80	4.60	19.84
Vanadium	mg/kg	-	-	25.80	4.44	29.69

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Zinc	mg/kg	200.00	410.00	30.20	8.93	38.03
BTEX						
Benzene	µg/kg	-	-	0.10	0.00	0.10
Toluene	µg/kg	-	-	0.10	0.00	0.10
Ethyl Benzene	µg/kg	-	-	0.10	0.00	0.10
meta- & para- xylenes	µg/kg	-	-	0.20	0.00	0.20
ortho-Xylene	µg/kg	-	-	0.10	0.00	0.10
Total BTEX	µg/kg	-	-	0.60	0.00	0.60
Total Petroleum Hydrocarbons						
TPH C6-C9 Fraction	mg/kg	-	-	5.00	0.00	5.00
TPH C10-14 Fraction	mg/kg	-	-	5.00	0.00	5.00
TPH C15-28 Fraction	mg/kg	-	-	25.00	0.00	25.00
TPH C29-36 Fraction	mg/kg	-	-	25.00	0.00	25.00
Polynuclear Aromatic Hydrocarbons (PAHs)[4]						
Acenaphthylene	µg/kg	44.00	640.00	2.50	0.00	2.50
Acenaphthene	µg/kg	16.00	500.00	2.50	0.00	2.50
Anthracene	µg/kg	85.00	1100.00	2.50	0.00	2.50
Benzo (a) anthracene	µg/kg	261.00	1600.00	2.50	0.00	2.50
Benzo (b) & (k) fluoranthene	µg/kg	-	-	5.00	0.00	5.00
Benzo (a) pyrene	µg/kg	430.00	1600.00	2.50	0.00	2.50
Benzo (e) pyrene	µg/kg	-	-	2.50	0.00	2.50
Benzo (g,h,i) perylene	µg/kg	-	-	2.50	0.00	2.50
Chrysene	µg/kg	384.00	2800.00	2.50	0.00	2.50
Coronene	µg/kg	-	-	5.00	0.00	5.00
Dibenz (a,h) anthracene	µg/kg	63.00	260.00	2.50	0.00	2.50
Fluoranthene	µg/kg	600.00	5100.00	3.00	1.12	3.98
Fluorene	µg/kg	19.00	540.00	2.50	0.00	2.50
Indeno (1,2,3-cd) pyrene	µg/kg	-	-	2.50	0.00	2.50
1-Methylnaphthalene	µg/kg	-	-	2.50	0.00	2.50
2-Methylnaphthalene	µg/kg	70.00	670.00	2.50	0.00	2.50
Naphthalene	µg/kg	160.00	2100.00	2.50	0.00	2.50
Phenanthrene	µg/kg	240.00	1500.00	2.50	0.00	2.50
Pyrene	µg/kg	665.00	2600.00	3.00	1.12	3.98
Total PAHs (as above)	µg/kg	4000.00	45000.00	50.00	0.00	50.00

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Chlorofluorocarbons						
Trichlorofluoromethane	mg/kg			2.50	0.00	2.50
Dichlorodifluoromethane	mg/kg			2.50	0.00	2.50
Phenols						
Phenol	mg/kg	-	-	0.25	0.00	0.25
2-Chlorophenol	mg/kg	-	-	0.25	0.00	0.25
2-Methylphenol	mg/kg	-	-	0.25	0.00	0.25
3-&4-Methylphenol	mg/kg	-	-	0.50	0.00	0.50
2-Nitrophenol	mg/kg	-	-	0.25	0.00	0.25
2,4-Dimethylphenol	mg/kg	-	-	0.25	0.00	0.25
2,4-Dichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,6-Dichlorophenol	mg/kg	-	-	0.25	0.00	0.25
4-Chloro-3-Methylphenol	mg/kg	-	-	0.25	0.00	0.25
2,4,6-Trichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,4,5-Trichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,3,4,6-Tetrachlorophenol	mg/kg	-	-	0.25	0.00	0.25
Pentachlorophenol	mg/kg	-	-	0.50	0.00	0.50
Organotin Compounds[4]						
Monobutyl tin	µgSn/kg	-	-	0.25	0.00	0.25
Dibutyl tin	µgSn/kg	-	-	0.30	0.13	0.41
Tributyl tin	µgSn/kg	5.00	70.00	0.52	0.31	0.79
Organochlorides						
1,1-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
Iodomethane	mg/kg	-	-	0.25	0.00	0.25
Methylene chloride	mg/kg	-	-	0.50	0.00	0.50
trans-1,2-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1-Dichloroethane	mg/kg	-	-	0.25	0.00	0.25
cis-1,2-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1,1-Trichloroethane	mg/kg	-	-	0.25	0.00	0.25
1,1-Dichloropropene	mg/kg	-	-	0.25	0.00	0.25
Carbon tetrachloride	mg/kg	-	-	0.25	0.00	0.25
1,2-Dichloroethane	mg/kg	-	-	0.25	0.00	0.25
Trichloroethene	mg/kg	-	-	0.25	0.00	0.25
Dibromomethane	mg/kg	-	-	0.25	0.00	0.25
1,1,2-Trichloroethane	mg/kg	-	-	0.25	0.00	0.25
Tetrachloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1,1,2-Tetrachloroethane	mg/kg	-	-	0.25	0.00	0.25
trans-1,4-Dichloro-2-butene	mg/kg	-	-	0.25	0.00	0.25

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
1,1,2,2-Tetrachloroethane	mg/kg	-	-	0.25	0.00	0.25
1,2,3-Trichloropropane	mg/kg	-	-	0.25	0.00	0.25
Pentachloroethane	mg/kg	-	-	0.25	0.00	0.25
1,2-Dibromo-3-chloropropane	mg/kg	-	-	0.25	0.00	0.25
Hexachlorobutadiene	mg/kg	-	-	0.25	0.00	0.25
Chlorobenzene	mg/kg	-	-	0.25	0.00	0.25
Bromobenzene	mg/kg	-	-	0.25	0.00	0.25
2-Chlorotoluene	mg/kg	-	-	0.25	0.00	0.25
4-Chlorotoluene	mg/kg	-	-	0.25	0.00	0.25
1,3-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,4-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2,4-Trichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2,3-Trichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
Organophosphorus Pesticides						
Dichlorvos	µg/kg	-	-	10.00	0.00	10.00
Demeton-S-methyl	µg/kg	-	-	10.00	0.00	10.00
Dimethoate	µg/kg	-	-	10.00	0.00	10.00
Diazinon	µg/kg	-	-	10.00	0.00	10.00
Chlorpyrifos-methyl	µg/kg	-	-	10.00	0.00	10.00
Parathion-methyl	µg/kg	-	-	10.00	0.00	10.00
Pirimiphos-methyl	µg/kg	-	-	10.00	0.00	10.00
Fenitrothion	µg/kg	-	-	10.00	0.00	10.00
Malathion	µg/kg	-	-	10.00	0.00	10.00
Chlorpyrifos	µg/kg	-	-	10.00	0.00	10.00
Fenthion	µg/kg	-	-	10.00	0.00	10.00
Parathion	µg/kg	-	-	10.00	0.00	10.00
Chlorfenvinphos	µg/kg	-	-	10.00	0.00	10.00
Bromophos-ethyl	µg/kg	-	-	10.00	0.00	10.00
Methidathion	µg/kg	-	-	10.00	0.00	10.00
Fenamiphos	µg/kg	-	-	10.00	0.00	10.00
Prothiofos	µg/kg	-	-	10.00	0.00	10.00
Ethion	µg/kg	-	-	10.00	0.00	10.00
Carbophenothion	µg/kg	-	-	10.00	0.00	10.00
Phosalone	µg/kg	-	-	10.00	0.00	10.00
Azinphos-methyl	µg/kg	-	-	10.00	0.00	10.00

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Organochlorine Pesticides						
Aldrin	µg/kg	-	-	0.50	0.00	0.50
alpha-BHC	µg/kg	-	-	0.50	0.00	0.50
beta-BHC	µg/kg	-	-	0.50	0.00	0.50
gamma-BHC (Lindane)[5]	µg/kg	0.32	1.00	0.50	0.00	0.50
delta-BHC	µg/kg	-	-	0.50	0.00	0.50
cis-Chlordane	µg/kg	-	-	0.50	0.00	0.50
trans-Chlordane	µg/kg	-	-	0.50	0.00	0.50
p,p'-DDD	µg/kg	2.00	20.00	0.50	0.00	0.50
p,p'-DDE	µg/kg	2.20	27.00	0.50	0.00	0.50
p,p'-DDT	µg/kg	-	-	0.50	0.00	0.50
Dieldrin[5]	µg/kg	0.02	8.00	0.50	0.00	0.50
alpha-Endosulfan	µg/kg	-	-	0.50	0.00	0.50
beta-Endosulfan	µg/kg	-	-	0.50	0.00	0.50
Endosulfan Sulphate	µg/kg	-	-	0.50	0.00	0.50
Endrin[5]	µg/kg	0.02	8.00	0.50	0.00	0.50
Endrin ketone	µg/kg	-	-	0.50	0.00	0.50
Endrin aldehyde	µg/kg	-	-	0.50	0.00	0.50
Heptachlor	µg/kg	-	-	0.50	0.00	0.50
Heptachlor epoxide	µg/kg	-	-	0.50	0.00	0.50
Hexachlorobenzene	µg/kg	-	-	0.50	0.00	0.50
Methoxychlor	µg/kg	-	-	0.50	0.00	0.50
Other Organic Compounds						
Vinyl Chloride	mg/kg	-	-	2.50	0.00	2.50
Synthetic Pyrethroids						
Bifenthrin	mg/kg	-	-	0.01	0.00	0.01
Bioresmethrin				0.01	0.00	0.01
Cyfluthrin (total)	mg/kg	-	-	0.01	0.00	0.01
Cyhalothrin (total)	mg/kg	-	-	0.01	0.00	0.01
Cypermethrin (total)	mg/kg	-	-	0.01	0.00	0.01
Deltamethrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Fenvalerate (& Es-)	mg/kg	-	-	0.01	0.00	0.01
Fluvalinate (& tau-)	mg/kg	-	-	0.01	0.00	0.01
Permethrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Phenothrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Herbicides						
Atrazine	µg/kg	-	-	0.01	0.00	0.01
Clopyralid	µg/kg	-	-	0.01	0.00	0.01

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Dicamba	µg/kg	-	-	0.01	0.00	0.01
Dichlorprop	µg/kg	-	-	0.01	0.00	0.01
Dinoseb	µg/kg	-	-	0.01	0.00	0.01
Fluroxypyr	µg/kg	-	-	0.01	0.00	0.01
Hexazinone	µg/kg	-	-	0.01	0.00	0.01
MCPA	µg/kg	-	-	0.01	0.00	0.01
Mecoprop	µg/kg	-	-	0.01	0.00	0.01
Metribuzine	µg/kg	-	-	0.01	0.00	0.01
Picloram	µg/kg	-	-	0.01	0.00	0.01
Prometryne	µg/kg	-	-	0.01	0.00	0.01
Simazine	µg/kg	-	-	0.01	0.00	0.01
Triclopyr	µg/kg	-	-	0.01	0.00	0.01
2,4 D	µg/kg	-	-	0.01	0.00	0.01
2,4 DB	µg/kg	-	-	0.01	0.00	0.01
2,4,5 T	µg/kg	-	-	0.01	0.00	0.01
2,4,5 TP (Silvex)	µg/kg	-	-	0.01	0.00	0.01
Carbamate Insecticides						
Aldicarb	mg/kg	-	-	0.01	0.00	0.01
Bendiocarb	mg/kg	-	-	0.01	0.00	0.01
Carbaryl	mg/kg	-	-	0.01	0.00	0.01
Carbofuran	mg/kg	-	-	0.01	0.00	0.01
Fenoxycarb	mg/kg	-	-	0.01	0.00	0.01
Methiocarb	mg/kg	-	-	0.01	0.00	0.01
Methomyl	mg/kg	-	-	0.01	0.00	0.01
Oxamyl	mg/kg	-	-	0.01	0.00	0.01
Pirimicarb	mg/kg	-	-	0.01	0.00	0.01
Polychlorinated Biphenyls (PCBs)						
Mono-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Di-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Tri-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Tetra-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Penta-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Hexa-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Hepta-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Octa-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Nona-PCB congeners	µg/kg	-	-	2.50	0.00	2.50

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Deca-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Total PCB congeners	µg/kg	23.00	-	2.50	0.00	2.50

1 SL - screening level from the NOD Guidelines
2 ML - maximum level from the NOD Guidelines
3 95% UCL - upper 95% confidence limit of the mean
4 Values have been normalised to 1% TOC, where present, as per the NOD Guidelines
5 As stated in the NOD Guidelines, the screening level for these analytes is lower than the detection limit. If detected, these substances are present at above the SL and must be assesses accordingly.

Table 3.4 Summary of analyses for subsample B samples (the sediment below 0.5 m) from all sites combined. Shading indicates where parameters exceeded the screening level (SL).

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Moisture Content	**%**	**-**	**-**	41.12	6.07	46.44
Particle Size Analysis						
Gravel (+2 mm)	%	-	-	0.40	0.89	1.18
Sand (2 mm – 0.06 mm)	%	-	-	43.40	20.60	61.46
Silt (0.06 mm – 0.002 mm)	%	-	-	23.80	7.40	30.28
Clay (<0.002 mm)	%	-	-	32.40	13.65	44.36
Nutrients						
Total Organic Carbon	%	-	-	1.33	1.02	2.22
Ammonia	mg/kg	-	-	11.00	4.68	15.10
Total Nitrogen	mg/kg	-	-	360.00	126.89	471.22
Phosphorus	mg/kg	-	-	324.00	8.94	331.84
Nitrate as N	mg/kg	-	-	0.30	0.11	0.40
Nitrite as N	mg/kg	-	-	0.25	0.00	0.25
Total Kjeldahl Nitrogen	mg/kg	-	-	360.00	126.89	471.22
Cyanides						
Cyanide - Total	mg/kg	-	-	0.05	0.00	0.05
Metals						
Selenium	mg/kg	-	-	0.57	0.19	0.74
Silver	mg/kg	1.00	3.70	0.05	0.00	0.05
Aluminium	mg/kg	-	-	7933.60	2347.68	9991.39
Antimony	mg/kg	2	25	2.50	0.71	3.12
Arsenic	mg/kg	20.00	70.00	10.20	0.79	10.89
Cadmium	mg/kg	1.50	10.00	0.05	0.00	0.05
Cobalt	mg/kg	-	-	8.36	0.38	8.70
Chromium	mg/kg	80.00	370.00	20.80	5.26	25.41
Copper	mg/kg	65.00	270.00	11.98	4.67	16.08
Iron	mg/kg	-	-	16000	3082.21	18701.62
Lead	mg/kg	50.00	220.00	5.64	1.73	7.15
Mercury	mg/kg	0.15	1.00	0.01	0.01	0.02
Manganese	mg/kg	-	-	426.00	75.03	491.77
Nickel	mg/kg	21.00	52.00	15.30	4.09	18.88
Vanadium	mg/kg	-	-	25.00	4.42	28.87
Zinc	mg/kg	200.00	410.00	28.80	6.87	34.82

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
BTEX						
Benzene	µg/kg	-	-	0.10	0.00	0.10
Toluene	µg/kg	-	-	0.10	0.00	0.10
Ethyl Benzene	µg/kg	-	-	0.10	0.00	0.10
meta- & para- xylenes	µg/kg	-	-	0.20	0.00	0.20
ortho-Xylene	µg/kg	-	-	0.10	0.00	0.10
Total BTEX	µg/kg	-	-	0.60	0.00	0.60
Total Petroleum Hydrocarbons						
TPH C6-C9 Fraction	mg/kg	-	-	5.00	0.00	5.00
TPH C10-14 Fraction	mg/kg	-	-	5.00	0.00	5.00
TPH C15-28 Fraction	mg/kg	-	-	25.00	0.00	25.00
TPH C29-36 Fraction	mg/kg	-	-	25.00	0.00	25.00
Polynuclear Aromatic Hydrocarbons (PAHs)[4]						
Acenaphthylene	µg/kg	44.00	640.00	2.50	0.00	2.50
Acenaphthene	µg/kg	16.00	500.00	2.50	0.00	2.50
Anthracene	µg/kg	85.00	1100.00	2.50	0.00	2.50
Benzo (a) anthracene	µg/kg	261.00	1600.00	2.50	0.00	2.50
Benzo (b) & (k) fluoranthene	µg/kg	-	-	5.00	0.00	5.00
Benzo (a) pyrene	µg/kg	430.00	1600.00	3.14	1.42	4.38
Benzo (e) pyrene	µg/kg	-	-	2.50	0.00	2.50
Benzo (g,h,i) perylene	µg/kg	-	-	2.50	0.00	2.50
Chrysene	µg/kg	384.00	2800.00	2.50	0.00	2.50
Coronene	µg/kg	-	-	5.00	0.00	5.00
Dibenz (a,h) anthracene	µg/kg	63.00	260.00	2.50	0.00	2.50
Fluoranthene	µg/kg	600.00	5100.00	4.27	3.96	7.75
Fluorene	µg/kg	19.00	540.00	2.50	0.00	2.50
Indeno (1,2,3-cd) pyrene	µg/kg	-	-	2.50	0.00	2.50
1-Methylnaphthalene	µg/kg	-	-	2.50	0.00	2.50
2-Methylnaphthalene	µg/kg	70.00	670.00	2.50	0.00	2.50
Naphthalene	µg/kg	160.00	2100.00	2.50	0.00	2.50
Phenanthrene	µg/kg	240.00	1500.00	2.50	0.00	2.50
Pyrene	µg/kg	665.00	2600.00	4.27	3.96	7.75
Total PAHs (as above)	µg/kg	4000.00	45000.00	50.00	0.00	50.00
Chlorofluorocarbons						
Trichlorofluoromethane	mg/kg	-	-	2.50	0.00	2.50
Dichlorodifluoromethane	mg/kg	-	-	2.50	0.00	2.50

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Phenols						
Phenol	mg/kg	-	-	0.25	0.00	0.25
2-Chlorophenol	mg/kg	-	-	0.25	0.00	0.25
2-Methylphenol	mg/kg	-	-	0.25	0.00	0.25
3-&4-Methylphenol	mg/kg	-	-	0.50	0.00	0.50
2-Nitrophenol	mg/kg	-	-	0.25	0.00	0.25
2,4-Dimethylphenol	mg/kg	-	-	0.25	0.00	0.25
2,4-Dichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,6-Dichlorophenol	mg/kg	-	-	0.25	0.00	0.25
4-Chloro-3-Methylphenol	mg/kg	-	-	0.25	0.00	0.25
2,4,6-Trichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,4,5-Trichlorophenol	mg/kg	-	-	0.25	0.00	0.25
2,3,4,6-Tetrachlorophenol	mg/kg	-	-	0.25	0.00	0.25
Pentachlorophenol	mg/kg	-	-	0.50	0.00	0.50
Organotin Compounds[4]						
Monobutyl tin	µgSn/kg	-	-	0.25	0.00	0.25
Dibutyl tin	µgSn/kg	-	-	0.26	0.14	1.26
Tributyl tin	µgSn/kg	5.00	70.00	0.94	1.01	1.83
Organochlorides						
1,1-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
Iodomethane	mg/kg	-	-	0.25	0.00	0.25
Methylene chloride	mg/kg	-	-	0.50	0.00	0.50
trans-1,2-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1-Dichloroethane	mg/kg	-	-	0.25	0.00	0.25
cis-1,2-Dichloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1,1-Trichloroethane	mg/kg	-	-	0.25	0.00	0.25
1,1-Dichloropropene	mg/kg	-	-	0.25	0.00	0.25
Carbon tetrachloride	mg/kg	-	-	0.25	0.00	0.25
1,2-Dichloroethane	mg/kg	-	-	0.25	0.00	0.25
Trichloroethene	mg/kg	-	-	0.25	0.00	0.25
Dibromomethane	mg/kg	-	-	0.25	0.00	0.25
1,1,2-Trichloroethane	mg/kg	-	-	0.25	0.00	0.25
Tetrachloroethene	mg/kg	-	-	0.25	0.00	0.25
1,1,1,2-Tetrachloroethane	mg/kg	-	-	0.25	0.00	0.25
trans-1,4-Dichloro-2-butene	mg/kg	-	-	0.25	0.00	0.25
1,1,2,2-Tetrachloroethane	mg/kg	-	-	0.25	0.00	0.25
1,2,3-Trichloropropane	mg/kg	-	-	0.25	0.00	0.25
Pentachloroethane	mg/kg	-	-	0.25	0.00	0.25
1,2-Dibromo-3-chloropropane	mg/kg	-	-	0.25	0.00	0.25

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Hexachlorobutadiene	mg/kg	-	-	0.25	0.00	0.25
Chlorobenzene	mg/kg	-	-	0.25	0.00	0.25
Bromobenzene	mg/kg	-	-	0.25	0.00	0.25
2-Chlorotoluene	mg/kg	-	-	0.25	0.00	0.25
4-Chlorotoluene	mg/kg	-	-	0.25	0.00	0.25
1,3-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,4-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2-Dichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2,4-Trichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
1,2,3-Trichlorobenzene	mg/kg	-	-	0.25	0.00	0.25
Organophosphorus Pesticides						
Dichlorvos	µg/kg	-	-	10.00	0.00	10.00
Demeton-S-methyl	µg/kg	-	-	10.00	0.00	10.00
Dimethoate	µg/kg	-	-	10.00	0.00	10.00
Diazinon	µg/kg	-	-	10.00	0.00	10.00
Chlorpyrifos-methyl	µg/kg	-	-	10.00	0.00	10.00
Parathion-methyl	µg/kg	-	-	10.00	0.00	10.00
Pirimiphos-methyl	µg/kg	-	-	10.00	0.00	10.00
Fenitrothion	µg/kg	-	-	10.00	0.00	10.00
Malathion	µg/kg	-	-	10.00	0.00	10.00
Chlorpyrifos	µg/kg	-	-	10.00	0.00	10.00
Fenthion	µg/kg	-	-	10.00	0.00	10.00
Parathion	µg/kg	-	-	10.00	0.00	10.00
Chlorfenvinphos	µg/kg	-	-	10.00	0.00	10.00
Bromophos-ethyl	µg/kg	-	-	10.00	0.00	10.00
Methidathion	µg/kg	-	-	10.00	0.00	10.00
Fenamiphos	µg/kg	-	-	10.00	0.00	10.00
Prothiofos	µg/kg	-	-	10.00	0.00	10.00
Ethion	µg/kg	-	-	10.00	0.00	10.00
Carbophenothion	µg/kg	-	-	10.00	0.00	10.00
Phosalone	µg/kg	-	-	10.00	0.00	10.00
Azinphos-methyl	µg/kg	-	-	10.00	0.00	10.00
Organochlorine Pesticides						
Aldrin	µg/kg	-	-	0.50	0.00	0.50
alpha-BHC	µg/kg	-	-	0.50	0.00	0.50
beta-BHC	µg/kg	-	-	0.50	0.00	0.50
gamma-BHC (Lindane)[5]	µg/kg	0.32	1.00	0.50	0.00	0.50
delta-BHC	µg/kg	-	-	0.50	0.00	0.50

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
cis-Chlordane	µg/kg	-	-	0.50	0.00	0.50
trans-Chlordane	µg/kg	-	-	0.50	0.00	0.50
p,p'-DDD	µg/kg	2.00	20.00	0.50	0.00	0.50
p,p'-DDE	µg/kg	2.20	27.00	0.50	0.00	0.50
p,p'-DDT	µg/kg	-	-	0.50	0.00	0.50
Dieldrin[5]	µg/kg	0.02	8.00	0.50	0.00	0.50
alpha-Endosulfan	µg/kg	-	-	0.50	0.00	0.50
beta-Endosulfan	µg/kg	-	-	0.50	0.00	0.50
Endosulfan Sulphate	µg/kg	-	-	0.50	0.00	0.50
Endrin[5]	µg/kg	0.02	8.00	0.50	0.00	0.50
Endrin ketone	µg/kg	-	-	0.50	0.00	0.50
Endrin aldehyde	µg/kg	-	-	0.50	0.00	0.50
Heptachlor	µg/kg	-	-	0.50	0.00	0.50
Heptachlor epoxide	µg/kg	-	-	0.50	0.00	0.50
Hexachlorobenzene	µg/kg	-	-	0.50	0.00	0.50
Methoxychlor	µg/kg	-	-	0.50	0.00	0.50
Other Organic Compounds						
Vinyl Chloride	mg/kg	-	-	2.50	0.00	2.50
Synthetic Pyrethroids						
Bifenthrin	mg/kg	-	-	0.01	0.00	0.01
Bioresmethrin	mg/kg	-	-	0.01	0.00	0.01
Cyfluthrin (total)	mg/kg	-	-	0.01	0.00	0.01
Cyhalothrin (total)	mg/kg	-	-	0.01	0.00	0.01
Cypermethrin (total)	mg/kg	-	-	0.01	0.00	0.01
Deltamethrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Fenvalerate (& Es-)	mg/kg	-	-	0.01	0.00	0.01
Fluvalinate (& tau-)	mg/kg	-	-	0.01	0.00	0.01
Permethrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Phenothrin (cis & trans)	mg/kg	-	-	0.01	0.00	0.01
Herbicides						
Atrazine	µg/kg	-	-	0.01	0.00	0.01
Clopyralid	µg/kg	-	-	0.01	0.00	0.01
Dicamba	µg/kg	-	-	0.01	0.00	0.01
Dichlorprop	µg/kg	-	-	0.01	0.00	0.01
Dinoseb	µg/kg	-	-	0.01	0.00	0.01
Fluroxypyr	µg/kg	-	-	0.01	0.00	0.01
Hexazinone	µg/kg	-	-	0.01	0.00	0.01
MCPA	µg/kg	-	-	0.01	0.00	0.01
Mecoprop	µg/kg	-	-	0.01	0.00	0.01

Parameter	Units	SL[1]	ML[2]	Mean	SD	95% UCL[3]
Metribuzine	µg/kg	-	-	0.01	0.00	0.01
Picloram	µg/kg	-	-	0.01	0.00	0.01
Prometryne	µg/kg	-	-	0.01	0.00	0.01
Simazine	µg/kg	-	-	0.01	0.00	0.01
Triclopyr	µg/kg	-	-	0.01	0.00	0.01
2,4 D	µg/kg	-	-	0.01	0.00	0.01
2,4 DB	µg/kg	-	-	0.01	0.00	0.01
2,4,5 T	µg/kg	-	-	0.01	0.00	0.01
2,4,5 TP (Silvex)	µg/kg	-	-	0.01	0.00	0.01
Carbamate Insecticides						
Aldicarb	mg/kg	-	-	0.01	0.00	0.01
Bendiocarb	mg/kg	-	-	0.01	0.00	0.01
Carbaryl	mg/kg	-	-	0.01	0.00	0.01
Carbofuran	mg/kg	-	-	0.01	0.00	0.01
Fenoxycarb	mg/kg	-	-	0.01	0.00	0.01
Methiocarb	mg/kg	-	-	0.01	0.00	0.01
Methomyl	mg/kg	-	-	0.01	0.00	0.01
Oxamyl	mg/kg	-	-	0.01	0.00	0.01
Pirimicarb	mg/kg	-	-	0.01	0.00	0.01
Polychlorinated Biphenyls (PCBs)						
Mono-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Di-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Tri-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Tetra-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Penta-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Hexa-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Hepta-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Octa-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Nona-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Deca-PCB congeners	µg/kg	-	-	2.50	0.00	2.50
Total PCB congeners	µg/kg	23.00	-	2.50	0.00	2.50

1 SL - screening level from the NOD Guidelines
2 ML - maximum level from the NOD Guidelines
3 95% UCL - upper 95% confidence limit of the mean
4 Values have been normalised to 1% TOC, where present, as per the NOD Guidelines
5 As stated in the NOD Guidelines, the screening level for these analytes is lower than the detection limit. If detected, these substances are present at above the SL and must be assesses accordingly.

3.5 Quality Assurance / Quality Control

The National Ocean Disposal Guidelines recommend that for field replicates (that is, more than one sample taken from the same site), a relative standard deviation (RSD[1]) or relative percent difference (RPD) of ± 50% is acceptable (Environment Australia 2002). This level of variation was achieved for between-core variation for most of the parameters and for all of the analytes. Between-core variation was not achieved for sediment settling rates of subsample A samples collected at site 3 (RSD = 53%).

Within core (i.e. between subsample) variation between subsamples 2A and 2QC3A was less than guideline level for most of the parameters and analytes. The exceptions were Selenium (RPD = 94%), Fluoranthene (RPD = 105%), Pyrene (RPD = 95%), Benzo (a) pyrene (RPD = 67%), Dibutyl tin (RPD = 69%) and Tributyl tin (RPD = 107%). In each case, this was because the concentration of the parameter was below laboratory detection limits in each sample, and as such the value was halved for calculation purposes. That is, the actual difference between the two subsamples may have been less than is implied by the data analysis.

Variation between laboratory replicates was acceptable in accordance with the NOD Guidelines (RPD <35%).

3.6 Acid Sulfate Soils

Field pH_F values were relatively high (usually >8) in most of the samples, and were relatively uniform across the sampling sites at the various depth intervals. pH_{FOX} (pH after oxidation with peroxide) values were usually around 1 to 2 pH units below pH_F values, but were still relatively neutral. These field results indicated that the sediments within the dredge area were not potential acid sulfate soils (PASS). Laboratory analyses were performed on collected sediment samples to confirm the presence of PASS.

Field results, along with laboratory results, are presented in Table 3.5.

[1] RSD = standard deviation ÷ mean x 100

Table 3.5 Results of acid sulfate soil testing using the SPOCAS method.

Field Morphology Summary					Laboratory Results*																
		Field pH							TAA	TPA	S_{KCl}	S_P	Ca_{KCl}	Ca_P	Mg_{KCl}	Mg_P	TSA	ANC_E	S_{POS}	Ca_A	Mg_A
Site	Soil Texture	Depth (m)	pH_F	pH_{FOX}	Sample Depth (m)	Sample ID	pH_{KCl}	pH_{OX}	mol H^+/t		%S		%Ca		%Mg		mol H^+/t	% $CaCO_3$	%S	%Ca	%Mg
							23A	23B	23F	23G	23C	23D	23V	23W	23S	23T	23H	23Q	23E	23X	21U
1A	Sand with silt	0.00	8.2	6.9	0 – 0.5	1A	9.2	7.8	<5	<5	0.08	0.13	0.18	4.4	0.056	0.25	<5	13	0.049	0.047	0.24
1A	Sand with silt	0.25	8.7	6.6	0.5 – 2.25	1B	9.1	7.8	<5	<5	0.13	0.18	0.21	4.8	0.061	0.27	<5	13	0.48	0.058	0.049
1A	Sand with silt	0.50	8.6	7.1																	
1A	Sand with silt	0.75	8.6	6.9																	
1A	Sand with silt	1.00	8.7	6.7																	
1A	Sand with silt	1.25	8.7	7.4																	
1A	Sand with silt	1.50	8.7	7.7																	
1A	Sand with silt	1.75	8.6	7.8																	
1A	Sand with silt	2.00	8.5	7.6																	
1A	Sand with silt	2.25	8.7	7.4																	
2	Silt and clay	0.00	8.3	7.2	0 – 0.5	2A	8.4	8	<5	<5	0.21	0.45	0.29	4	0.2	0.42	<5	11	0.068	0.11	0.14
2	Silt and clay	0.25	8.7	6.7	0.5 – 1.0	2B	8.6	7.8	<5	<5	0.21	0.69	0.3	3.4	0.18	0.4	<5	8	0.15	4.2	4.6
2	Silt and clay	0.50	8.5	7.5																	
2	Silt and clay	0.75	8.5	7.3																	
2	Silt and clay	1.00	8.5	7.3																	
3	Silt with sand	0.00	8.4	7.4	0 – 0.5	3A	8.6	7.8	<5	<5	0.17	0.23	0.24	5.1	0.089	0.33	<5	13	3.8	3.1	4.8
3	Silt with sand	0.25	8.5	7.3	0.5 – 1.0	3B	8.6	7.7	<5	<5	0.22	0.27	0.27	4.8	0.14	0.36	<5	13	4.5	4.5	4.5
3	Silt with sand	0.50	8.5	7.3																	
3	Silt with sand and clay	0.75	8.7	7.3																	
3	Silt with sand and clay	1.00	8.7	6.3																	
4	Silt and clay	0.00	8.3	7.2	0 – 0.5	4A	8.6	7.6	<5	<5	0.23	0.3	0.28	4.7	0.12	0.34	<5	13	4.1	3.3	0.2
4	Silt and clay	0.25	8.6	7.1	0.5 – 1.25	4B	8.8	7.7	<5	<5	0.18	0.29	0.25	4.8	0.1	0.33	<5	13	0.21	0.22	0.21
4	Silt and sand	0.50	8.6	7.1																	
4	Silt and sand	0.75	8.6	7.2																	
4	Silt and sand	1.00	8.9	7.3																	

Field Morphology Summary					Laboratory Results*																
		Field pH							TAA	TPA	S_{KCl}	S_P	Ca_{KCl}	Ca_P	Mg_{KCl}	Mg_P	TSA	ANC_E	S_{POS}	Ca_A	Mg_A
Site	Soil Texture	Depth (m)	pH_F	pH_{FOX}	Sample Depth (m)	Sample ID	pH_{KCl}	pH_{OX}	mol H^+/t		%S		%Ca		%Mg		mol H^+/t	% $CaCO_3$	%S	%Ca	%Mg
							23A	23B	23F	23G	23C	23D	23V	23W	23S	23T	23H	23Q	23E	23X	21U
4	Clay	1.25	8.9	6.7																	
5	Silt	0.00	8.6	7.1	0 – 0.5	5A	8.6	7.6	<5	27	0.22	0.36	0.27	4.4	0.17	0.44	27	12	0.24	0.22	0.22
5	Silt	0.25	8.6	7.5	0.5 – 1.0	5B	8.6	7.7	<5	<5	0.18	0.33	0.26	3.6	0.15	0.38	<5	10	0.22	0.27	0.23
5	Clay	0.50	8.6	7.3																	
5	Silt	0.75	8.6	6.9																	
5	Silt	1.00	8.6	7																	

At each of the sites, actual acidity of the soils was low. The potential acidity was also low, with the exception of subsample A from site 5, which contained some clay material. The net acidity of the sediments is presented in Table 3.6 below.

Sediments are likely to be mixed during dredging and disposal, and the spoil will be disposed offshore. Therefore, acid sulfate soils are not considered to be a risk to aquatic ecology.

Table 3.6 Acid base accounting results for net acidity at each site. Shading indicates where parameters exceeded the *State Planning Policy 2/02* criteria.

Site	ASS Texture-based criteria (1-1000 tonnes soil) (mol H^+/t)			Titratable Actual Acidity	Titratable Potential Acidity	Acid Neutralizing Capacity	Net Acidity	Liming Rate
	≤ 5% Clay	5-40% Clay	≥ 40% Clay	mol H^+/t	mol H^+/t	mol H^+/t	mol H^+/t	kg $CaCo_3$/tonne
1A	18	36	62	<5	<5	2500	<10	<0.75
1B	18	36	62	<5	<5	2500	<10	<0.75
2A	18	36	62	<5	<5	2150	<10	<0.75
2B	18	36	62	<5	<5	1600	<10	<0.75
3A	18	36	62	<5	<5	2500	<10	<0.75
3B	18	36	62	<5	<5	2500	<10	<0.75
4A	18	36	62	<5	<5	2500	<10	<0.75
4B	18	36	62	<5	<5	2500	<10	<0.75
5A	18	36	62	<5	27	2473	47	3.5
5B	18	36	62	<5	<5	2000	<10	<0.75

4 Conclusions

Sediments in the outer channel were sandy, whilst those within the harbour could be described as sandy-clay. We are awaiting the results of settling rate analysis.

Most parameters analysed did not exceed the NOD guideline levels, with the exception of antimony. Mean levels of antimony exceeded the NOD Guideline screening level by 0.6 and 0.5 mg/kg for subsample A and B samples, respectively.

Net acidity for site 5, subsample A (the top 0.5 m of sediment) exceeded the *State Planning Policy 2/02* (SPP 2/02) Texture-based Action Criteria for treatment of acid sulfate soils (ASS) or potential acid sulfate soils (PASS). As the spoil will be disposed of at sea, and as sediments are likely to be mixed during dredging and disposal, the acid sulfate soils detected in the top 0.5 m of sediment at site 5 will be diluted with the soils of low acidity found throughout the dredge area. Therefore, acid sulfate soils are not considered to be a risk to aquatic ecology.

The results of quality assurance / quality control analyses were generally acceptable.

5 References

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frc environmental 2007b, *Sediment Sampling and Analysis, Wynnum Creek Channel*, report prepared for Queensland Transport, August 2007.

Appendix A Field Core Logs

Site 1A

Client:	Queensland Transport	Location:	Rosslyn Bay
Date:	17th January 2009	Weather:	Fine
Corer Type:	Stainless steel push / piston core	Sea State:	Calm
Scientist:	LT / SW	Core Taken By: SW	
Composite subsample taken by: LT		Core Cleaned By: SW	

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273565	7437103	09:00	2.4	2.3	1.6	-0.8	-3.1

Depth (m)	Colour	Particle Size	Mottles	Plasticity	Odour	Shell %
0.00	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
0.25	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
0.50	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
0.75	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
1.00	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
1.25	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
1.50	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
1.75	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
2.00	Light grey	Sand with silt	Nil	Very slight	Nil	<2%
2.25	Light grey	Sand with silt	Nil	Some	Nil	<2%

Site 2

Client: Queensland Transport
Date: 17th January 2009
Corer Type: Stainless steel push / piston core
Scientist: LT / SW
Composite subsample taken by: LT

Location: Rosslyn Bay
Weather: Fine, slight breeze
Sea State: Smooth
Core Taken By: SW
Core Cleaned By: SW

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273769	7436976	15:30	3.2	1.2	1.6	-1.6	-2.8

Depth (m)	Colour	Particle Size	Mottles	Plasticity	Odour	Shell %
0.00	Beige	Silt and clay	Nil	Moderate	Nil	<2%
0.25	Light grey	Silt and clay	Streaks of dark grey	Moderate	Nil	<2%
0.50	Light grey	Silt and clay	Streaks of dark grey	Moderate	Nil	<2%
0.75	Light grey	Silt and clay	Streaks of dark grey	Moderate	Nil	<2%
1.00	Dark grey	Silt and clay	Nil	Moderate	Nil	<2%

Site 3

Client:	Queensland Transport	Location:	Rosslyn Bay
Date:	17th January 2009	Weather:	-
Corer Type:	Stainless steel push / piston core	Sea State:	Moderate
Scientist:	LT / SW	Core Taken By: SW	
Composite subsample taken by: LT		Core Cleaned By: SW	

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273696	7436979	16:30	3.6	1.2	2.6	-1.0	-2.2

Depth (m)	Colour	Particle Size	Mottles	Plasticity	Odour	Shell %
0.00	Beige	Silt with sand	Nil	Moderate	Nil	<2%
0.25	Beige	Silt with sand	Nil	Moderate	Nil	<2%
0.50	Light grey	Silt with sand	Nil	Moderate	Nil	<2%
0.75	Light grey	Silt with sand and clay	Nil	Moderate	Nil	<2%
1.00	Light grey	Silt with sand and clay	Nil	Moderate	Nil	<2%

Site 4

Client:	Queensland Transport	Location:	Rosslyn Bay
Date:	18th January 2009	Weather:	Fine
Corer Type:	Stainless steel push / piston core	Sea State:	Calm
Scientist:	LT / SW	Core Taken By: SW	
Composite subsample taken by: LT / SW		Core Cleaned By: SW	

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273697	7436906	09:00	3.1	1.3	1.7	-1.4	-2.7

Depth (m)	Colour	Particle Size	Mottles	Plasticity	Odour	Shell %
0.00	Beige	Silt and clay	Nil	High	Nil	<2%
0.25	Grey	Silt and clay	Nil	High	Nil	<2%
0.50	Grey	Silt and sand	Nil	Moderate	Nil	<2%
0.75	Grey	Silt and sand	Nil	Moderate	Nil	<2%
1.00	Grey	Silt and sand	Nil	Moderate	Nil	<2%
1.25	Light grey	Clay	Nil	High	Nil	<2%

Site 5

Client:	Queensland Transport	Location:	Rosslyn Bay
Date:	17th January 2009	Weather:	Fine
Corer Type:	Stainless steel push / piston core	Sea State:	Calm
Scientist:	LT / SW	Core Taken By: SW	
Composite subsample taken by: LT		Core Cleaned By: SW	

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273,654	7,436,787	18:20	3.1	1.2	1.6	-1.5	-2.7

Depth (m)	Colour	Particle Size	Mottles	Plasticity	Odour	Shell %
0.00	Beige	Silt	Nil	Moderate	Nil	<2%
0.25	Grey	Silt	Nil	Moderate	Nil	<2%
0.50	Beige	Clay	Some	High	Nil	<2%
0.75	Grey	Silt	Nil	Moderate	Nil	<2%
1.00	Grey	Silt	Nil	Moderate	Nil	<2%

Sediment Sampling & Analysis 2011

Rosslyn Bay Boat Harbour

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Contents

Tables

Figures

Summary

The results of the sediment sampling and analysis program undertaken at Rosslyn Bay Boat Harbour by frc environmental on behalf of the Department of Transport and Main Roads (TMR) are presented in this report. Sediment sampling and analysis was done in accordance with the Sampling and Analysis Plan (SAP) prepared by frc environmental in accordance with the *National Assessment Guidelines for Dredging* (NAGD) and approved by the Great Barrier Reef Marine Park Authority (GBRMPA) in August 2011.

The settling rate of sediment was slightly faster in surface sediment than sediment from deeper subsamples. Sediments of the dredge area were largely composed of silt and clay.

Concentrations of total nitrogen were higher than those recorded during the previous sampling and than concentrations recorded in association with boat harbours and ramps along the Queensland coast, however they were lower than concentrations recorded in sediment from several parts of south-east Queensland.

Concentrations of total phosphorus were slightly lower than those recorded during the previous sampling, and than those recorded in association with boat harbours and ramps along the Queensland coast. However concentrations were lower than those recorded in sediment from several parts of south-east Queensland.

The concentration of the parameters analysed did not exceed the NAGD screening levels, with the exception of nickel. The concentration of nickel was below the SQG-high level in all subsamples. Elevated concentrations of nickel have been recorded in the region and are likely to reflect the geology of the central Queensland region. The concentration of nickel in the dredge area as a whole (22.66 mg/kg) was similar to that recorded during sediment sampling and analysis in the harbour by GHD (22.97 mg/kg) (upper 95th percentile confidence limit of the means). As such, it is considered that the dredge spoil is suitable for offshore disposal without further investigation of nickel concentrations.

The results of quality assurance / quality control analyses were generally acceptable.

1 Introduction

The results of the sediment sampling and analysis program undertaken at Rosslyn Bay Boat Harbour by frc environmental on behalf of the Department of Transport and Main Roads (TMR) are presented in this report. Sediment sampling and analysis was done in accordance with the sediment sampling and analysis plan (SAP), prepared by frc environmental and approved by the Great Barrier Reef Marine Park Authority (GBRMPA) in August 2011.

1.1 Background

TMR plans to undertake maintenance dredging of accumulated silt in the harbour entrance, internal navigation channels and public mooring areas. The harbour requires dredging every three to four years in order to maintain navigable depths and was last dredged in March and April 2009.

The spoil from the last six dredging events has been disposed of at a site 1.1 km north east of the harbour entrance, located within the Farnborough section of the Great Barrier Reef Marine Park. The Marine Park permit that TMR holds for dredge spoil disposal at the site is currently under an application for extension to facilitate the proposed 2012 dredging works. An application has also been made by TMR for a Sea Dumping Permit under the *Sea Dumping Act (1981)* given TMR's previous permit expired in June 2011.

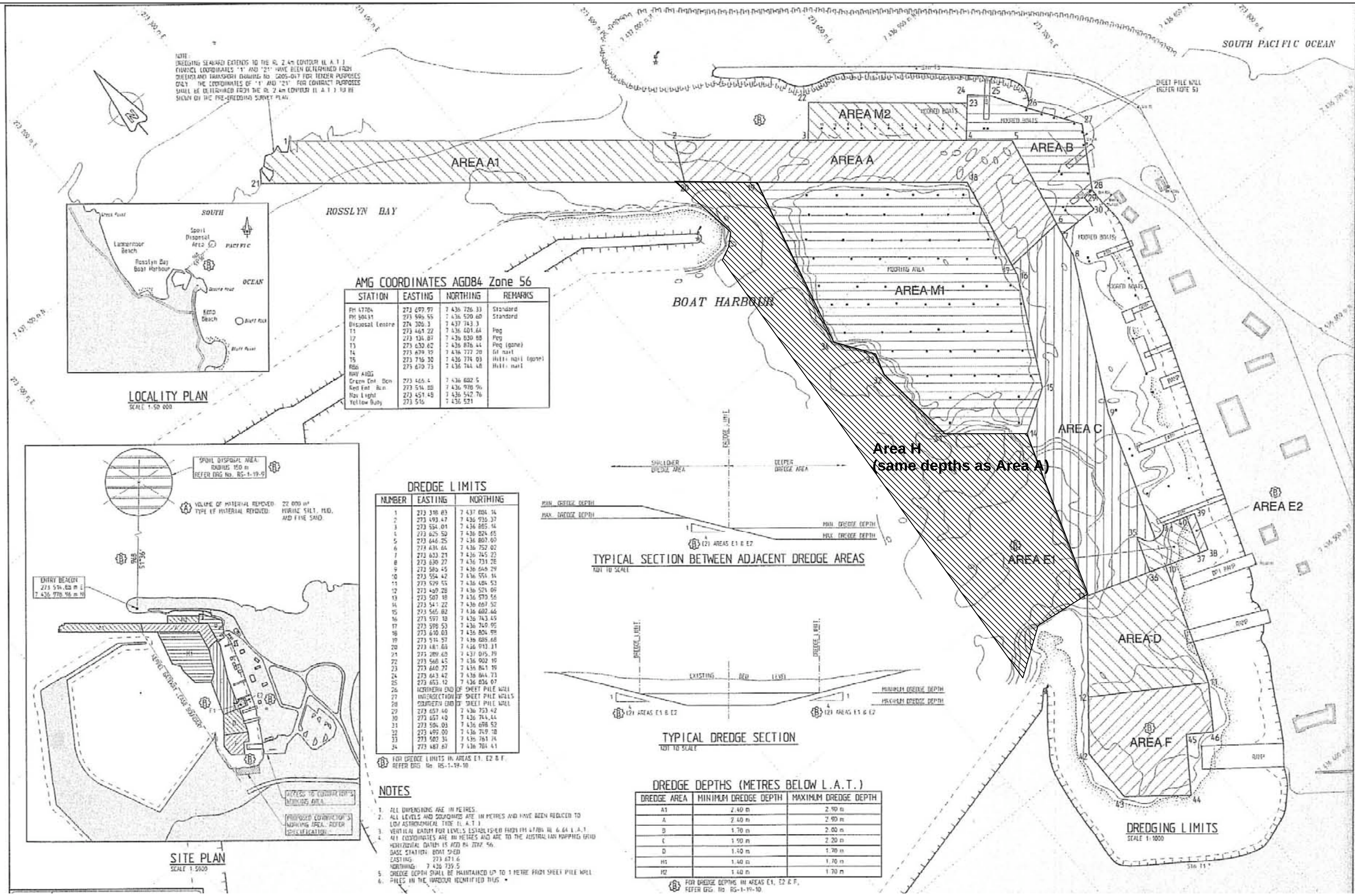
The proposed dredging in 2012 is expected to generate approximately 57 661 m^3 of spoil, with approvals to reflect a maximum dredge spoil volume of 60 000 m^3. Nine areas of the harbour will be dredged, to a maximum depth of between 1.7 and 2.9 metres below lowest astronomical tide (LAT) (Table 1.1; Figure 1.1).

Table 1.1 Description of dredge areas, estimated dredge depths and dredge volumes (provided by TMR).

Dredge Area	Description	Minimum Dredge Depth (m below LAT)	Maximum Dredge Depth (m below LAT) [A]	Area (m^2)	Estimated Dredge Volume (m^3 *in situ*) [B]
A1	Outer Entrance Channel	2.5	2.9	6 040	5 136
A	Inner Entrance Channel	2.5	2.9	6 570	6 202
B	Public Access Area	1.7	2.0	2 790	1 280
C	Inner Access Channel	1.9	2.2	4 740	4 833
D	Inner Access Channel	1.4	1.7	4 000	1 267
F	Inner Access Channel	1.4	1.7	3 560	1 265
M1	Pile Mooring Area	1.4	1.7	16 480	6 612
M2	Pile Mooring Area	1.4	1.7	2 090	1 166
H	Potential Secondary Public Channel Area	2.5	2.9	15 066	29 900

[A] Maximum dredge depth = design dredge depth + dredge tolerance (0.3 to 0.5 m).

[B] All proposed dredge area volumes are based on dredging to maximum dredge depth and a September 2010 hydrographic survey.



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Rosslyn Bay Boat Harbour: Sediment Sampling & Analysis

Figure 1.1 Dredge areas at Rosslyn Bay Harbour.

Adapted from figure provided by TMR

August 2011

1.2 Survey Area

Rosslyn Bay Boat Harbour is located within Keppel Bay and adjacent to the Mackay / Capricorn management area of the Great Barrier Reef Marine Park. It is one of 14 State boat harbours along the Queensland Coast.

The boat harbour is a vital contributor to the economy of Yeppoon, the wider Rockhampton regional area and beyond. As the main point of access by sea to the Keppel group of islands, the harbour supports a large tourist industry. There is also a heavy reliance on the harbour by a number of other industries, most notably commercial fishing, recreational fishing and boating.

All harbour uses depend on the maintenance of navigable depths in the harbour, it is therefore essential that TMR continue to carry out periodic maintenance dredging to preserve harbour function and the viability of the industries it supports.

2 Methods

Sediment sampling was undertaken at Rosslyn Bay Boat Harbour from 24 to 26 August 2011. The sediment sampling and analysis plan (SAP) for dredging was designed in accordance with the *National Assessment Guidelines for Dredging* (NAGD) (DEWHA 2009).

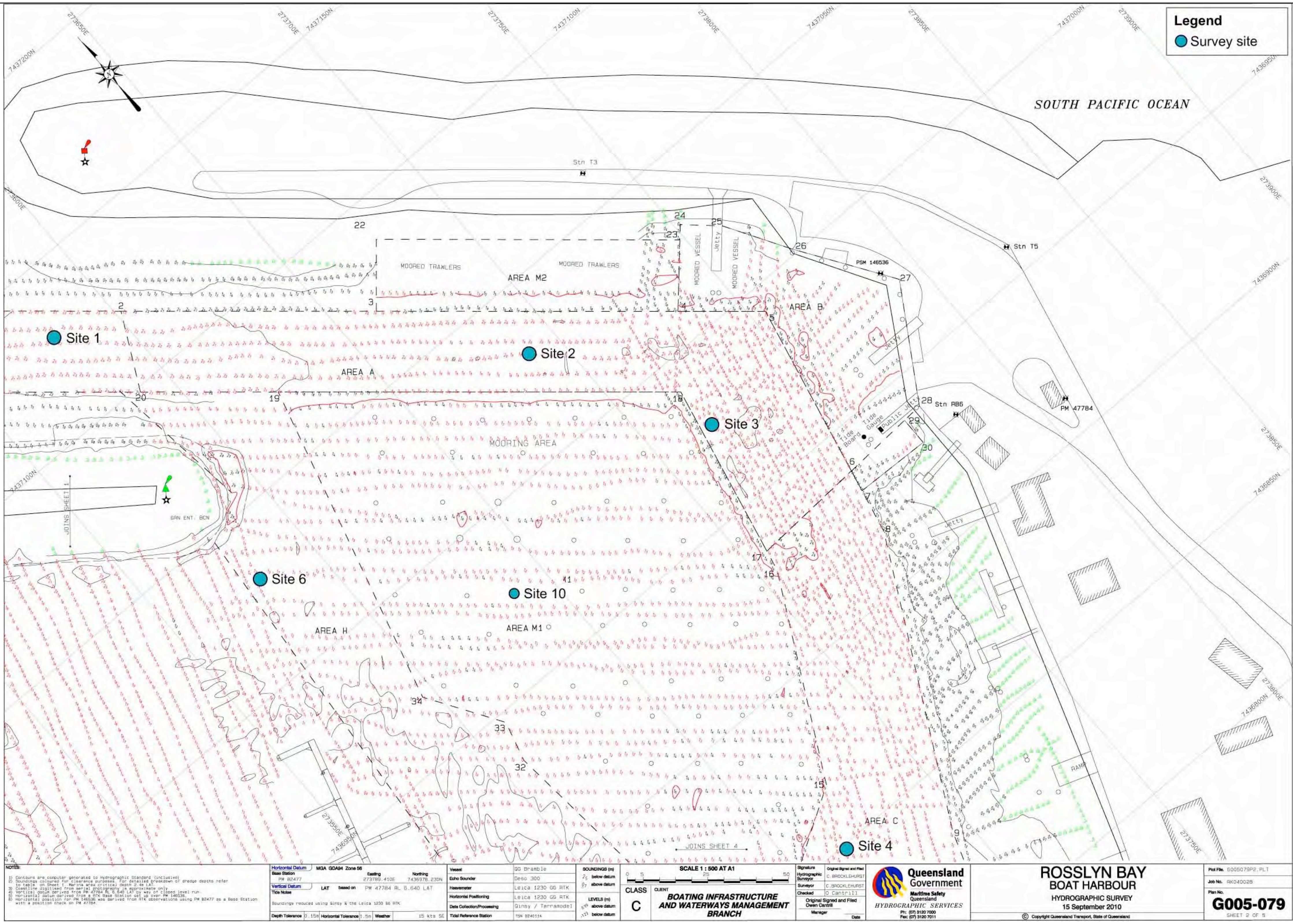
2.1 Survey Design

Sediment cores were collected from ten sites from the following dredge areas:

- outer entrance channel (area A1) – site 1
- inner entrance channel (area A) – site 2 and site 3
- inner access channel (area C) – site 4
- inner access channel (area D) – site 5
- potential secondary public channel area (area H) – site 6 to 9, and
- pile mooring area (area M1) – site 10.

The locations of the sites surveyed are presented in Figure 2.1 and Figure 2.2. The GPS location of each site is presented in the Field Core Logs (Appendix A).

Cores were taken as close as practical to the proposed sample sites, with the exception of sites 1 and 6 which were relocated for safety reasons due to sea state conditions in the entrance channel during sampling. Site 1 was relocated to behind the outer breakwater (further up the entrance channel) and site 6 was relocated to the leeward side of the inner breakwater. However these sites were still located within the originally intended dredge areas. Site 7 was located just outside of area H due to the effects of wind and tide on the anchored survey vessel.

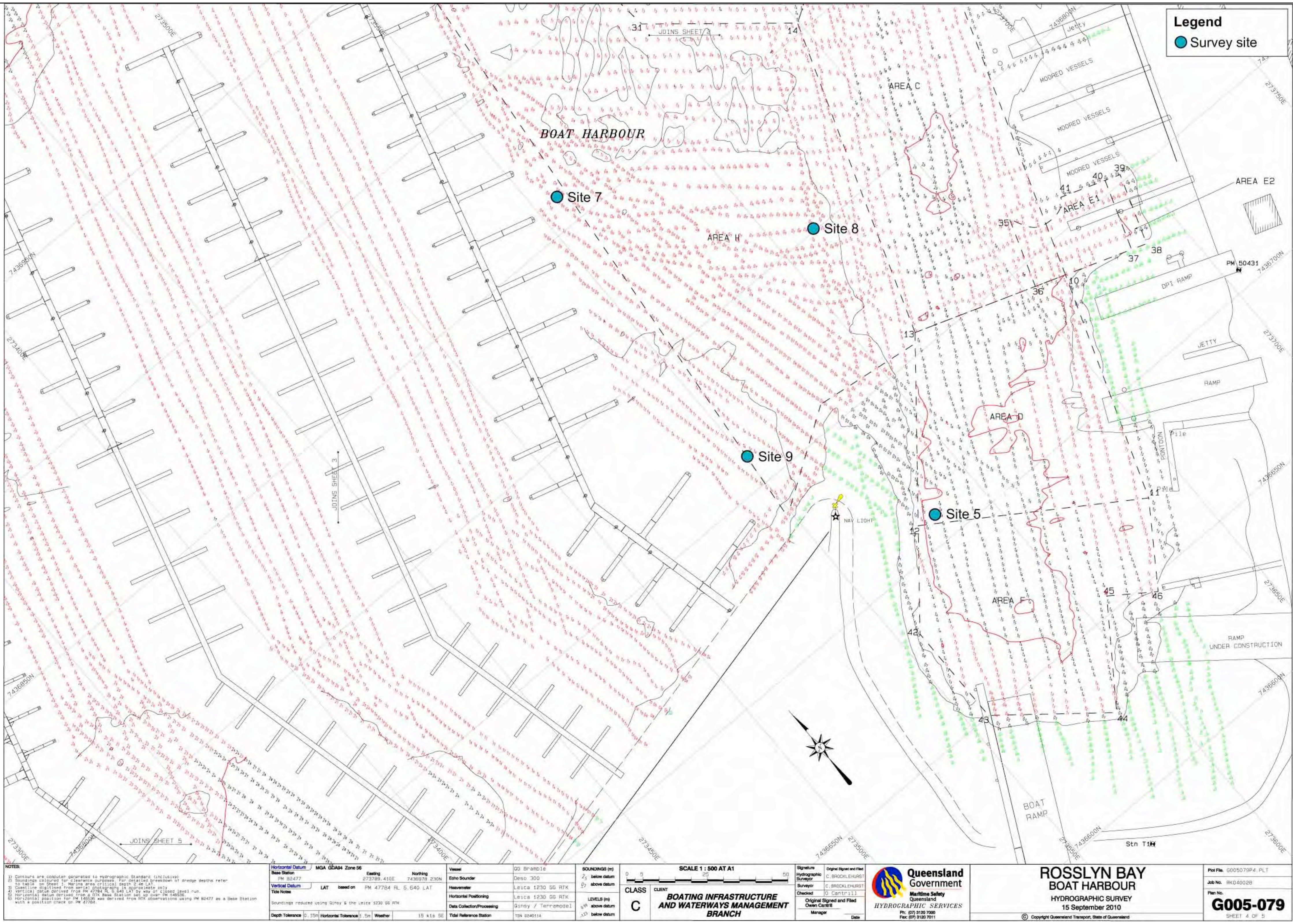


Rosslyn Bay Boat Harbour: Sediment Sampling & Analysis

Figure 2.1 Location of core sites 1, 2, 3, 4, 6 and 10.

Adapted from figure provided by TMR

October 2011



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Rosslyn Bay Boat Harbour: Sediment Sampling & Analysis	
Figure 2.2 Location of core sites 5, 7, 8 and 9.	
Adapted from figure provided by TMR	October 2011

2.2 Sample Collection

Cores were collected using a 50 mm stainless steel push corer at all sites. Sampling equipment was cleaned of all traces of sediment and rinsed with ambient seawater between cores. Collected cores were drawn off into poly-sleeves, eliminating the chance of cross-contamination post-coring. At least two cores were taken at each site, immediately adjacent to each other, to ensure an adequate quantity of sediment was collected. The sediment from each core was thoroughly mixed, so that each subsample sent to the laboratory was a homogenous mix of each core taken at that site.

In accordance with quality assurance and control (QA/QC) procedures outlined in Appendix F of the NAGD, triplicate core samples were collected from site 2 (Core 2, 2QC1 and 2QC2) to assess field variation in contaminant concentrations. Further, an extra set of subsamples were be collected from site 10 subsample A (subsample 10A, 10A QA1 and 10A QA2) to assess variation associated with subsample handling and laboratory analysis (that is, in accordance with the NAGD, sediment from one subsample was split into three containers, with one of the three samples sent to a second laboratory for analysis).

Each core (including the field triplicate cores) was taken to a depth as close as practical to 0.5 m below the proposed maximum dredge depth in each area and divided into three sections:

- the upper 0.5 m of the core (subsample A)
- 0.5 m to 1.0 m (subsample B), and
- the remainder of the sediment core (subsample C).

For sites where subsample C was longer than 1 m, additional samples were collected, specifically:

- 5 subsamples per core at sites 7 and 8: subsample A (0 to 0.5 m), B (0.5 to 1.0 m), C (1.0 to 1.5 m), D (1.5 to 2.0 m) and E (2.0 to 2.5 m), and
- 4 subsamples at site 9: subsample A (0 to 0.5 m), B (0.5 to 1.0 m), C (1.0 to 1.5 m), D (1.5 to 2.1 m).

Each section of the core was mixed and a single composite subsample was taken from each section. Field QA/QC, subsampling and core log data collection was undertaken in accordance with the NAGD.

The seabed was higher than anticipated at most sites, suggesting that some siltation had occurred since the September 2010 hydrographic survey.

2.3 Laboratory Analyses

Physical Characteristics

Subsamples were analysed for the physical parameters outlined in Table 1, Appendix A of the NAGD, as presented in Table 2.1.

Table 2.1 Physical parameters analysed.

Parameter	Practical Quantitation Limit (PQL)
Moisture content	0.1%
Total organic carbon	0.1%
Particle size and settling rate	Size Distribution (sieve + hydrometer) and rates of settlement after 50% and 90% of settlement, in seawater. Includes interpretive statement in relation to sea disposal.

Nutrients

Nutrient concentrations in the sediment were analysed, as outlined in Table 2.2. Practical Quantitation Limits (PQLs) stated in Appendix A of the NAGD were met, for all analyses except total nitrogen and total phosphorus where the advised target PQL for total nitrogen was 20 mg/kg and for total phosphorus was 1 mg/kg. These are above the PQL of 0.1 mg/kg specified in the NAGD; however would be considered to be low concentrations based on our experience of concentrations in sediments along the Queensland Coast.

Table 2.2 Nutrient parameters that will be analysed for each subsample.

Parameter	**Practical Quantitation Limit (PQL)**
Total nitrogen	20 (mg/kg) [A]
Total Kjeldahl nitrogen	0.1 (mg/kg)
Total nitrate	0.1 (mg/kg)
Total nitrite	0.1 (mg/kg)
Total phosphorus	1.0 (mg/kg) [A]
Total orthophosphate	0.1 (mg/kg)
Ammonia	0.1 (mg/kg)

[A] Under advice from the analytical laboratory, the target PQL for total nitrogen and total phosphorus has been set above the PQL of 0.1 mg/kg for nutrients, as specified in the NAGD.

Contaminants

The concentrations of potential contaminants in the sediment, as, presented in Table 2.3, were analysed in each subsample.

Table 2.3 Potential contaminants of concern that will be analysed for each subsample.

Parameter	Practical Quantitation Limit (PQL)
Organotin compounds (monobutyltin, dibutyltin, tributyltin)	1.0 (µgSn/kg [A])
Metals and metalloids (mg/kg)	
Silver	0.1
Aluminium [B]	200
Arsenic	1.0
Cadmium	0.1
Cobalt	0.5
Chromium	1.0
Copper	1.0
Iron [B]	100
Mercury	0.01
Manganese	10
Nickel	1.0
Lead	1.0
Antimony	0.5
Selenium	0.1
Vanadium	2.0
Zinc	1.0

[A] Microgram tin per kilogram.

[B] Not toxic contaminants but included because they can be useful normalising elements.

2.4 Data Analysis

The assessment of sediment quality followed the approach outlined in the NAGD. Any results lower than the PQL were entered as half the PQL, for statistical and analytical purposes (DEWHA 2009).

The upper 95% confidence limit of the arithmetic mean for the subsample A samples, subsample B samples, subsample C samples, subsample D samples, subsample E samples and all of the samples collected from the dredge area, were then compared to the screening levels outlined in Table 2 of the NAGD.

3 Results and Discussion

Sediment cores were sampled from the 24 to 26 August 2011. The weather was overcast and the water was mostly calm during sampling; sea state was rough at site 1. No litter was seen in the dredge area or was collected in the cores.

3.1 Settling Rate in Seawater

The settling rate of surface sediment (subsample A) was slightly faster than deeper sediment (Table 3.1). Approximately 90% of the sediment (by volume) from subsample A settled within 10.02 minutes in contrast to the 13.91 minutes it took for the sediment from subsample E to settle.

Table 3.1 Time required to settle approximately 90% (volume) of the total sediment.

Settling rate	Units	Mean	SD	95% UCL[A]
Subsample A (the upper 0.5m of the core)	minutes	10.02	1.71	10.95
Subsample B (0.5m to 1.0m)	minutes	11.52	2.61	12.99
Subsample C (1.0 m to 1.5 m)	minutes	11.59	2.69	13.11
Subsample D (1.5m to 2.0m)	minutes	11.84	3.46	15.75
Subsample E (2.0 m to 1.5 m)	minutes	13.91	6.76	23.28

[A] 95% UCL - upper 95% confidence limit of the mean

Note that settling rates do not typically correlate well to particle size distributions determined using a sieve and hydrometer method (Gasparon, M. [University of Queensland], pers. comm. 2008).

3.2 Particle Size Distribution

Silt and clay comprised the greatest proportion of the sediments in all subsamples, and for the dredge area as a whole. Subsample D and E samples (the deeper sediment) had a slightly higher proportion of silt and clay, and lower proportion of sand, than shallower sediments (Table 3.2 to Table 3.6).

3.3 Total Organic Carbon

Mean total organic carbon (TOC) concentration was slightly higher in surface sediment (0.85% in subsample A samples) than in deeper subsample (ranging from 0.66% in subsample C samples to 0.79% in subsample E samples) (Table 3.2 to Table 3.6).

3.4 Nutrients

There are no NAGD guideline levels for sediment nutrient concentrations. Nitrogen concentrations were relatively high (up to 1000 mg/kg) whereas phosphorus concentrations were relatively low (up to 391 mg/kg).

Total Nitrogen

The mean total nitrogen concentration was higher in the surface sediment (868 mg/kg in subsample A samples) than deeper sediment (ranging from 634 mg/kg in subsample C samples to 785 mg/kg in subsample E samples). Most of the nitrogen in the sediment was organic, in the form of total Kjeldahl nitrogen (Table 3.2 to Table 3.6). The concentration was highest in the surface sediment (subsample A) at site 2 (1000 mg/kg) (see the laboratory reports presented in Appendix K for site-specific results).

These concentrations were higher than those recorded during the previous sampling in 2009 when the mean concentration of total nitrogen was up to 410 mg/kg (frc environmental 2009b). They are also higher than concentrations recorded in association with boat harbours and ramps along the Queensland coast such as Bowen Boat Harbour, Newell Beach and Jacobs Well (frc environmental 2004a; b; 2010), however they were lower than concentrations recorded in sediment from several parts of south-east Queensland (frc environmental 2006; 2007b; a; 2009a).

Total Phosphorus

The mean total phosphorus concentration was generally similar in all subsamples, but slightly higher in the shallowest and deepest sediment (390 mg/kg to 391 mg/kg in subsample A and E samples, compared to 340 mg/kg to 353 mg/kg in subsample B, C and D samples). The concentration was highest at site 2 in subsample A (450 mg/kg) and B (430 mg/kg) samples (Table 3.2 to Table 3.6).

These concentrations were slightly higher than those recorded during the previous sampling in 2009 where the mean concentration of total phosphorus was up to 332 mg/kg (frc environmental 2009b). They were also slightly higher than those recorded in association with boat harbours and ramps along the Queensland coast such as Bowen Boat Harbour, Newell Beach and Jacobs Well (frc environmental 2004a; b; 2010), but lower than those recorded in sediment from several parts of south-east Queensland (frc environmental 2006; 2007b; a; 2009a).

3.5 Contaminants

Organotin

The concentration of monobutyltin (MBT) was below laboratory level of reporting (LOR) for all samples analysed (Table 3.2 to Table 3.6).

The mean concentration of dibutyltin (DBT) was above the laboratory LOR in most samples analysed; it was below the LOR in the deepest sediment (subsample E samples). The mean concentration was higher in subsample D samples (0.876 μSn/kg) than shallower sediments (ranging from 0.488 μSn/kg in subsample B samples to 0.658 μSn/kg in subsample C samples) (Table 3.2 to Table 3.6). There is no NAGD guideline level for sediment DBT concentrations.

The concentration of tributyltin (TBT) was below the laboratory LOR in all subsample C, D and E samples. The concentration was above the LOR, but below the NAGD screening level, in all subsample A and B samples; it was slightly higher in subsample B samples (mean of 0.373 μSn/kg) than subsample A samples (mean of 0.317 μSn/kg) (Table 3.2 to Table 3.6).

Metals and Metalloids

The mean concentration (and the 95% upper confidence limits of means) of most metals and metalloids was below the NAGD screening level, where available. The 95% upper confidence limit of the mean concentration of nickel was above the screening level in for all subsample depths, and for the dredge area as a whole (i.e. in all subsamples). The concentration of nickel generally increased with sediment depth. The concentration of nickel was below the SQG-high level in all subsamples (Table 3.2 to Table 3.6).

Elevated concentrations of nickel were recorded in the harbour in 2005 (GHD 2005), and they have also been recorded in the region (together with chromium and antimony) and are likely to reflect the geology of the central Queensland region rather than anthropogenic influences (Moss & Costanzo 1998; Rolfe et al. 2004).

3.6 Quality Assurance / Quality Control

Laboratory Replicates

The NAGD recommend that for laboratory replicates, a relative standard deviation (RSD[1]) or relative percent difference (RPD[2]) of ± 35% is acceptable (DEWHA 2009). The RPD between laboratory replicates was more than ± 35% for several variables:

- mercury at site 1 in subsample A (67%) and at site 10 in subsample C (67%)
- selenium at site 2 in subsample C (QC2) (67%), at site 7 in subsample A (49%) and at site 10 in subsample C (107%), and
- DBT at site 4 in subsample C (83%) and at site 10 in subsample C (83%).

Given that the concentration of these parameters was below the screening level, this does not affect the interpretation of the results.

[1] RSD = standard deviation ÷ mean x 100
[2] RPD = the difference between two samples ÷ mean x 100

Field Replicates

The NAGD recommend that for field replicates, an RPD or RSD of ± 50% between field replicates is acceptable (DEWHA 2009). The RSD between field replicates at site 2 was more than 50% for selenium in subsample C; it was within ± 50%, and typically within ± 10%, for the other parameters. The RPD between field replicates of subsample A at site 10 was more than ± 50% for DBT (126%) and selenium (115%) samples; all other variables were within ± 6%. These results do not affect the interpretation of the results as there is no screening level for of selenium or DBT.

Inter-laboratory Comparison

The RSD between replicates analysed by different laboratories was within ± 35%, and generally ± 15%, for most variables in most subsamples[3]. The RSD was more than ± 35% for iron (83%), DBT (71%), selenium (65%) and TOC (65%).

For iron, the concentration recorded by the second laboratory (SGS) was substantially lower (35-times) than that recorded by Advanced Analytical. For DBT, the difference was due to high variation between samples analysed by Advanced Analytical, and also an artefact of different laboratory limits of reporting for Advanced Analytical and SGS. For selenium, the difference was due to high variation between samples analysed by Advanced Analytical. For TOC, the concentration recorded by SGS was more than twice that recorded by Advanced Analytical. There are no screening levels for these variables.

[3] The speciation of phosphorus and the units for settling rates were different for each laboratory, hence an assessment of inter-laboratory variation was not possible for these parameters.

Table 3.2 Summary of analyses for subsample A samples (the top 0.5 m of sediment).

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	57.04	4.73	59.61
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	N/A
Sand (2 mm – 0.06 mm)	%	–	–	20.92	13.00	27.99
Silt (0.06 mm – 0.002 mm)	%	–	–	30.46	4.86	33.10
Clay (<0.002 mm)	%	–	–	48.62	10.62	54.39
Nutrients						
Total Organic Carbon	%	–	–	0.85	0.07	0.89
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	<0.1	0.00	N/A
Ammonia as N	mg/kg	–	–	21.85	6.03	25.12
Total Kjeldahl Nitrogen	mg/kg	–	–	868.46	125.16	936.50
Total Nitrogen	mg/kg	–	–	868.46	125.16	936.50
Total Phosphorus	mg/kg	–	–	391.54	26.41	405.89
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	18076.92	3593.08	20030.11
Arsenic	mg/kg	20	70	10.68	0.96	11.20
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	8.96	0.42	9.19
Chromium	mg/kg	80	370	32.38	4.61	34.89
Copper	mg/kg	65	270	16.11	3.70	18.12
Iron	mg/kg	–	–	27538.46	4629.89	30055.25
Mercury	mg/kg	0.15	1	0.02	0.00	0.02
Manganese	mg/kg	–	–	471.54	117.04	535.16
Nickel	mg/kg	21	52	22.31	3.43	24.17
Lead	mg/kg	50	220	6.06	0.72	6.45
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.17	0.12	0.23
Vanadium	mg/kg	–	–	38.85	5.00	41.56
Zinc	mg/kg	200	410	38.08	5.95	41.31
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	0.35	0.26	0.49
Tributyltin	µgSn/kg	9	70	0.27	0.07	0.31

[1] SL – screening level from the NAGD. Shading denotes values that exceed the SL.

[2] SQG-High – sediment quality high values for contamination from the NAGD

[3] 95% UCL – upper 95% confidence limit of the mean

– not available

Table 3.3 Summary of analyses for subsample B samples (sediment 0.5 m deep to 1.0 m deep).

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	50.82	5.72	54.05
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	N/A
Sand (2 mm – 0.06 mm)	%	–	–	29.00	14.47	37.19
Silt (0.06 mm – 0.002 mm)	%	–	–	30.67	5.45	33.75
Clay (<0.002 mm)	%	–	–	0.00	0.00	N/A
Nutrients						
Total Organic Carbon	%	–	–	0.73	0.08	0.77
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	<0.1	0.00	N/A
Ammonia as N	mg/kg	–	–	11	23	14
Total Kjeldahl Nitrogen	mg/kg	–	–	748.33	119.07	815.70
Total Nitrogen	mg/kg	–	–	748.33	119.07	815.70
Total Phosphorus	mg/kg	–	–	359.17	32.60	377.61
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	16283.33	3690.24	18371.25
Arsenic	mg/kg	20	70	10.92	0.67	11.29
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	8.78	0.50	9.06
Chromium	mg/kg	80	370	30.67	5.77	33.93
Copper	mg/kg	65	270	15.64	4.51	18.19
Iron	mg/kg	–	–	25583.33	4461.11	28107.40
Mercury	mg/kg	0.15	1	0.02	0.00	0.02
Manganese	mg/kg	–	–	419.17	68.82	458.10
Nickel	mg/kg	21	52	20.83	4.20	23.21
Lead	mg/kg	50	220	5.81	0.96	6.35
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.14	0.08	0.18
Vanadium	mg/kg	–	–	36.33	6.23	39.86
Zinc	mg/kg	200	410	36.33	6.96	40.27
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	0.36	0.27	0.51
Tributyltin	µgSn/kg	9	70	0.27	0.07	0.31

1 SL – screening level from the NAGD. Shading denotes values that exceed the SL.
2 SQG-High – sediment quality high values for contamination from the NAGD
3 95% UCL – upper 95% confidence limit of the mean
– not available

Table 3.4 Summary of analyses for subsample C samples (sediment 1.0 m deep to 1.5 m deep).

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	44.75	5.28	47.87
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	N/A
Sand (2 mm – 0.06 mm)	%	–	–	28.67	16.21	37.84
Silt (0.06 mm – 0.002 mm)	%	–	–	33.42	6.86	37.30
Clay (<0.002 mm)	%	–	–	37.92	10.97	44.12
Nutrients						
Total Organic Carbon	%	–	–	0.66	0.10	0.72
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	0.08	0.06	0.11
Ammonia as N	mg/kg	–	–	26.36	7.61	30.86
Total Kjeldahl Nitrogen	mg/kg	–	–	634.55	126.99	709.59
Total Nitrogen	mg/kg	–	–	634.55	126.99	709.59
Total Phosphorus	mg/kg	–	–	340.00	17.89	350.57
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	14045.45	3976.27	16395.24
Arsenic	mg/kg	20	70	11.00	0.45	11.26
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	8.54	0.50	8.83
Chromium	mg/kg	80	370	27.82	7.35	32.16
Copper	mg/kg	65	270	14.39	5.65	17.73
Iron	mg/kg	–	–	22636.36	4738.62	25436.66
Mercury	mg/kg	0.15	1	0.01	0.01	0.02
Manganese	mg/kg	–	–	416.36	72.15	459.00
Nickel	mg/kg	21	52	19.18	5.62	22.50
Lead	mg/kg	50	220	5.54	1.25	6.28
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.14	0.12	0.22
Vanadium	mg/kg	–	–	33.00	7.17	37.24
Zinc	mg/kg	200	410	33.27	8.45	38.27
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	0.46	0.42	0.71
Tributyltin	µgSn/kg	9	70	<0.5	0.00	N/A

1 SL – screening level from the NAGD. Shading denotes values that exceed the SL.

2 SQG-High – sediment quality high values for contamination from the NAGD

3 95% UCL – upper 95% confidence limit of the mean

– not available

Table 3.5 Summary of analyses for subsample D samples (sediment 1.5 m deep to 2.0 m deep).

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	48.23	1.85	50.33
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	N/A
Sand (2 mm – 0.06 mm)	%	–	–	13.67	8.50	23.29
Silt (0.06 mm – 0.002 mm)	%	–	–	33.00	2.65	35.99
Clay (<0.002 mm)	%	–	–	53.33	11.15	65.95
Nutrients						
Total Organic Carbon	%	–	–	0.74	0.08	0.83
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	<0.1	0.00	N/A
Ammonia as N	mg/kg	–	–	24.00	3.61	28.08
Total Kjeldahl Nitrogen	mg/kg	–	–	766.67	96.09	875.40
Total Nitrogen	mg/kg	–	–	766.67	96.09	875.40
Total Phosphorus	mg/kg	–	–	353.33	23.09	379.47
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	17666.67	3055.05	21123.72
Arsenic	mg/kg	20	70	10.00	0.00	N/A
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	8.90	0.56	9.53
Chromium	mg/kg	80	370	35.00	5.29	40.99
Copper	mg/kg	65	270	18.33	2.52	21.18
Iron	mg/kg	–	–	26666.67	3511.88	30640.67
Mercury	mg/kg	0.15	1	0.02	0.00	N/A
Manganese	mg/kg	–	–	330.00	26.46	359.94
Nickel	mg/kg	21	52	24.33	4.16	29.04
Lead	mg/kg	50	220	6.47	0.70	7.26
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.10	0.04	0.15
Vanadium	mg/kg	–	–	40.33	5.86	46.96
Zinc	mg/kg	200	410	41.33	6.11	48.25
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	0.65	0.38	1.08
Tributyltin	µgSn/kg	9	70	<0.5	0.00	N/A

1 SL – screening level from the NAGD. Shading denotes values that exceed the SL.
2 SQG-High – sediment quality high values for contamination from the NAGD
3 95% UCL – upper 95% confidence limit of the mean
– not available

Table 3.6 Summary of analyses for subsample E samples (sediment deeper than 2.0 m deep down to 0.5 m below the maximum dredge depth).

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	48.85	2.47	52.28
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	N/A
Sand (2 mm – 0.06 mm)	%	–	–	10.50	9.19	23.24
Silt (0.06 mm – 0.002 mm)	%	–	–	28.00	7.07	37.80
Clay (<0.002 mm)	%	–	–	61.50	16.26	84.04
Nutrients						
Total Organic Carbon	%	–	–	0.79	0.04	0.85
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	<0.1	0.00	N/A
Ammonia as N	mg/kg	–	–	26.00	2.83	29.92
Total Kjeldahl Nitrogen	mg/kg	–	–	785.00	7.07	794.80
Total Nitrogen	mg/kg	–	–	785.00	7.07	794.80
Total Phosphorus	mg/kg	–	–	390.00	14.14	409.60
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	20500.00	2121.32	23439.95
Arsenic	mg/kg	20	70	10.25	1.06	11.72
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	9.70	0.42	10.29
Chromium	mg/kg	80	370	40.50	4.95	47.36
Copper	mg/kg	65	270	20.50	3.54	25.40
Iron	mg/kg	–	–	30000.00	2828.43	33919.93
Mercury	mg/kg	0.15	1	0.02	0.00	N/A
Manganese	mg/kg	–	–	325.00	35.36	374.00
Nickel	mg/kg	21	52	29.50	4.95	36.36
Lead	mg/kg	50	220	7.15	0.64	8.03
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.13	0.02	0.15
Vanadium	mg/kg	–	–	46.00	4.24	51.88
Zinc	mg/kg	200	410	46.00	5.66	53.84
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Tributyltin	µgSn/kg	9	70	<0.5	0.00	N/A

1 SL – screening level from the NAGD. Shading denotes values that exceed the SL.
2 SQG-High – sediment quality high values for contamination from the NAGD
3 95% UCL – upper 95% confidence limit of the mean
– not available

Table 3.7 Summary of analyses for all subsamples analysed.

Parameter	Units	SL[1]	SQG-high[2]	Mean	SD	95% UCL[3]
Moisture Content	%	–	–	50.26	6.80	52.20
Particle Size Analysis						
Gravel (+2 mm)	%	–	–	0.00	0.00	0.00
Sand (2 mm – 0.06 mm)	%	–	–	24.43	14.66	28.86
Silt (0.06 mm – 0.002 mm)	%	–	–	31.43	5.61	33.12
Clay (<0.002 mm)	%	–	–	44.14	12.43	47.90
Nutrients						
Total Organic Carbon	%	–	–	0.75	0.11	0.78
Nitrate as N	mg/kg	–	–	<0.1	0.00	N/A
Nitrite as N	mg/kg	–	–	0.06	0.04	0.07
Ammonia as N	mg/kg	–	–	24.54	7.13	26.60
Total Kjeldahl Nitrogen	mg/kg	–	–	758.70	145.35	800.70
Total Nitrogen	mg/kg	–	–	758.70	145.35	800.70
Total Phosphorus	mg/kg	–	–	364.47	32.36	373.72
Metals						
Silver	mg/kg	1	3.7	<0.1	0.00	N/A
Aluminium	mg/kg	–	–	16317.02	3997.73	17459.93
Arsenic	mg/kg	20	70	10.81	0.78	11.04
Cadmium	mg/kg	1.5	10	<0.1	0.00	N/A
Cobalt	mg/kg	–	–	8.81	0.53	8.96
Chromium	mg/kg	80	370	30.87	6.40	32.70
Copper	mg/kg	65	270	15.64	4.55	16.94
Iron	mg/kg	–	–	25404.26	4848.40	26790.36
Mercury	mg/kg	0.15	1	0.02	0.00	0.02
Manganese	mg/kg	–	–	428.30	95.42	455.58
Nickel	mg/kg	21	52	21.28	4.84	22.66
Lead	mg/kg	50	220	5.88	0.99	6.16
Antimony	mg/kg	2	–	<0.5	0.00	N/A
Selenium	mg/kg	–	–	0.14	0.09	0.17
Vanadium	mg/kg	–	–	36.60	6.67	38.50
Zinc	mg/kg	200	410	36.40	7.43	38.53
Organotin Compounds						
Monobutyltin	µgSn/kg	–	–	<0.5	0.00	N/A
Dibutyltin	µgSn/kg	–	–	0.40	0.30	0.48
Tributyltin	µgSn/kg	9	70	0.26	0.05	0.28

1 SL – screening level from the NAGD. Shading denotes values that exceed the SL.
2 SQG-High – sediment quality high values for contamination from the NAGD
3 95% UCL – upper 95% confidence limit of the mean
– not available

4 Conclusions

The settling rate of sediment was slightly faster in surface sediment than sediment from deeper subsamples. Sediments of the dredge area were largely composed of silt and clay.

Concentrations of total nitrogen were higher than those recorded during the previous sampling and than concentrations recorded in association with boat harbours and ramps along the Queensland coast, however they were lower than concentrations recorded in sediment from several parts of south-east Queensland.

Concentrations of total phosphorus were slightly lower than those recorded during the previous sampling, and than those recorded in association with boat harbours and ramps along the Queensland coast. However concentrations were lower than those recorded in sediment from several parts of south-east Queensland.

The concentration of DBT was above the laboratory LOR in most samples analysed. The concentration of TBT was above the LOR, but below the NAGD screening level, in all subsample A and B samples; it was slightly higher in subsample B samples than subsample A samples.

The 95% upper confidence level of the mean concentration of nickel was above the screening level for all subsample depths and for the dredge area as a whole. The concentration of nickel was below the SQG-high level in all subsamples. Elevated concentrations of nickel have been recorded in the region and are likely to reflect the geology of the central Queensland region (Moss & Costanzo 1998; Rolfe et al. 2004). The concentration of nickel in the dredge area as a whole (22.66 mg/kg) was similar to that recorded during sediment sampling and analysis in the harbour by GHD (2005) (22.97 mg/kg) (upper 95th percentile confidence limit of the means). As such, it is considered that the dredge spoil is suitable for offshore disposal without further investigation of nickel concentrations.

The results of quality assurance / quality control analyses were generally acceptable, with the exception of laboratory replicates of mercury, selenium and DBT, field replicates of selenium and DBT, and inter-laboratory replicates of iron, selenium and TOC. Given that these variables were below the screening level, where available, this does not affect the interpretation of the results.

5 References

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Appendix A Field Core Logs

Site 1

Client: Department of Transport and Main Roads
Date: 26 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: LJ

Location: Rosslyn Bay
Weather: Overcast
Sea state: Rough
Core taken by: SW
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273581.523	7437138.873	11:34	2.8	1.9	-1.24	-1.56	-3.46

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Sand/silt	Sandy loam	Nil	None	Nil	Nil
0.25	Light brown	Sand/silt	Sandy loam	Nil	None	Nil	Nil
0.5	Grey/brown	Sand/silt	Sandy loam	Nil	None	Nil	Nil
0.75	Grey	Silt/sand	Silty loam	Nil	None	Nil	Nil
1	Grey	Silt/sand	Silty loam	Nil	None	Nil	Nil
1.25	Grey	Silt/sand	Silty loam	Nil	None	Nil	Nil
1.5	Dark grey	Silt/sand	Silty loam	Nil	None	Nil	Nil

Site 2

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm
Core taken by: SW
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273690.713	7437029.806	11:09	2.8	1.9	-1.35	-1.45	-3.35

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Sand/silt	Loam	Nil	Low	Nil	Nil
0.25	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.75	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1.25	Grey	Sand/silt	Sandy loam	Nil	Low	Nil	Nil
1.5	Grey	Sand/silt	Clayey loam	Nil	Low	Nil	Nil

Site 2 (QC1)

Client:	Department of Transport and Main Roads	Location: Rosslyn Bay
Date:	25 August 2011	Weather: Overcast
Corer type:	Stainless steel push corer	Sea state: Calm
Scientist:	SW / LJ	Core taken by: SW
Composite subsample taken by: SW		Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273690.713	7437029.806	11:40	2.5	2.2	-1.16	-1.34	-3.54

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Sand/silt	Loam	Nil	Low	Nil	Nil
0.25	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.75	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1.25	Grey	Sand/silt	Sandy loam	Nil	Low	Nil	Nil
1.5	Grey	Sand/silt	Clayey loam	Nil	Low	Nil	Nil

Site 2 (QC2)

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm
Core taken by: SW
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273690.713	7437029.806	11:41	2.5	2.2	-1.16	-1.34	-3.54

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Sand/silt	Loam	Nil	Low	Nil	Nil
0.25	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.75	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1	Grey	Silt	Silty loam	Nil	Low	Nil	Nil
1.25	Grey	Sand/silt	Sandy loam	Nil	Low	Nil	Nil
1.5	Grey	Sand/silt	Clayey loam	Nil	Low	Nil	Nil

Site 3

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm
Core taken by: SW
Core cleaned by: SW / LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273719.557	7436976.423	12:15	2.2	2.3	-1.10	-1.10	-3.40

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.25	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.75	Dark grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1	Dark grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.25	Dark grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.5	Dark grey	Sand/silt	Sandy loam	Nil	Low	Nil	Nil

Site 4

Client:	Department of Transport and Main Roads	Location: Rosslyn Bay
Date:	25 August 2011	Weather: Overcast
Corer type:	Stainless steel push corer	Sea state: Calm
Scientist:	SW / LJ	Core taken by: SW
Composite subsample taken by: SW		Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273665.16	7436848.307	10:47	2.8	1.50	-1.50	-1.30	-2.80

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Brown	Silt	Silty loam	Nil	None	Nil	Nil
0.25	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt/sand	Clayey loam	Nil	Low/moderate	Nil	Nil
0.75	Grey	Silt/sand	Clayey loam	Nil	Moderate	Nil	Nil
1	Grey	Silt/sand	Clayey loam	Nil	Moderate/high	Nil	Nil
1.25	Light grey	Clay	Clayey loam	Nil	High	Nil	Nil

Site 5

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: LJ

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm
Core taken by: SW
Core cleaned by: SW / LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273584.146	7436708.457	9:55	3.1	1.75	-1.95	-1.15	-2.90

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Dark brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.25	Dark grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.5	Dark grey	Silt	Silty loam	Nil	Low/moderate	Nil	Nil
0.75	Grey	Silt/sand	Sandy loam	Nil	Moderate	Nil	Nil
1	Grey	Silt/sand	Sandy loam	Nil	Moderate	Nil	Nil
1.25	Grey	Silt/sand	Sandy loam	Nil	Moderate	Nil	Nil
1.5	Grey	Silt/sand	Sandy loam	Nil	Moderate /high	Nil	Nil
1.75	Light grey/brown	Clay	Clayey loam	Nil	High	Nil	Nil

Site 6

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm to moderate
Core taken by: SW
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273581.773	7437030.297	13:29	2.5	2.2	-1.32	-1.18	-3.38

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.25	Light grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.5	Light grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.75	Light grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1	Light grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.25	Light grey	Silt/clay	Clayey loam	Nil	Low/moderate	Nil	Nil
1.5	Light grey	Silt/clay	Clayey loam	Nil	Low/moderate	Nil	Nil

Site 7

Client: Department of Transport and Main Roads
Date: 24 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Fine
Sea state: Calm
Core taken by: SW
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273558.975	7436859.137	12:14	2.2	2.8	-1.49	-0.72	-3.52

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.25	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.5	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.75	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.25	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.5	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.75	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
2	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
2.5	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil

Site 8

Client:	Department of Transport and Main Roads	Location: Rosslyn Bay
Date:	24 August 2011	Weather: Fine
Corer type:	Stainless steel push corer	Sea state: Calm
Scientist:	SW / LJ	Core taken by: SW
Composite subsample taken by: SW		Core cleaned by: SW

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273613.166	7436801.728	11:04	2.1	2.8	-1.42	-0.68	-3.48

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.25	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.5	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
0.75	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
1	Brown/grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.25	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
1.5	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
1.75	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
2	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil
2.5	Brown/grey	Silt	Silty loam	Nil	Low	Nil	Nil

Site 9

Client: Department of Transport and Main Roads
Date: 25 August 2011
Corer type: Stainless steel push corer
Scientist: SW / LJ
Composite subsample taken by: SW

Location: Rosslyn Bay
Weather: Overcast
Sea state: Calm
Core taken by: LJ
Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273551.658	7436760.317	13:07	2.1	2.0	-1.22	-0.88	-3.18

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Dark brown	Silt	Silty loam	Nil	Low	Nil	Nil
0.25	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.5	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
0.75	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.25	Grey	Silt/sand	Silty loam	Nil	Low	Nil	Nil
1.5	Grey	Silt/clay	Clayey loam	Nil	Moderate	Organic smell	Nil
1.75	Grey/green	Silt/clay	Clayey loam	Nil	Moderate	Organic smell	Nil
2	Grey/green	Silt/clay	Clayey loam	Nil	Moderate	Organic smell	Nil

Site 10

Client: Department of Transport and Main Roads Location: Rosslyn Bay
Date: 25 August 2011 Weather: Overcast
Corer type: Stainless steel push corer Sea state: Calm
Scientist: SW / LJ Core taken by: SW
Composite subsample taken by: SW Core cleaned by: LJ

Easting (WGS84, Zone 56)	Northing (WGS84, Zone 56)	Time (24 hrs)	Water Depth (m)	Core Length (m)	Tide wrt LAT	Top of Core wrt LAT	Bottom of Core wrt LAT
273639.149	7436976.911	14:36	2.8	1.75	-1.93	-0.87	-2.62

Depth (m)	Colour	Particle Size	Texture	Mottles	Plasticity	Odour	Shell (%)
0	Light brown	Silt/sand	Silty loam	Diffuse	None	Nil	Nil
0.25	Grey/brown	Silt/sand	Silty loam	Diffuse	None	Nil	Nil
0.5	Grey/brown	Silt/sand	Silty loam	Diffuse	None	Nil	Nil
0.75	Grey/black	Silt/sand	Sandy loam	Nil	Low	Nil	Nil
1	Grey/black	Silt/sand	Sandy loam	Nil	Low	Nil	Nil
1.25	Grey	Silt/sand	Sandy loam	Nil	Low/moderate	Nil	Nil
1.5	Grey	Silt/sand	Sandy loam	Nil	Low/moderate	Nil	Nil

Appendix B Laboratory Analysis Certificates

ROSSLYN BAY BOAT HARBOUR

Sediment Sampling and Analysis Results Report

Prepared for:

DEPARTMENT OF TRANSPORT AND MAIN ROADS
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Prepared by:

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19 April 2016

BEN557-TD-EV-REP-0002 Rev. 0

Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to present a sediment sampling and analysis results report in accordance with the scope of services set out in the contract between KBR and Department of Transport and Main Roads ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from examination of records in the public domain, results and obsservations recorded in the field, and analysis provided by external laboratories. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to the site provided by the Client. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon information in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between KBR and the Client. KBR accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Revision History

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Approved by
A	18/11/2015	Issued for Client Review	G. Ross	K. Walker	G. Ross
B	03/02/2016	Issued for Client Review	G. Ross	D. Shooter	G. Ross
C	15/04/2016	Issued for Client Review	K. Walker	D. Shooter	K. Walker
0	19/04/2016	Issued for Use	K. Walker	D. Shooter	K. Walker

CONTENTS

1 Introduction

1.1 BACKGROUND

The Department of Transport and Main Roads (TMR) is responsible for management and maintenance of the entrance channel, key navigational channels and public access areas of the Rosslyn Bay boat harbour. The remaining areas are managed by the harbour lessees. In the wake of Cyclone Marcia in 2015, recent hydrographic surveys show that significant siltation has occurred and there is a need for a new dredging campaign. As part of TMR's maintenance responsibilities, TMR is planning to undertake maintenance dredging of the Rosslyn Bay boat harbour.

The proposed dredging is to take place in 12 dredge compartments as indicated in Figure 1.1, and the latest bathymetric survey is included in Appendix A. The entrance channel (dredge compartments A and A1) is where a majority of the dredge material is estimated to be located. Other areas to be dredged include the public access area, inner access channel, mooring areas, berthing areas and the secondary public channel. The estimated dredge volume from each dredge compartment is outlined in Table 1.1.

Table 1.1 Dredge volumes for Rosslyn Bay boat harbour

Dredge compartment	Description	Maximum Dredge Depth* (mLAT)	Area (m^2)	Estimated Dredge Volume# (incl. batters) (m^3 in-situ)
A1	Outer Entrance Channel	2.80	6,040	4,810
A	Inner Entrance Channel	2.80	6,572	7,829
B	Public Access Area	2.00	2,776	2,535
C	Inner Access Channel	2.20	8,956	3,473
D	Inner Access Channel	1.70	3,996	952
F	Inner Access Channel	1.70	3,827	942
M1	Pile Mooring Area	1.70	1,6379	3,487
M2	Pile Mooring Area	1.70	2,090	4,751
E1	Berthing Area	2.20	726	1,032
E2	Berthing Area	2.20	115	217
H1	Secondary Public Channel	2.90	8,289	2,348
G	Secondary Public Channel	2.90	7,163	1,728

* *The maximum dredge depth has been determined based on the design depth with a dredging tolerance (0.3 m and 0.5 m)*

\# *Assumes all dredging is to the maximum dredge depth and allows for 45% infilling from survey to time dredging commences*

In order to support the proposed dredging program, Kellogg Brown & Root Pty Ltd (KBR) has been commissioned by TMR to undertake sediment sampling and analysis and provide a report which summarises the findings for the TMR managed section of the Rosslyn Bay boat harbour. This document describes the sediment properties, assesses the presence of anthropogenic contamination for a specified list of parameters in the sediment and compares the findings against the *National Assessment Guidelines for Dredging 2009* (NAGD).

Figure 1.1
LOCALITY PLAN

Sampling was undertaken on the 24 September 2015 to confirm the physical and chemical characteristics of the sediments within the identified areas of Rosslyn Bay boat harbour. The identified areas are the same areas which have been subject to sediment investigations in the past (FRC 2011, FRC 2008, GHD 2005). The selection of the sampling locations, sampling methodology, handling of sediment samples and quality control procedures were all undertaken in accordance with the NAGD as outlined in the Sampling and Analysis Plan (KBR, 2015). Sediment cores were initially collected from 10 sampling locations. The findings of the results of the initial sampling program prompted further investigation which targeted key areas of the boat harbour. The additional sampling and analysis program was undertaken on 8 December 2015 and included sampling an additional 12 sediment cores from key areas.

The results of the additional sampling undertaken on 8 December 2015 confirmed the heterogeneous presence of elevated concentrations of TBT around site BH9 and the decision was taken to carry out pore water analysis and further elutriate testing to investigate potential bioavailability of TBT in accordance with Phase III of the NAGD. Further targeted sampling from an additional 12 cores from the BH9 area was therefore carried out on 3 March 2016.

This document reports the field and laboratory results of the investigations undertaken and informs the suitability of the material for unconfined offshore disposal.

1.2 PREVIOUS DREDGING WORKS

The Rosslyn Bay boat harbour has been dredged approximately every 3–4 years since 2000 to maintain safe navigation. The harbour was most recently dredged in 2012, when approximately 78,000 m^3 of material was removed and deposited at an approved offshore disposal area approximately 1.1 km north of the Harbour Entrance. Prior to the 2012 dredging campaign, other dredging campaigns were also undertaken within the boat harbour in March/April 2009 (where approximately 28,000 m^3 of material was removed) and in November 2006 (where approximately 31,000 m^3 of material was removed) with all material deposited at the same approved offshore disposal area.

1.3 PROPOSED DREDGING

The harbour has been separated into 12 dredge compartments based on their use and location in order to plan and manage the dredge campaign. The proposed maximum dredge depth in each dredge compartment is shown in Table 1.1. The location of each dredge compartment is shown in Figure 1.1. All of the works are proposed to take place within the existing channel and mooring areas, there is no capital dredging proposed.

1.3.1 Dredge volumes

The maximum dredge depth has been determined based on the design depth for the dredge compartment and a dredging tolerance (between 0.3 m and 0.5 m). The estimated volume of material to be dredged from each compartment has been calculated in cubic metres based on the most recent hydrographic survey data (collected in March 2015), and the maximum dredge depth (design depth plus typical constructional tolerance). The dredge volumes have been calculated to include 1:4 batter slopes.

The total volume of in-situ material estimated for removal is approximately 35,000 m^3. In addition 15,000 m^3 has been estimated to account for infilling since the last hydrographic survey. The total volume of material which TMR is planning to remove from the boat harbour is therefore up to 50,000 m^3.

1.3.2 Dredging methods

The dredging method for the harbour and channel area is dependent on a range of factors including the characteristics of the material to be dredged, dredge depth and accuracy required, site conditions (including environmental factors and spatial extent of the area to be dredged), logistics (vessel traffic and dredge manoeuvrability) and environmental considerations including noise and water impacts.

The equipment to be used for dredging and disposal has yet to be nominated, however consideration of the sediment characteristics will inform the preferred dredge method.

1.4 NATIONAL ASSESSMENT GUIDELINES FOR DREDGING

The material to be dredged has been assessed using the NAGD, which is the most relevant guidance for the proposed dredging works. The NAGD is used as a tool to guide the assessment process and provide a framework for assessing both dredging and dredged sediment disposal activities. The NAGD requires that, where limited data exists or the data which does exist is out of date, sediment be analysed for a range of potential contaminants. Results of sediment analysis are compared with the sediment quality screening levels provided in Appendix A of the NAGD. These screening levels provide an indication of the suitability of the material for unconfined ocean disposal.

The NAGD provide details on the approach required to be undertaken for assessing potential contaminants. The methodology for assessing the suitability of dredged material for unconfined ocean disposal is illustrated in Figure 1.2 which can be used as a guide for the project. The focus of this report is on Phase I and II as outlined in the NAGD, which involves a review of existing information on the proposed dredge material and the sampling and analysis of sediments in comparison to the screening levels as stated in Appendix A of the NAGD. Where any contaminants are identified which exceed the relevant Screening Levels, a review of information, further sampling, or testing may be required as detailed in Phases III–V of the NAGD.

1.5 SAMPLING OBJECTIVES

The objectives of the sediment sampling and analysis program are to:

- provide sufficient data to characterise the sediment to be dredged, in terms of its physical and chemical properties
- provide sufficient data to assess the suitability of the sediment for unconfined ocean disposal using the NAGD guidelines.

1.6 SCOPE OF WORKS

The scope of this report includes:

- documentation of field activities and data including core photographs, physical descriptions of sediment cores and a map of sediment sampling locations
- presentation of analytical results including Quality Assurance (QA) and Quality Control (QC) data and data validation
- assessment of sediment for unconfined ocean disposal, based on the data from the above.

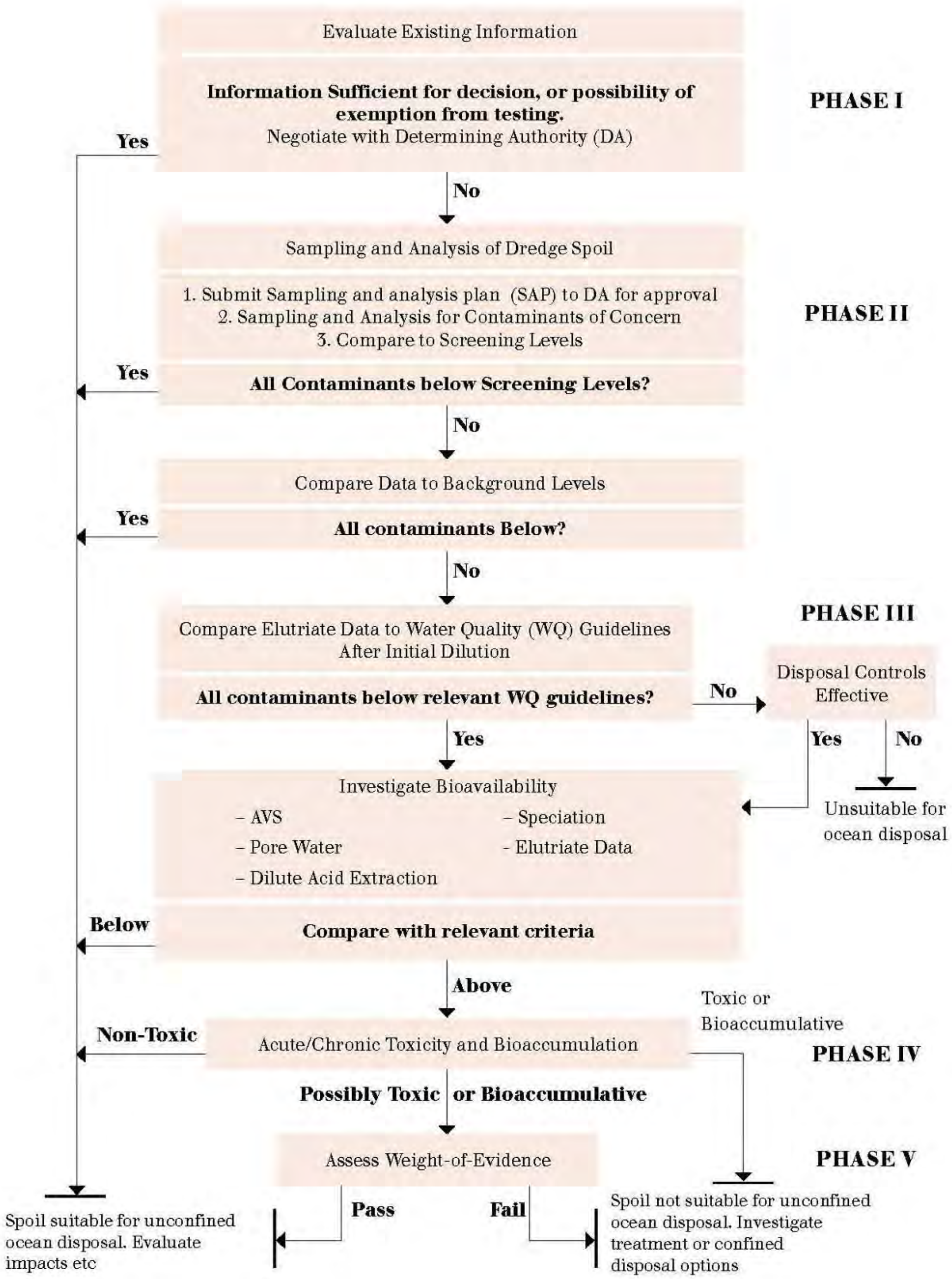

Figure 1.2
METHODOLOGY FOR ASSESSING THE SUITABILITY OF DREDGED MATERIAL FOR UNCONFINED OCEAN DISPOSAL (DEWHA, 2009 – NAGD)

2 Environmental setting

2.1 ROSSLYN BAY BOAT HARBOUR

The Rosslyn Bay boat harbour is located approximately 8 km south of the township of Yeppoon, approximately 600 km north of Brisbane. The boat harbour has over 500 marina berths, as well as public navigation channels, boat ramps, moorings and is a hub for local tourism and industry. The harbour serves as a key access point to the Keppel Islands. The boat harbour consists of an enclosed basin, with a diameter of approximately 500 m and is bound by natural features, rock walls and reclaimed land. Two rock breakwaters protect the north facing, seaward side of the harbour and form the entrance channel.

The Rosslyn Bay boat harbour is adjacent to the Mackay/Capricorn management area of the Great Barrier Reef Marine Park and is one of 14 State boat harbours along the Queensland Coast designed to provide sheltered havens for recreational and commercial boating. TMR is responsible for management of approximately 30% of the boat harbour area, the remaining area being the responsibility of lessees. TMR is responsible for the entrance channel, internal navigation and access channels public access areas and moorings.

The majority of the harbour’s commercial industry is located on the eastern boundary of the harbour and includes two commercial jetties and a variety of commercial and industrial properties on the water’s edge. There are two boat ramps located in the south-eastern corner of the boat harbour. The entire western portion of the boat harbour is maintained by Keppel Gateway Pty Ltd who operates the Keppel Bay Marina.

2.2 EXISTING SEDIMENT PROPERTIES

Since 2000, there have been four separate sediment investigations undertaken within the Rosslyn Bay boat harbour. The investigations were undertaken in August 2000, May 2005, December 2008 and August 2011 to support previous maintenance dredging campaigns.

2.2.1 Sediment characteristics

Previous sediment analysis has shown consistent results across the site for the physical properties of the sediment. The sediment matrix typically consists of fine to medium grained sand with varying amounts of silt, clay and gravel mixed in. Below the recently accumulated surface sediments (typically between 0.5 m and 1.0 m) the profile generally increases in clay content and becomes stiffer.

The chemical properties of the sediments have also been relatively consistent in previous sediment investigations. The majority of analyses has previously reported contaminants below the screening levels of the National Ocean Disposal Guidelines (NODG, 2002) and the NAGD (DEWHA, 2009). The concentration of nickel has previously been identified within sediment in the harbour at levels which slightly exceed the NAGD screening level, however this finding is consistent with the surrounding geology and natural environmental factors which can attribute to naturally elevated concentrations of nickel and arsenic in sediment in Australia (DEWHA, 2009). Previously dredged sediment has met the requirements for unconfined offshore placement.

Previous sediment sampling and analysis undertaken at the Rosslyn Bay boat harbour has identified individual sub-samples where Tributyltin (TBT) is present (FRC, 2011, GHD, 2005). During the most recent sampling and analysis campaign at Rosslyn Bay boat harbour (FRC, 2011) the concentration of normalised TBT was below the NAGD guideline value of 9 µgSn/kg. Historical data available for the concentration of TBT in sediment within the Rosslyn Bay boat harbour indicates that the organotin compound is not normally present in concentrations of concern, but may be present in isolated locations in the accumulated sediment.

Previous testing of sediment samples retrieved from the boat harbour for acid sulfate soil identified that the overall likelihood of the presence of potential acid sulfate soils was minimal due to the excess neutralising capacity of most of the accumulated sediment to be dredged (GHD, 2005). The results of the analysis showed that the sediments did not constitute a risk to the surrounding environment from generation of acid particularly given the handling and disposal methods which will be employed.

Given the consistent results from previous sediment sampling and analysis programs, that there have been no significant changes to the surrounding land uses, or the industries which operate within the Rosslyn Bay boat harbour, the sediments within the proposed dredge compartments are considered to be '*probably clean*'. The investigation described in this report targeted the recently accumulated sediment (the sediment which is intended to be dredged) and the potential contaminants which historical data shows have a higher likelihood of occurring.

3 Field methods and analytical procedures

3.1 ASSESSMENT APPROACH

The sampling and analysis regime for this investigation was designed on the basis of the potential level of risk present within the sediments of Rosslyn Bay boat harbour based on data from previous investigations. The selection of sampling locations was determined in accordance with the NAGD grid method (detailed in Appendix D of the NAGD) and focused on the potential for occurrence of contaminants and those areas where the greatest amount of material will be dredged.

A primary list of analytes was provided from TMR and was based on investigations undertaken in 2011. The list is presented in Tables 3.1. The 'Primary' list of analytes includes parameters from the NAGD including nutrients, metals and particle size. In addition to the 'Primary' list of analytes, approximately 20% of the sub-samples were also analysed for petroleum hydrocarbons. The sub-samples which were selected for analysis for hydrocarbons were generally samples in the surface layer of sediment, which are more likely to be affected by hydrocarbons.

Screening levels (derived from NAGD) which indicate the concentration below which there is minimal risk of adverse environmental consequence are provided in Table 3.1. Table 3.1 also outlines the relevant PQLs as derived from the NAGD. The Practical Quantitation Limits (PQL) are those values assigned to each analyte which are necessary to accurately determine contaminant concentrations at or near natural levels, or to reliably detect organic substances that may have impacts at very low environmental concentrations.

Table 3.1 Primary list of parameters

Parameter	Units	Practical Quantitation Limit	Screening level (as per NAGD)
Moisture Content	%	NS	NS
Particle Size Analysis (sieve and hydrometer) and settling rate after 50% and 90% of settlement in seawater		NS	NS
Nutrients			
Total Organic Carbon	%	0.1	NS
Nitrate as N	mg/kg	0.1	NS
Nitrite as N	mg/kg	0.1	NS
Ammonia as N	mg/kg	0.1	NS
Total Kjeldahl Nitrogen	mg/kg	0.1	NS
Total Nitrogen	mg/kg	0.1	NS
Total Phosphorus	mg/kg	0.1	NS

Parameter	Units	Practical Quantitation Limit	Screening level (as per NAGD)
Metals			
Silver	mg/kg	0.1	1.0
Aluminium	mg/kg	200	NS
Arsenic	mg/kg	1	20
Cadmium	mg/kg	0.1	1.5
Cobalt	mg/kg	0.5	NS
Chromium	mg/kg	1	80
Copper	mg/kg	1	65
Iron	mg/kg	100	NS
Mercury	mg/kg	0.01	0.15
Manganese	mg/kg	10	NS
Nickel	mg/kg	1	21
Lead	mg/kg	1	50
Antimony	mg/kg	0.5	2.0
Selenium	mg/kg	0.1	NS
Vanadium	mg/kg	2	NS
Zinc	mg/kg	1	200
Organotin Compounds			
Monobutyltin	µgSn/kg	1	NS
Dibutyltin	µgSn/kg	1	NS
Tributyltin	µgSn/kg	1	9
Hydrocarbons*			
Total Petroleum Hydrocarbons (TPH)	mg/kg	100	550
Polyaromatic Hydrocarbons (PAH)	mg/kg	0.005	NS
Sum of PAH's	mg/kg	0.1	10

NS Limit Not Specified
PQL Practical quantitation limit (as per the NAGD guidelines)
* *Analysis for hydrocarbons was limited to approximately 20% of the sub-samples collected*

3.2 SAMPLING LOCATIONS AND DIVISION OF CORES

A total of 10 sampling locations were selected on the basis of the dredge volume, level of risk and previous sediment investigations. Sampling locations are shown in Figure 3.1.

All sample locations were specified relative to MGA Zone 56 (GDA 94) and identified on-site by DGPS. All sample depths were referenced to LAT. Where possible, sediment cores were collected from each location to approximately 0.5 m below the maximum dredge depth. The approach is outlined in the sediment sampling and Analysis plan approved by TMR in 2015 (KBR, 2015).

Given the amount of data from previous sediment investigations which defines the chemical characteristics of the sediment within the Rosslyn Bay boat harbour, the NAGD indicate that a minimum number of six sampling locations could be justified for the proposed volume of dredge sediment to be removed. From discussions with

TMR during the development of the SAP 10 sampling locations were proposed to provide appropriate coverage of the boat harbour.

Figure 3.1 shows the location of the sampling locations in relation to the boat harbour and the proposed dredge compartment. The maximum dredge depth, and length of core retrieved is outlined for each sampling location in Table 3.2.

Table 3.2 Sample locations and depths

Core Number	Dredge Compartment	Approx. Easting (GDA)	Approx. Northing (GDA)	Target core length (m)	Core length retrieved (m)	Number of sub-samples
BH 1*	A1	273575	7437114	1.75	2.4	6*
BH 2	A	273665	7437064	2.05	1.9	3
BH 3	B	273756	7436944	1.50	2.0	4
BH 4	C	273718	7436884	1.60	1.6	3
BH 5	M1	273688	7436937	0.70	1.5	3
BH 6	G	273597	7436984	1.85	1.1	3
BH 7*	E1	273677	7436741	1.60	1.5	9*
BH 8	H1	273644	7436850	1.50	1.5	3
BH 9	F	273595	7436638	1.15	1.3	3
BH 10	G	273574	7436756	2.05	1.7	3

* *Denotes QA/QC sample location*

During sediment core retrieval, the vibrocorer met refusal at all locations in stiff clay. The clay encountered was consistent with natural material underlying the accumulated sediments at depths which were generally consistent with the design depth in each dredge compartment. In some instances, refusal of the vibrocorer occurred above the targeted depth (0.5 m below the proposed maximum dredge depth) but in all but one case, this was below the maximum dredge depth and the underlying material is unlikely to be disturbed during dredging. The core collected at BH6 reached refusal prior to the proposed maximum dredge depth, the underlying material is unlikely to be disproportionately contrasting from the other material collected in the sampling program as this material appears to be undisturbed, natural clay.

3.3 SAMPLING METHODOLOGY

Sediment cores were collected using a vibracorer mounted on a work boat. Sediment sampling sites were located using a boat mounted GPS with confirmation by a hand held GPS unit (overall accuracy approximately ±4 m). The water depth was then recorded using a depth sounder and direct measurements. The recorded depth and sampling time were used to calculate the bed level based on tide stage in order to determine the minimum length of core required to reach 0.5 m below maximum dredge depth. All cores were retained within a plastic sleeve to avoid cross contamination and were labelled for identification prior to being taken onshore for sub-sampling.

Figure 3.1
SAMPLING LOCATIONS

Once the sediment cores were onshore they were sliced open for physical characterisation. Notes were recorded detailing the colour, texture, presence of shell or organic matter and particle sizing of the cores based on field identification techniques. A photographic record of all cores was also collected, prior to sub-sampling.

For all samples that required mixing, the procedure was carried out using stainless steel bowls and utensils (which were rinsed and decontaminated between samples) and placed in appropriately sterilised containers provided by the laboratories. Samples were then stored in eskies on ice and delivered to the laboratories for processing and analysis. A Chain of Custody form was included in each esky.

Sample identifications were labelled directly onto soil bags and jars with a water proof marker pen. Sample labels included the following information:

- project and date
- sample point number
- sample depth
- other comments as required.

3.4 CHAIN OF CUSTODY

A Chain of Custody (COC) record was utilised by field personnel to document possession of all samples collected for chemical analysis. The COC record included the following information:

- project name and number
- date
- name(s) of sampler(s)
- sample type, identification number
- number and type of containers
- required analyses.

The sampling methods complied with the requirements of the NAGD. Sample storage, preservation, handling and holding were all undertaken in accordance with these guidelines.

3.5 SUB-SAMPLING

The sub-sampling intervals selected for each core allowed for a thorough assessment of sediment composition throughout the profile. The division of sediment cores was based on the volume of sample required for analysis and the guidance provided in the NAGD. Where possible the cores were divided as follows:

- an upper layer sample is to be taken from 0–0.5 m of each core
- one sample from the mid to lower horizon of each core will be taken between 0.5 m and 1.0 m
- one sample will be taken from the remainder of the sediment core, from 1.0 m to 0.5 m below the maximum dredge depth or to the end of core.

In some cases, in the field adjustments were required based on the actual core length retrieved as well as the actual bed level encountered. In accordance with the Quality Assurance and Quality Control procedures of the NAGD, one triplicate core was collected to assess field variation, with a duplicate split sample taken from one core to assess variation associated with sub-sampling handling. The triplicate core was collected at BH7 and the duplicate split sample was taken at BH1/0–0.5 m and labelled BHX.

Any sediment collected, but not analysed was sent to the laboratory for storage, In the event that additional laboratory testing is required this sediment may be used for analysis, providing it is requested within the laboratory holding timeframes.

An illustration of the sub-sampling approach for the 10 sampling locations is presented in Figure 3.2.

Table 3.3 Sub-sample analysis

Sample Site	Core length retrieved (m)	Photo of the Sample/Core	Physical Description	No. sub-samples for analysis
BH 1#	2.4	✓	✓	5
BH 2	1.9	✓	✓	3
BH 3	2.0	✓	✓	3
BH 4	1.6	✓	✓	3
BH 5	1.5	✓	✓	2
BH 6	1.1	✓	✓	3
BH 7*	1.5	✓	✓	9
BH 8	1.5	✓	✓	3
BH 9	1.3	✓	✓	3
BH 10	1.7	✓	✓	3

Split sample collected

* *Triplicate Core*

3.6 SEDIMENT ANALYSIS

A total of 37 sub-samples were collected and analysed, from the 10 sampling locations, this includes QA/QC samples. The sub-samples were subjected to the ‘Primary’ list of laboratory analysis, with 7 (approximately 20%) of the sub-samples (most surface samples) being selected for additional analysis for hydrocarbons. Three of the sub-samples were not analysed for particle size due to restrictions on the volume of sample available for analysis at that interval.

All cores were divided as close to 0.5 m intervals as feasible, in order to gain a better understanding of the surface, above maximum dredge depth and below maximum dredge depth sediment characteristics (refer to Figure 3.2).

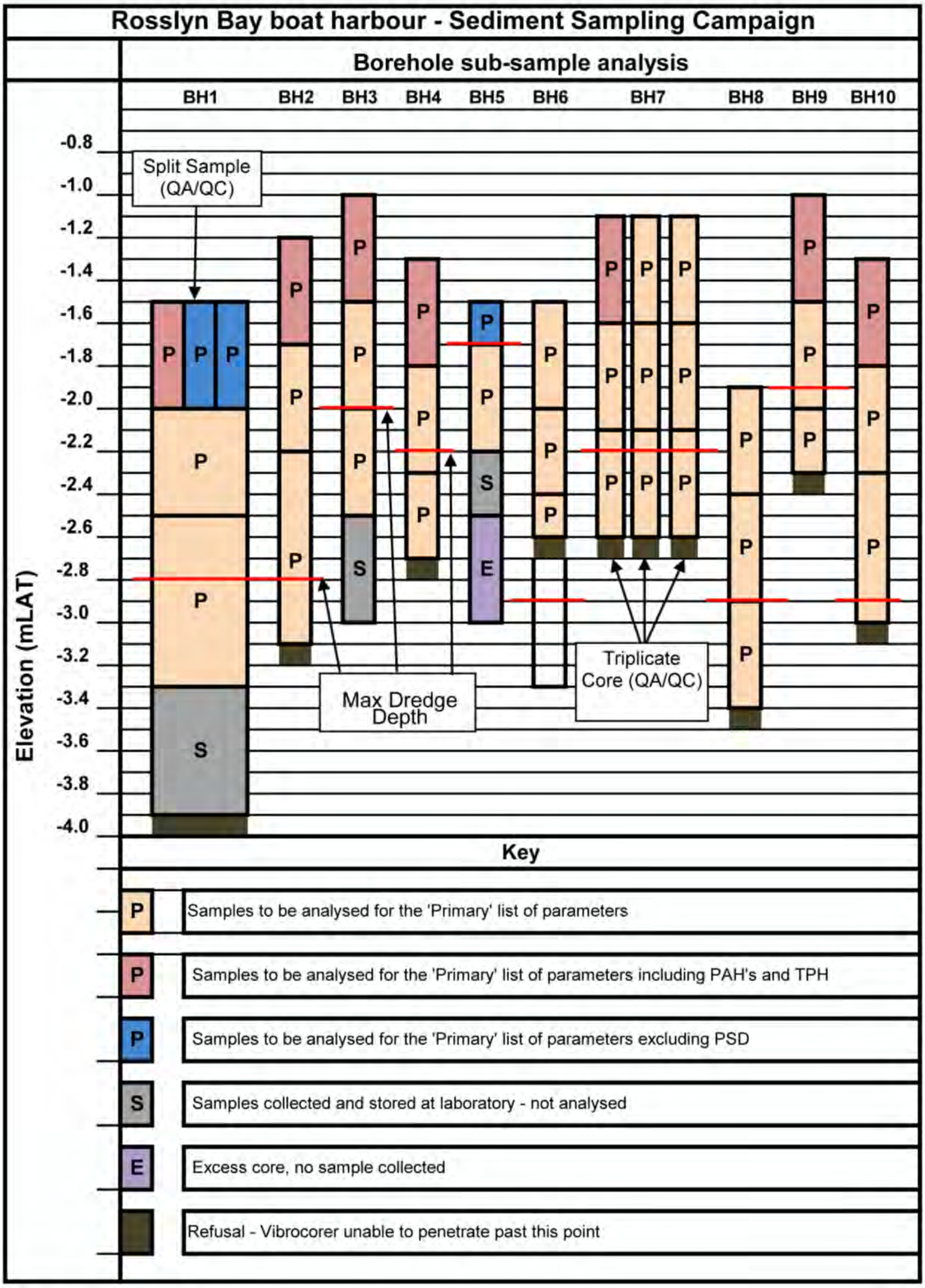

Figure 3.2
VISUAL REPRESENTATION OF SUB-SAMPLE ANALYSIS

3.7 QUALITY ASSURANCE AND QUALITY CONTROL SAMPLES

Quality assurance and quality control (QA/QC) procedures were implemented to ensure that the samples and data collected meet the requirements for comparison with the NAGD.

3.7.1 Field sampling

All field sampling procedures were carried out in accordance with the SAP. Core sub-sample intervals were revised at sampling locations based on the bed level encountered which tended to vary from the anticipated bed level (from the hydrographic survey).

The split sample was taken from surface sediment of BH1 (from 0.0 to 0.5 m). Three sub-samples were collected from this location, one primary sample, and two 'blind' duplicate samples which had different nomenclature (labelled BHX). The purpose of the blind sample was to test for any variation in repeatability within the laboratory's analytical procedures. The laboratory reported results showed that the laboratory was able to accurately repeat the primary results within acceptable tolerances.

A triplicate core (three separate cores taken from the same location) was taken at BH7, the three cores were recorded as BH7A, BH7B, and BH7C. This was undertaken to assess the spatial variability of the sediments physical and chemical characteristics. The reported results identified some spatial variability in the chemical properties of the sediment, but the physical characteristics were relatively consistent.

A summary of laboratory analysis undertaken, and the results can be found in Appendix B.

3.7.2 Laboratory Quality Control and Quality Assurance

ALS Environmental is a NATA accredited laboratory for the analysis of the marine sediment. The laboratory completed the NAGD required QA/QC testing including use of laboratory blank samples, spike recovery and replicate sampling. Table 3.5 outlines the laboratory used for the analysis of samples including QA/QC samples.

Table 3.4 Summary of laboratories used

Laboratory	Analysis
ALS Environmental Division, Brisbane: 2 Blyth Street Stafford QLD 4053 Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 825	All primary analyses
SGS Alexandria Environmental Unit 16, 33 Maddox Street Alexandria NSW 2015	All secondary laboratory analysis

The Laboratory Quality Control report is included in Appendix C.

Based on the data presented in the Laboratory Quality Control report and QA/QC Compliance Assessment, the reported results are considered satisfactory.

3.8 ADDITIONAL SAMPLING AND TESTING - 8 DECEMBER 2015

The results of the first round of sampling and analysis undertaken on 24 September 2015 showed isolated occurrence of elevated TBT concentrations in some of the sub-samples retrieved. The results indicated that sample heterogeneity, and statistical outliers may be skewing the overall TBT concentration. An additional sampling and analysis program was therefore planned and carried out with the intent of confirming the representative TBT concentration in those areas of isolated elevated occurrence, and the spatial extent of any elevated concentrations.

The additional sampling and analysis program was designed to target three locations from the first sampling program which showed signs of isolated elevated TBT concentration. The three sample sites were BH4, BH7 and BH9 in Dredge Compartment C, E1 and F respectively. The additional sampling program included additional sediment cores at BH4, BH7 and BH9 (all practical effort was made to retrieve these from the same locations used in the first event) to confirm the representativeness of the initial results. The repeat sediment cores were given the same nomenclature as the original but with post-script ‘A’, and a different sample collection date. That is for ease of interpretation in this report the sediment cores collected as part of the additional sampling program have been referred to as BH4A, BH7A and BH9A respectively.

In addition to the repeat cores, the follow-up sampling program included three sample locations within a 5–10 m radius of each of the original BH4, BH7 and BH9 sample locations. These cores helped to determine the spatial variability of the elevated TBT concentrations at these locations.

The additional sampling and analysis program included a total of 12 additional sediment cores. Figure 3.3 shows the location of the additional sediment cores which were collected on 8 December 2015, with the sample locations undertaken in September 2015 also shown for reference.

All sampling carried out as part of the additional sampling program was undertaken in accordance with the method described in the previous sections. The location, length of core retrieved and number of sub samples collected at each sampling location is summarised in Table 3.5. All sampling locations are specified relative to MGA Zone 56 (GDA 94) and were identified on-site by dual GPS. During sediment core retrieval, the vibrocorer met refusal at all locations in stiff underlying clay which was consistent with natural material underlying the accumulated sediment, the depths were generally consistent with the design depth and the depth encountered during the initial round of sampling.

Table 3.5 Sub-sample analysis

Core Number	Approx. Easting (GDA)	Approx. Northing (GDA)	Target core length (m)	Core length retrieved (m)	Number of sub-samples for analysis	Photo of the Sediment Core	Physical Description of the Core
BH 4A	273719	7436888	1.4	1.1	6	✓	✓
BH 7A*	273657	7436739	1.9	1.7	7	✓	✓
BH 9A*	273596	7436639	1.1	1.3	7	✓	✓
BH 11	273723	7436893	1.3	1.2	6	✓	✓
BH 12	273714	7436888	1.3	1.1	6	✓	✓

Core Number	Approx. Easting (GDA)	Approx. Northing (GDA)	Target core length (m)	Core length retrieved (m)	Number of sub-samples for analysis	Photo of the Sediment Core	Physical Description of the Core
BH 13	273710	7436873	1.3	1.1	6	✓	✓
BH 14	273669	7436751	1.5	1.5	6	✓	✓
BH 15	273668	7436756	1.2	1.2	6	✓	✓
BH 16	273656	7436739	1.4	1.2	6	✓	✓
BH 17	273596	7436644	1.3	1.0	6	✓	✓
BH 18	273585	7436629	1.4	1.4	6	✓	✓
BH 19	273583	7436632	1.5	1.7	6	✓	✓

* *QA/QC sample collected*

The target core length was determined based on achieving 0.5 m beyond the maximum dredge depth. In some cases the core length retrieved did not reach the target depth, but all cores were able to penetrate passed the proposed maximum dredge depth. Figure 3.4 shows the sub sampling approach for the additional sampling program. The illustration includes a comparison with the original sample cores BH4, BH7 and BH9 to show the relationship between the replicate cores and the sediment cores retrieved during the September 2015 sampling program.

3.8.1 Field sampling

The additional program field sampling procedures were in accordance with the revised SAP (which was approved by TMR prior to mobilization). Where necessary the core sub-sample intervals were revised slightly in the field based on the actual bed level encountered (if it varied from the anticipated bed level based on the hydrographic survey and the findings of the previous sampling regime).

Split samples were collected from all sample locations, with one sample sent to the primary laboratory for analysis and the duplicate sample sent to the secondary laboratory for analysis. Two of the sub-samples were designated for further QA/QC testing and a further 'blind' duplicate sample, which had different nomenclature (labelled BHX and BHZ) were collected from BH9A/0.0–0.5 m and BH7A/0.0–0.5 m respectively. The purpose of the blind duplicate samples were to test for any variation in repeatability within the laboratory's analytical procedures. The laboratory results showed that each laboratory was able to accurately repeat the primary results within acceptable tolerances.

Given the elevated TBT results from the first sampling program, it was expected that there may be some more elevated TBT results in the additional samples. Therefore it was decided that elutriate testing may be required in line with the methodology for assessing suitability of material for unconfined ocean disposal (refer to Figure 1.2). During the additional sampling program, a water sample was collected from an area that was outside of the entrance channel of the boat harbor and was representative of the water at the proposed disposal location. This sample was submitted to the primary laboratory with the sediment samples. The water sample was subject to analysis for low levels of TBT which confirmed that there was no soluble TBT in the water above the LOR.

A summary of laboratory analysis undertaken, and the results can be found in Appendix B.

Figure 3.3
LOCATION OF ADDITIONAL SAMPLE SITES

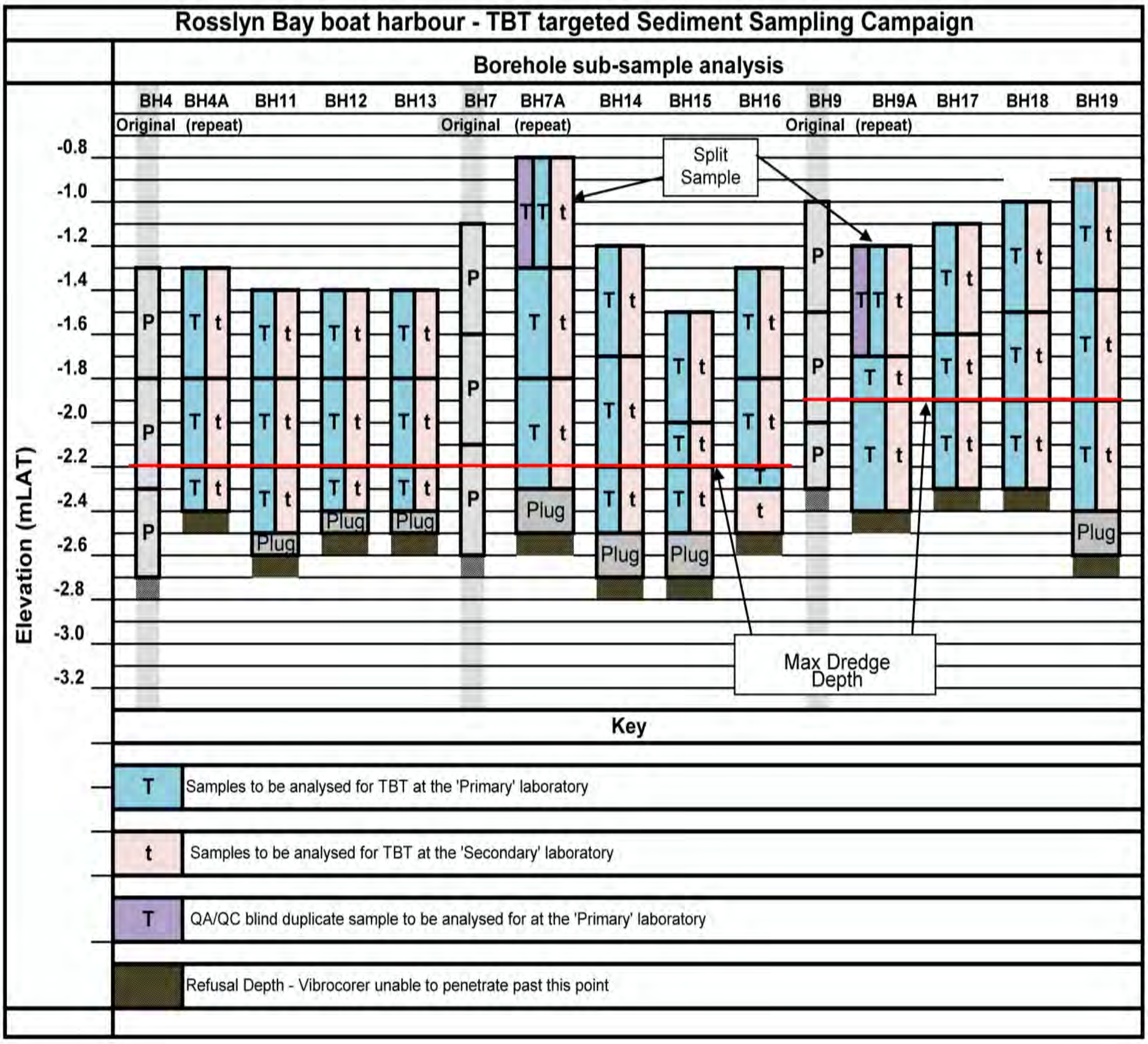

Figure 3.4
VISUAL REPRESENTATION OF ADDITIONAL SUB-SAMPLE ANALYSIS

3.9 ADDITIONAL SAMPLING AND TESTING - 3 MARCH 2016

From the previous sampling and analysis programs carried out the results showed isolated occurrences of elevated TBT concentrations in sub-samples retrieved around the BH9 area at depths above the maximum dredge depth. As part of the steps outlined within the NAGD further bioavailability testing was undertaken to collect sufficient sample volume to allow pore water analysis and further elutriate testing to be undertaken. This was carried out on 3 March 2016.

For this additional sampling sediment cores were collected using a manual piston sampler. At each location, a sediment core representative of the depth proposed for dredging was collected.

Laboratory analysis was for TBT in sediment, TBT by elutriate method, and for TBT in pore water. Due to the complexity of the TBT analysis in a marine sediment matrix and the variable nature of the sediment encountered selected split samples, duplicate analysis and analysis of a split sample at an independent laboratory to provide verification and QA/QC pore water analysis were undertaken.

Similar to the previous sampling carried out in December 2015. The March program included collection of additional cores which were stored at the laboratory in case these were needed. The number and internal of cores is shown in Figure 3.5. Sampling locations for the sediment collected were the same sites as those used in the December 2015 campaign. Figure 3.3 shows the location of the cores collected on 8 December 2015.

Aside from the samples being collected by piston sampler rather than vibrocorer, all sampling was carried out in accordance with the methods described for previous sampling events. The location, length of core retrieved and number of sub samples collected at each sampling location is summarised in Table 3.6. All sampling locations are specified relative to MGA Zone 56 (GDA 94) and were identified on-site by GPS. The depths were consistent with the design depth and the depth encountered during the previous sampling.

Table 3.6 Sub-sample analysis

Core Number	Approx. Easting (GDA)	Approx. Northing (GDA)	Target core length (m)	Core length retrieved (m)	Number of sub-samples for analysis	Photo of the Sediment Core	Physical Description of the Core
BH 9*	273596	7436639	0.7	1.0	7	✓	✓
BH 17	273596	7436644	0.8	0.8	Storage	✓	✓
BH 18	273585	7436629	0.9	0.9	Storage	✓	✓
BH 19	273583	7436632	1.0	1.0	Storage	✓	✓

* *QA/QC sample collected*

The target core length was determined based on achieving maximum dredge depth. All cores were able to penetrate to the proposed maximum dredge depth.

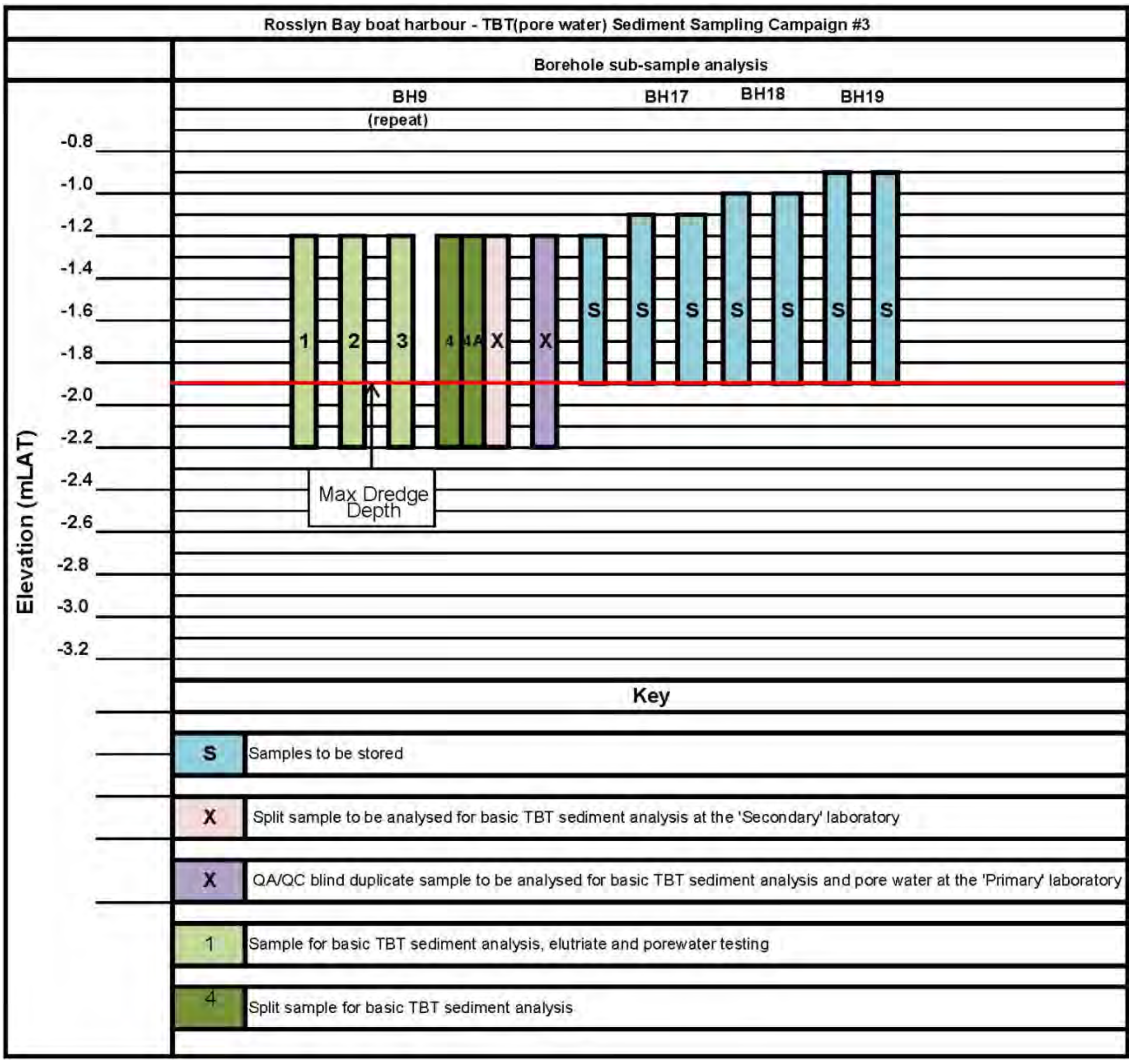

Figure 3.5
VISUAL REPRESENTATION OF ADDITIONAL SUB-SAMPLE ANALYSIS

4 Results

4.1 FIELD OBSERVATIONS

During the retrieval of sediment cores, observations of field conditions (weather, tides and currents), sampling location, date, time and identity of the sampler were all recorded. Observations of the visual state of the sampling site and surrounding area were also noted including any litter present and vessel traffic. Throughout the field sampling there was no evidence of litter or other gross pollutants within the project area. Vessel traffic was low to moderate with the majority of traffic comprised of small commercial and recreational boats. A barge mounted crane was noted in the boat harbour, but was not active during the field sampling.

4.2 PHYSICAL CHARACTERISTICS

The physical characteristic of the sediment was informed by conducting particle size (including by hydrometer) analysis for most of the sub-samples collected. The volume of sediment available at BH5/0.0–0.2, and the two QC/QC samples collected at BH1/0.0–0.5 m was insufficient for particle size distribution, therefore the analysis could not be carried out at this location. A description of each sediment core can be found in Appendix D, and corresponding photographs are presented in Appendix E.

4.2.1 Particle Size

The particle size of the sediment was found to be mixture of fine grained sand and silts and clays. The sediment encountered at BH1, BH2 and BH9 were notably sandier than the other locations, this is attributed to the location of those sediment cores (in the navigation channel and near the boat ramp) where fine particles (silt and clay) are less likely to accumulate and settle.

At the remaining sampling locations, the proportions of fine material (clay and silt) and sand were approximately equal. Most of these cores were collected in areas close to boat moorings, where vessel traffic is commonly less frequent, allowing fine particles to settle, therefore it is not considered unusual to identify increased quantities of silt and clay in these areas. Typically the proportion of silt and clay was marginally higher than sand in the upper portion of the sediment core (surface samples typically collected from 0–0.5 m), but sand content tended to increase with depth.

The underlying natural material encountered at most locations was typically stiff clay with fine sand. Traces of shell, gravel and coarse material were noted in some locations across the boat harbour. The full laboratory results are presented in Appendix C.

4.3 CHEMICAL CONTAMINANTS

A summary of results of the laboratory analysis are presented in Appendix B, and where available, NAGD screening levels are provided for comparison.

4.3.1 Metals and metalloids

As part of the sampling event, metal analysis was carried out on all 37 of the sub-samples. The analysis included 16 metals (refer to Table 3.1). The upper 95% confidence limit of the mean (UCL) of the reported results for all metals and metalloids except nickel were below the NAGD screening levels. The 95% UCL of the mean concentration of nickel was 23.52 mg/kg, which is slightly above the NAGD screening level of 21 mg/kg. The concentration of nickel in the sub-samples appeared to be in line with typical nickel concentrations in sediment in the area. Nickel has been consistently reported in elevated concentration in the Rosslyn Bay boat harbour in previous investigations (95% UCL of 22.66 mg/kg in 2005 (GHD, 2005), and 95% UCL of 22.97 mg/kg in 2011 (FRC, 2011)) and is likely to be a function of naturally elevated concentrations found within certain geological formations in the central Queensland region and not associated with anthropogenic contamination.

It is noted in the NAGD that sediment in Australia commonly has naturally elevated concentrations of nickel and arsenic (DEWHA, 2009). Table 4 in Appendix A of the NAGD present the Sediment Quality Guideline (SQG) high values for metals and metalloids, these values represent the concentration above which a certain metal or metalloid is considered high risk. The SQG-high value presented for nickel is 52 mg/kg, the 23.52 mg/kg 95% UCL for nickel is well below the SQG-high value.

4.3.2 Nutrients

There are no screening levels or guidelines for the concentration of nutrients in sediment specified in the NAGD. Compared with previous sampling events at the Rosslyn Bay boat harbour, the mean concentration of total nitrogen appears to be slightly lower than previous years 624 mg/kg (compared to 758 mg/kg in 2011) and the mean concentration of total phosphorus is also lower, 278 mg/kg (compared to 364 mg/kg in 2011). The maximum reported concentration of total nitrogen was 1290 mg/kg (at BH7/0–0.5 m), which is considered relatively high, but not uncommon in shallow sediment profiles in public boat harbours. Most of the nitrogen in sediment was comprised of organic nitrogen in the form of total Kjeldahl nitrogen (TKN) with a strong correlation between total nitrogen and TKN in most sub-samples. Total phosphorus concentrations were recorded up to 445 mg/kg, which remains in line with previous maximum total phosphorus concentrations in the boat harbour.

4.3.3 Total organic carbon

All samples showed low organic material content, with the majority of Total Organic Carbon (TOC) levels being less than 1%. One sample, BH7C (0.5–1.0 m) recorded the highest TOC concentration of 1.01%, which is still a low concentration of organic material.

4.3.4 Hydrocarbons

The suite of hydrocarbons which were analysed in accordance with the NAGD included total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylene, napthene (BETXN) and polynuclear aromatic hydrocarbons (PAHs). Seven sub-samples with the highest risk (generally surface sediments) were selected for hydrocarbon analysis.

Some aromatic hydrocarbons were reported in individual sub-samples at concentrations above the LOR including napthalene, pyrene and perylene, however the concentrations of the sum of PAHs were below the NAGD screening level.

No elevated TPH concentrations were noted in any of the sub-samples, the maximum concentration of total recoverable hydrocarbon (sum) was 68 mg/kg at BH7A/0.0–0.5 m, well below the 550 mg/kg screening level.

4.3.5 Organotin compounds

The reported concentration of monobutyltin (MBT) and dibutyltin (DBT) for most of the sub-samples was below the LOR. The samples which reported concentrations above the LOR remained relatively low. There are no NAGD screening levels for MBT and DBT.

Analysis for tributyltin (TBT) was undertaken on all 37 of the sub-samples collected. The concentration of TBT was reported above the LOR of 0.5 µgSn/kg in 15 of the 37 sub-samples. In five individual sub-samples, TBT results were reported which were above the screening level of 9 µgSn/kg (from Table 2 in Appendix A of the NAGD). None of these individual results exceeded the SQG-high value of 80 µgSn/kg (from Table 4 in Appendix A of the NAGD). The analytical laboratory reported sample heterogeneity issues within a number of the sub-samples for which TBT was reported above the screening level, and for a number of these the reported 'spike recovery' for quality control was also poor.

TBT is known to often be strongly heterogeneous within sediment samples (i.e. it can occur as small particles which are not evenly distributed through the sediment) and it is a difficult parameter to analyse from strongly saline marine sediments. To address this, it is preferable to analyse larger aliquots of the sample sediment (i.e. the amount of sample actually put through the laboratory extraction and analysis process). In the case of the five initial elevated results it was noted the aliquot volume analysed was small (5g). Consequently, reanalysis of these was carried out on larger aliquots (up to 40 g) to ensure that the analysis was as representative of the overall sediment samples as possible, and that 'spike recovery' QC data performed well.

In four of the five cases, applying these criteria to the reanalysis resulted in reported TBT concentrations less than the screening level, with one sub-sample (9.4 µgSn/kg) slightly above the screening level. A summary of the results are included in Appendix B, while the full laboratory reports are included in Appendix C.

The laboratory results indicated that additional sampling was called for as there were a number of elevated TBT results. Further investigation of the representativeness, extent and distribution of the isolated elevated TBT concentrations was considered warranted given the inconsistency between replicate laboratory results and analysis, and the presence of potential statistical outliers in the dataset.

4.4 RESULTS FROM ADDITIONAL SAMPLING - 8 DECEMBER 2015

The results of the additional sampling confirmed that the majority of sediment to be dredged from the Rosslyn Bay boat harbour does not contain elevated concentration of TBT. Isolated elevated TBT concentrations were found at a small number of locations within the proposed dredge area. The laboratory analysis results of the additional sampling undertaken are summarised in Appendix B, while the full laboratory reports are presented in Appendix C. The laboratory analysis confirmed that there were some elevated TBT concentrations in a few isolated sub-samples. Initial results showed some inconsistencies but these were checked and confirmed as necessary.

Laboratory results which were greater than two standard deviations above the remaining results were re-analysed at both the primary and secondary laboratories. In accordance with the methodology outlined in the NAGD (DEWHA, 2009 Appendix A), where a sample is shown to be a statistical outlier, it can be sent for reanalysis, and should reanalysis confirm that the result is a statistical outlier, it can be removed from the dataset and replaced by the mean of the remaining results for that sub-sample. Three statistical outliers were identified in the sub-samples collected as part of this program of analysis. This is a consequence of the heterogeneous occurrence of TBT in sediments (e.g. infrequent paint flakes in the accumulated sediment). Table 4.1 shows the results of the sub-samples which have been identified as statistical outliers and the average of the re-sampled results which have been included in its place.

Table 4.1 Statistical outliers in TBT results in the proposed dredge sediment

Sample number	TBT concentration in outlier	Replicate concentration range	Mean of remaining TBT results for the given sub-sample
units	µgSn/kg	µgSn/kg	µgSn/kg
BH7/0.0–0.5	71.8	0.7–9.4	3.1
BH9A/0.0–0.5	69.0	6.1–32.7	16.5
BHX	187.0	13.0–19.0	14.8

In order to determine the 95% UCL of the mean for TBT within the dredge area, the laboratory results for TBT were normalised (as described in Appendix A of the NAGD), and statistical outliers were removed from the dataset (as above). Any TBT results collected from below the maximum dredge depth were also removed from the data set, as they are not representative of the proposed dredge area (i.e. it is not proposed to dredge this sediment).

Based on the results, the sediment within the boat harbour could clearly be separated into two distinct categories based on the sediment characteristics. The majority of the sediment analysed could be categorised as 'probably clean' and showed no sign of significant TBT contamination, while a small volume of the sediment was subject to elevated TBT concentrations. Geographically, the data showed that sediment within Dredge Compartment F (near the public boat ramp) was generally subject to elevated TBT concentrations, while sediment from the remaining Dredge Compartments tended to be 'probably clean'.

The data confirmed that the sediment within the majority of the boat harbour was 'probably clean' as the 95% UCL of the mean of normalised TBT for the proposed dredge area (excluding Dredge Compartment F) is 2.5 µgSn/kg. From this information it is clear that for a majority of the sediment in the proposed dredge area in Rosslyn Bay boat harbour, the concentration of TBT is well below the NAGD guideline value, and is considered this sediment is suitable for unconfined ocean disposal without further assessment.

The TBT data collected from within Dredge Compartment F, when separated from the remaining TBT data has a 95% UCL of the mean of normalised TBT of 36.0 µgSn/kg. The concentration of TBT within Dredge Compartment F of the Rosslyn Bay boat harbour therefore requires further assessment. This information is summarised in Table 4.2. The Pro-UCL output for these results is included in Appendix F.

Table 4.2 Results of 95% UCL calculations for TBT

Dredge Area	Number of TBT results	95% UCL of the mean normalised TBT
Dredge Compartment F	29	36.0 µgSn/kg
Proposed dredge area without Dredge Compartment F	68	2.5 µgSn/kg

No individual test result from within the proposed dredge area, aside from those which were shown to be outliers, exceeded the SQG-high value of 80 µgSn/kg (from Table 4 in Appendix A of the NAGD).

Based on the methodology for assessing the suitability of dredged material for unconfined ocean disposal (as shown in Figure 1.2), elutriate analysis of the dredge material was carried out and the results compared to the water quality guidelines.

4.4.1 Results of elutriate analysis on sediment in Dredge Compartment F

Elutriate analysis for TBT was undertaken on three sub-samples collected from within Dredge Compartment F of the Rosslyn Bay boat harbour. A water sample was collected outside of the entrance channel of the boat harbour which is considered to be representative of the water at the proposed disposal location, this sample was used for the elutriate analysis. The elutriate analysis was carried out by the primary laboratory in line with the NAGD methodology and is summarised in Table 4.3.

Table 4.3 Summary of elutriate TBT analysis

Sample number	# TBT replicates in sediment	Replicate analysis range (TBT in sediment) µgSn/kg	Mean TBT concentration in sediment µgSn/kg	Mean normalised TBT concentration in sediment µgSn/kg	Elutriate TBT analysis concentration in water µgSn/L	Comment
BH9A/0.0–0.5	7	13.0–69.0	24.5	36.2	0.035	1 x statistical outlier in sediment analysis
BH18/0.0–0.5	3	5.5–6.7	6.1	14.1	<0.003	Elutriate result below LOR
BH19/0.5–0.1	2	4.6–4.8	4.7	17.4	<0.003	Elutriate result below LOR

The results show that one sediment sample, which was representative of the location which reported the highest TBT concentrations within the proposed dredge area, returned a result from elutriate analysis above the LOR but nonetheless as a low concentration. Two samples with elevated TBT present produced elutriate TBT below detection limits (i.e. the TBT present in the sediment was not released into solution).

The elutriate TBT concentrations reported were compared to the relevant water quality guidelines. In this instance, for TBT, the relevant water quality guidelines were determined to be the ANZECC guidelines for toxicants. The 95 % level of protection is the recommended guideline for a slightly-to-moderately disturbed ecosystem (which is representative of the condition of the proposed receiving environment). The 95% species protection level trigger value for TBT in marine ecosystems is 0.006 µgSn/L. The two elutriate results below the LOR were below the 95% trigger value. The elutriate TBT concentration reported for sub sample BH9A/0.0–0.5 m of 0.035 µgSn/L is above the 95% protection level trigger value.

The sediment within Dredge Compartment F is marine silt and clay. The nature of these types of sediment is that TBT will typically remain bound to sediment during sediment re-suspension (such as occurs during disposal). The sub sample at BH9/0.0–0.5 m is specific to a small localised area of sediment with an elevated concentration of TBT. In practice this small volume of sediment will be mixed with a much larger volume of sediment (without elevated TBT) during the dredging process. The effect of this is that the two low elutriate test results will be representative of the prevailing behaviour of TBT in the receiving environment. The large majority of the sediment to be dredged is unlikely to release TBT into the water column during disposal at any significant concentration (as evidenced by two elutriate TBT result below the LOR despite reporting slightly elevated normalised TBT concentrations).

It is also of note that the elutriate concentration reported at BH9A/0.0–0.5 m is below the 80 % level of protection trigger value for TBT in marine ecosystems (0.05 µgSn/L). Given that this result is representative of the highest likely TBT concentration to be encountered within the dredge sediment, and the nature of the proposed dredging, it is not likely that there will be any significant concentration of TBT released into the water column during disposal.

As such, the proposed dredge sediment is considered suitable for unconfined ocean disposal.

4.5 RESULTS FROM ADDITIONAL TARGETED SAMPLING FOR PORE WATER ANALYSIS - 3 MARCH 2016

The laboratory analysis results from the March 2016 additional sampling included sediment TBT, elutriate TBT and pore water TBT in samples from the BH9 location where elevated concentrations of TBT were previously found. The results are tabulated alongside other results in Appendix B, while the full laboratory reports are presented in Appendix C.

The analysis completed showed that there was one subsample BH9 R2 that recorded an elevated TBT concentrations of 19.3 µgSn/L which provides a normalised result of 44.9 µgSn/L which is similar to results where isolated elevated TBT concentrations have been recorded in previous sampling programs. The other subsamples showed of TBT to be either below limit of reporting or at very low trace levels. Again, no individual test results from BH9 exceeded the SQG-high value of 80 µgSn/kg (from Table 4 in Appendix A of the NAGD).

Elutriate analysis and pore water analysis of the dredge material were also carried out and the results compared to the water quality guidelines.

For the elutriate analysis undertaken for the samples at BH9 all the results showed TBT concentrations were below limits of reporting for this contaminant, including for the sample that had elevated TBT in the sediment.

For the pore water analysis undertaken for the samples at BH9 all the results showed TBT concentrations were below limits of reporting for this contaminant. Again, this was also the case for the sample confirmed to contained elevated TBT in the sediment.

The results of the analysis are summarised below:

Table 4.4 Summary of additional TBT analysis results at BH9 for basic sediment analysis, elutriate and pore water

Location	Organotin Compounds	Organotin Compounds (Soluble)/Elutriate	Organotin Compounds (Soluble)/Pore Water
	Tributyltin (Normalised)	Tributyltin	Tributyltin
units	µgSn/kg	ngSn/L	ngSn/L
BH9 R1	7.4	<2	<2
BH9 R2	44.9	<2	<2
BH9 R3	4.7	<2	<2
BH9 R4	1.9	NA	NA
BH9 R4A (split sample)	2.3	NA	NA
BHX (R4 duplicated)	N/A	NA	<3

5 Conclusions

Sediment sampling and analysis was undertaken within the proposed areas to be dredged within the Rosslyn Bay boat harbour. The results of this investigation, along with previous results from sediment sampling and analysis provide chemical and physical characterisation of the sediments within the dredge area.

The analysis included key contaminants of concern. The contaminants selected for the investigation were based on the results of previous sediment investigations conducted within the harbour and the surrounding land uses and potential contamination sources identified. The key physical and chemical properties were compared with the recommended NAGD screening levels.

Particle size distribution indicates that the material proposed to be dredged would consist of silt, clay and sand in varying proportions. Sand content was highest in the entrance channel (Dredge Compartments A and A1) and close to the boat ramp (Dredge Compartment F). Clay and silt content tended to be higher in the dredge compartments close to boat moorings, where fine sediments could more easily settle. The physical appearance of the sediment to be dredged varies slightly in each dredge compartment, however the majority of material encountered during the sampling event was grey to dark grey silt and clay with fine sand, the underlying sediment in most areas was stiff light grey clay.

The results of chemical analysis of the sediment samples obtained from the Rosslyn Bay boat harbour indicated that the concentration of all metals, with the exception of nickel, were below the relevant NAGD screening level. The 95% upper confidence level of the mean concentration of nickel for all sub-samples was 23.52 mg/kg, which is above the 21 mg/kg NAGD screening level. The elevated concentration of nickel reported in the sediment is in line with previously reported concentrations from the boat harbour (22.66 mg/kg in 2011 and 22.97 mg/kg in 2005) and given the location of the boat harbour is not unusual. The cause of the elevated nickel concentration is attributed to geological characteristics found to occur naturally in central Queensland, this is noted in previous reports (FRC, 2011) and in the NAGD (DEWHA, 2009).

Analysis of sediments for the presence of organotin compounds identified tributyltin (TBT) is above the LOR of 0.5 µgSn/kg in a number of the sub-samples. The concentrations of TBT reported in some of individual sub-samples were elevated and warranted further investigation. In order to confirm the accuracy, concentration and extent of the elevated concentrations of TBT identified as part of the initial sampling program, additional sampling was carried out.

The results of the additional sampling and analysis confirmed isolated elevated TBT results in some sub-samples, however a majority of the proposed dredge area showed no considerable TBT present. The sediment sub-samples which generally exhibited elevated TBT results were largely from the southern portion of the boat harbour.

Sediment samples outside of Dredge Compartment F were characterised as 'probably clean', as they were unlikely to be impacted by elevated TBT. The 95% UCL of the mean of normalised TBT in the proposed dredge area without Dredge Compartment F is 2.5 µgSn/kg.

As elevated concentrations of TBT were identified in Dredge Compartment F, this portion of the dredge area was assessed separately. The 95% UCL of the mean of normalised TBT concentration in Dredge Compartment F is 36.0 µgSn/kg, as this result was above the NAGD screening level of 9 µgSn/kg, further analysis of the sediments from this area was undertaken in the form of elutriate analysis and subsequent pore water analysis.

The elutriate analysis of TBT from sediment from Dredge Compartment F showed that, TBT concentrations in the water column would typically not exceed the 95% species level of protection trigger value. The nature of the sediment is that TBT will typically remain bound to sediment during sediment re-suspension (evidenced by the majority of elutriate TBT results recording results below the LOR despite reporting slightly elevated normalised TBT concentrations).One elutriate test result from the December sampling program BH9A exceeded the 95%, but was within the 80% species protection level for TBT in marine environments. This sample was from an isolated location with elevated TBT in the sediment above what is representative of the majority of sediment in this location. In practice the small volume of sediment with elevated TBT will be mixed with a much larger volume of sediment (without elevated TBT) during the dredging process.

As per the NAGD guidelines (Figure 1.2) further bioavailability assessment was undertaken by completing further elutriate testing and pore water analysis on sediments from BH9, the location where elevated TBT concentrations were found. The elutriate and pore water TBT concentrations were compared to the relevant water quality guidelines. In this instance, for TBT, the relevant water quality guidelines were determined to be the ANZECC guidelines for toxicants. The 95 % level of protection is the recommended guideline for a slightly-to-moderately disturbed ecosystem (which is representative of the condition of the proposed receiving environment). The 95% species protection level trigger value for TBT in marine ecosystems is 0.006 µgSn/L.

All the pore water analysis undertaken reported results below the limit of reporting and below the water quality guidelines value, which indicates there is no TBT present within the pore water of the sediments at BH9 within dredge Area F.

Based on the results of sampling and analysis from the sediment investigation it is considered that the material to be dredged remains suitable for unconfined offshore disposal.

6 References

Department of Transport and Main Roads (TMR), 2015, *Tender Specification PMD 43/15 Sediment sampling and analysis - Rosslyn Bay boat harbour dredging 2015*

DEWHA, 2009. *National Assessment Guidelines for Dredging (NAGD),* Department of Environment, Water, Heritage and the Arts, Canberra

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frc environmental, 2011, *Rosslyn Bay boat harbour: Sediment Sampling & Analysis 2011*, report prepared for Department of Transport and Main Roads. ref 110609

GHD, 2005, *Rosslyn boat harbour Long-term Dredging Strategy, sediment sampling and analysis*, report prepared for Queensland Transport

KBR, 2015, *Rosslyn Bay boat harbour - Sampling and Analysis Plan*, report prepared for Queensland Transport

Appendix D

SEDIMENT CORE DESCRIPTIONS

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Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH1					
Sediment Core Location	**Easting**	273572	**Northing**	7437114	**Projection**	GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	12:55	[24 hour]
Tide height	1.25	[mLAT]
Measured water depth	2.8	[m]
Bed level	-1.55	[mLAT]
Target core depth	-3.3	[mLAT]
Core length required	1.75	[m]
Core length retrieved	2.4	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.5 m	Silty SAND	fine to medium grained, grey	-
0.5 - 2.3 m	Silty SAND	medium firm, fine to medium grained, grey	-
2.3 - 2.4 m	Sandy CLAY	Light grey clay with orange/brown mottling, fine grained, becoming stiff	-
2.4 m	Refusal	Refusal at 2.4 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH1/0-0.5	Primary + TPH	ES15311905-002
BH1/0.5-1	Primary	ES15311905-003
BH1/1-1.6	Primary	ES15311905-004
BH1/1.6-1.7	Storage	ES15311905-005
BHX (duplicate of BH1/0-0.5)	Primary - PSD (QA/QC)	ES15311905-041
240915 (split of BH1/0-0.5)	Primary - PSD (QA/QC)	ES15311905-001

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH2					
Sediment Core Location	**Easting**	273665	**Northing**	7437064	**Projection**	GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	13:10	[24 hour]
Tide height	1.35	[mLAT]
Measured water depth	2.6	[m]
Bed level	-1.25	[mLAT]
Target core depth	-3.3	[mLAT]
Core length required	2.05	[m]
Core length retrieved	1.9	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.2 m	Silty SAND	Light brown, sticky, fine grained	-
0.2 - 1.9 m	Clayey Silty SAND	Grey, sticky, medium soft, fine grained	-
1.9 m	Refusal	Resusal at 1.9 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH2/0-0.5	Primary + TPH	ES15311905-006
BH2/0.5-1	Primary	ES15311905-007
BH2/1-1.9	Primary	ES15311905-008

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID BH3

Sediment Core Location **Eastings** 273756 **Northings** 7436944 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	11:10	[24 hour]
Tide height	1.0	[mLAT]
Measured water depth	2.0	[m]
Bed level	-1.0	[mLAT]
Target core depth	-2.5	[mLAT]
Core length required	1.5	[m]
Core length retrieved	2.0	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.3 m	Sandy Clayey SILT	soft, grey, fine grained - sand content increasing with depth	-
1.3 - 1.5 m	Silty Clayey SAND	grey, fine grained, becoming firm	-
1.5 - 1.55 m	SHELL	Coase shell fragments, white	-
1.55 - 2.0 m	Sandy CLAY	Light grey, fine grained, becoming stiff	-
2.0 m	Refusal	Resusal at 2.0 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH3/0-0.5	Primary + TPH	ES15311905-009
BH3/0.5-1	Primary	ES15311905-010
BH3/1-1.5	Primary	ES15311905-011
BH3/1.5-2.0	Storage	-

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH4						
Sediment Core Location		**Easting**	273718	**Northings**	7436884	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	10:55	[24 hour]
Tide height	1.03	[mLAT]
Measured water depth	2.1	[m]
Bed level	-1.1	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.6	[m]
Core length retrieved	1.6	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.2 m	Clayey SAND	fine grained, grey, soft and sticky	-
0.2 - 1.4 m	Clayey SAND	grey, fine to medium grianed, medium soft. Sand content increasing with depth	-
1.4 - 1.6 m	Sandy CLAY	Light grey, fine grained, stiff clay	-
1.6 m	Refusal	Refusal at 1.6 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH4/0 - 0.5	Primary + TPH	ES15311905-012
BH4/0.5 - 1	Primary	ES15311905-013
BH4/1.0 - 1.5	Primary	ES15311905-014

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Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID BH5

Sediment Core Location **Eastings** 273688 **Northings** 7436937 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	13:35	[24 hour]
Tide height	1.1	[mLAT]
Measured water depth	2.6	[m]
Bed level	-1.5	[mLAT]
Target core depth	-2.2	[mLAT]
Core length required	0.7	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.2 m	Silty SAND	fine grained, grey-brown, loose, sticky	-
0.2 - 1.3 m	Sandy CLAY	fine grained, grey, medium soft	-
1.3 - 1.5 m	Sandy CLAY	fine grained, light grey, stiff	-
1.5 m	Refusal	refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH5/0-0.2	Primary - no PSD	ES15311905-015
BH5/0.2-0.7	Primary	ES15311905-016
BH5/0.7-1.0	Storage	-

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Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH6					
Sediment Core Location	**Easting**	273597	**Northing**	7436984	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	13:20	[24 hour]
Tide height	1.45	[mLAT]
Measured water depth	3.0	[m]
Bed level	-1.55	[mLAT]
Target core depth	-3.4	[mLAT]
Core length required	1.85	[m]
Core length retrieved	1.1	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.9 m	Sandy silty CLAY	fine to medium grained, grey, soft, sticky	-
0.9 - 1.0 m	SHELL	Coase shell fragments, white	-
1.0 - 1.1 m	Sandy CLAY	Light grey, fine grained, becoming stiff	-
1.1 m	Refusal	Refusal at 1.1 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH6/0-0.5	Primary	ES15311905-018
BH6/0.5-0.9	Primary	ES15311905-019
BH6/0.9-1.1	Primary	ES15311905-020

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH7A						
Sediment Core Location		**Eastings**	273667	**Northings**	7436734	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	9:50	[24 hour]
Tide height	1.6	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.1	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.6	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.6 m	Silty sandy CLAY	Grey, fine grianed, loose	-
0.6 - 0.8 m	Sandy CLAY	Grey, fine to medium grained, becoming firm	-
0.8 - 1.3 m	Clayey SAND	Grey, fine grained, some organic matter present, firm	-
1.3 - 1.5 m	Sandy CLAY	Light grey clay with orange/brown mottling, fine grained, becoming stiff	-
1.5 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH7A/0 - 0.5	Primary+TPH	ES15311905-021
BH7A/0.5 - 1	Primary	ES15311905-024
BH7A/1.0 - 1.5	Primary	ES15311905-027

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH7B						
Sediment Core Location		**Eastings**	273667	**Northings**	7436734	**Projection**	GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	9:58	[24 hour]
Tide height	1.6	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.1	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.6	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.6 m	Silty sandy CLAY	Grey, fine grianed, loose	-
0.6 - 0.8 m	Sandy CLAY	Grey, fine to medium grained, becoming firm	-
0.8 - 1.3 m	Clayey SAND	Grey, fine grained, some organic matter present, firm	-
1.3 - 1.5 m	Sandy CLAY	Light grey clay with orange/brown mottling, fine grained, becoming stiff	-
1.5 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH7B/0 - 0.5	Primary+TPH	ES15311905-022
BH7B/0.5 - 1	Primary	ES15311905-025
BH7B/1.0 - 1.5	Primary	ES15311905-028

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Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID BH7C

Sediment Core Location **Eastings** 273667 **Northings** 7436734 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	10:06	[24 hour]
Tide height	1.6	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.1	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.6	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.6 m	Silty sandy CLAY	Grey, fine grianed, loose	-
0.6 - 0.8 m	Sandy CLAY	Grey, fine to medium grained, becoming firm	-
0.8 - 1.3 m	Clayey SAND	Grey, fine grained, some organic matter present, firm	-
1.3 - 1.5 m	Sandy CLAY	Light grey clay with orange/brown mottling, fine grained, becoming stiff	-
1.5 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH7C/0 - 0.5	Primary+TPH	ES15311905-023
BH7C/0.5 - 1	Primary	ES15311905-026
BH7C/1.0 - 1.5	Primary	ES15311905-029

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID BH8

Sediment Core Location **Eastings** 273644 **Northings** 7436850 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	13:40	[24 hour]
Tide height	1.1	[mLAT]
Measured water depth	3	[m]
Bed level	-1.9	[mLAT]
Target core depth	-3.4	[mLAT]
Core length required	1.5	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Sandy silty CLAY	Grey, fine grianed, loose	-
0.7 - 0.9 m	Sandy silty CLAY	Grey, fine grained, medium soft, sticky	-
0.9 - 1.0 m	CLAY	Light grey, firm	-
1.0 - 1.3 m	Sandy silty CLAY	Grey, fine grained, becoming stiff	-
1.3 - 1.5 m	CLAY	Light grey, stiff	
1.5 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH8/0-0.5	Primary+TPH	ES15311905-030
BH8/0.5-1	Primary	ES15311905-031
BH8/1-1.4	Primary	ES15311905-032

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID	BH9						
Sediment Core Location		**Eastings**	273718	**Northings**	7436884	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	9:20	[24 hour]
Tide height	1.95	[mLAT]
Measured water depth	3	[m]
Bed level	-1.05	[mLAT]
Target core depth	-2.2	[mLAT]
Core length required	1.15	[m]
Core length retrieved	1.3	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Clayey SAND	Dark grey, very fine grained, loose sticky	-
0.7 - 1.0 m	Clayey SAND	Dark grey, fine to medium grained, soft, traces of coarse material	-
1.0 - 1.2 m	Clayey SAND	Gark grey, fine to medium grianed, becoming firm	-
1.2 - 1.3 m	Sandy CLAY	Light grey, fine grained, becoming stiff	-
1.3 m	Refusal	Refusal at 1.3 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH9/0-0.5	Primary+TPH	ES15311905-030
BH9/0.5-1	Primary	ES15311905-031
BH9/1-1.4	Primary	ES15311905-032

KBR

Job Number	BEN 557	**Date**	24/09/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & CE		

Sediment Core ID BH10B

Sediment Core Location **Eastings** 273576 **Northings** 7436751 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	12:45	[24 hour]
Tide height	1.15	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.35	[mLAT]
Target core depth	-3.4	[mLAT]
Core length required	2.05	[m]
Core length retrieved	1.7	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.3 m	Silty sandy CLAY	Grey, fine grianed, loose	-
0.3 - 1.6 m	Sandy silty CLAY	Grey, fine grained, medium soft, sticky	-
1.6 - 1.7 m	Sandy CLAY	Light grey clay with orange/brown mottling, fine grained, stiff	-
1.7 m	Refusal	Refusal at 1.7 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH10B/0 - 0.5	Primary+TPH	ES15311905-038
BH10B/0.5 - 1.0	Primary	ES15311905-039
BH10B/1.0 - 1.7	Primary	ES15311905-040

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH4A						
Sediment Core Location		**Easting**	273719	**Northings**	7436888	**Projection**	GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	13:15	[24 hour]
Tide height	1.2	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.3	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.4	[m]
Core length retrieved	1.1	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Clayey SAND	grey, fine to medium grained, loose	-
1.0 - 1.1 m	CLAY	grey, stiff. Sand content increasing with depth	-
1.1 m	Refusal	Refusal at 1.1 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH4/0 - 0.5	TBT	Primary + Secondary
BH4/0.5 - 1	TBT	Primary + Secondary
BH4/1.0 - 1.5	TBT	Primary + Secondary

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH11

Sediment Core Location **Easting** 273723 **Northings** 7436893 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	13:30	[24 hour]
Tide height	1.1	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.4	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.3	[m]
Core length retrieved	1.2	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.8 m	Sandy silty CLAY	grey, fine to medium grained, soft, loose	-
0.8 - 1.1	Sandy CLAY	grey, fine to medium grained, medium soft	-
1.1 - 1.2 m	CLAY	grey, stiff	-
1.2 m	Refusal	Refusal at 1.2 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH11/0 - 0.4	TBT	Primary + Secondary
BH11/0.4 - 0.8	TBT	Primary + Secondary
BH11/0.8 - 1.1	TBT	Primary + Secondary
BH11/1.1 - 1.2	STORAGE	Primary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH12						
Sediment Core Location		**Easting**	273714	**Northings**	7436888	**Projection**	GDA'94 Zone 56K
Core retrieval method		Vibrocorer					

Time at site	13:35	[24 hour]
Tide height	1.1	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1.4	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.3	[m]
Core length retrieved	1.1	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.8 m	Sandy silty CLAY	grey, fine to medium grained, soft, loose	-
0.8 - 1.0	Sandy CLAY	grey, fine to medium grained, medium soft	-
1.0 - 1.1 m	CLAY	grey, stiff	-
1.1 m	Refusal	Refusal at 1.1 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH12/0 - 0.4	TBT	Primary + Secondary
BH12/0.4 - 0.8	TBT	Primary + Secondary
BH12/0.8 - 1.0	TBT	Primary + Secondary
BH12/1.0 - 1.1	STORAGE	Primary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH13						
Sediment Core Location		**Easting**	273710	**Northings**	7436873	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	13:10	[24 hour]
Tide height	1.2	[mLAT]
Measured water depth	2.6	[m]
Bed level	-1.4	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.3	[m]
Core length retrieved	1.1	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Silty Sandy CLAY	dark grey, loose, sticky, fine grained sand	-
1.0 - 1.1 m	Sandy CLAY	grey, stiff, fine grained sand	-
1.1 m	Refusal	Refusal at 1.1 m on stiff clay	-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH13/0 - 0.4	TBT	Primary + Secondary
BH13/0.4 - 0.8	TBT	Primary + Secondary
BH13/0.8 - 1.0	TBT	Primary + Secondary
BH13/1.0 - 1.1	STORAGE	Primary

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH7A

Sediment Core Location **Eastings** 273657 **Northings** 7436739 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	11:10	[24 hour]
Tide height	2	[mLAT]
Measured water depth	2.8	[m]
Bed level	-0.8	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.9	[m]
Core length retrieved	1.7	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Silty sandy CLAY	Grey, fine grianed, loose	-
0.7 - 1.5 m	Sandy CLAY	Grey, fine to medium grained, medium firm, sand content increasing	-
1.5 - 1.7 m	CLAY	Light brown/grey, becoming stiff	-
1.7 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH7/0 - 0.5	TBT	Primary + Secondary
BHZ (7/0.0-0.5)	TBT	Primary
BH7/0.5 - 1	TBT	Primary + Secondary
BH7/1 - 1.5	TBT	Primary + Secondary
BH7/1.5 - 1.7	STORAGE	Primary + Secondary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH14					
Sediment Core Location	**Eastings**	273669	**Northings**	7436751	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	11:45	[24 hour]
Tide height	1.7	[mLAT]
Measured water depth	2.9	[m]
Bed level	-1.2	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.5	[m]
Core length retrieved	1.5	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.3 m	Silty sandy CLAY	Grey, fine grianed, loose	-
1.3 - 1.5 m	Sandy CLAY	Light grey, fine grained, becoming stiff	-
1.5 m	Refusal	Refusal at 1.5 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH14/0.0 - 0.5	TBT	Primary + Secondary
BH14/0.5 - 1.0	TBT	Primary + Secondary
BH14/1.0 - 1.3	TBT	Primary + Secondary
BH14/1.3 - 1.5	STORAGE	Primary + Secondary

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH15

Sediment Core Location **Eastings** 273668 **Northings** 7436756 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	11:30	[24 hour]
Tide height	1.9	[mLAT]
Measured water depth	3.4	[m]
Bed level	-1.5	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.2	[m]
Core length retrieved	1.2	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Silty sandy CLAY	Grey, fine grianed, loose, sticky	-
0.7 - 1.0 m	CLAY	Grey, sticky, marine clay	-
1.0 - 1.2 m	CLAY	Light grey, becoming stiff	-
1.2 m	Refusal	Refusal at 1.2 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH15/0.0 - 0.5	TBT	Primary + Secondary
BH15/0.5 - 0.7	TBT	Primary + Secondary
BH15/0.7 - 1.0	TBT	Primary + Secondary
BH15/1.0 - 1.2	STORAGE	Primary + Secondary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH16

Sediment Core Location **Eastings** 273656 **Northings** 7436739 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	11:10	[24 hour]
Tide height	2.3	[mLAT]
Measured water depth	3.6	[m]
Bed level	-1.3	[mLAT]
Target core depth	-2.7	[mLAT]
Core length required	1.4	[m]
Core length retrieved	1.2	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Silty clayey SAND	Grey, fine grianed, loose	-
1.0 - 1.2 m	Clayey SAND	Light grey, fine to medium grained, becoming stiff	-
1.2 m	Refusal	Refusal at 1.2 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH16/0.0 - 0.5	TBT	Primary + Secondary
BH16/0.5 - 0.9	TBT	Primary + Secondary
BH16/0.9 - 1.0	TBT	Primary
BH16/1.0 - 1.2	TBT	Secondary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH9A

Sediment Core Location **Eastings** 273596 **Northings** 7436639 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	9:34	[24 hour]
Tide height	3.1	[mLAT]
Measured water depth	4.3	[m]
Bed level	-1.2	[mLAT]
Target core depth	-2.4	[mLAT]
Core length required	1.2	[m]
Core length retrieved	1.3	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Clayey Silty SAND	Dark grey, fine grained, loose, sticky	trace gravel
0.7 - 1.1 m	Sandy CLAY	Light grey, fine rained, medium-firm	-
1.1 - 1.3 m	Sandy CLAY	Light grey, clay content incresing, becoming stiff	-
1.3 m	Refusal	Refusal at 1.3 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH9/0-0.5	TBT	Primary + Secondary
BHX (9/0-0.5)	TBT	Primary
BH9/0.5-0.7	TBT	Primary + Secondary
BH9/0.7-1.1	TBT	Primary + Secondary

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH17						
Sediment Core Location		**Eastings**	273596	**Northings**	7436644	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	9:55	[24 hour]
Tide height	2.9	[mLAT]
Measured water depth	4	[m]
Bed level	-1.1	[mLAT]
Target core depth	-2.4	[mLAT]
Core length required	1.3	[m]
Core length retrieved	1	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.9 m	Clayey SAND	Grey, fine to medium grained, loose, some silt	
0.9 - 1.0 m	Sandy CLAY	Light grey, fine grained, clay content incresing, becoming stiff	
1.0 m	Refusal	Refusal at 1.0 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH17/0-0.5	TBT	Primary + Secondary
BH17/0.5-0.8	TBT	Primary + Secondary
BH17/0.8-1.0	TBT	Primary + Secondary

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID	BH18						
Sediment Core Location		**Eastings**	273596	**Northings**	7436639	**Projection**	GDA'94 Zone 56K

Core retrieval method	Vibrocorer	
Time at site	10:20	[24 hour]
Tide height	2.6	[mLAT]
Measured water depth	3.6	[m]
Bed level	-1	[mLAT]
Target core depth	-2.4	[mLAT]
Core length required	1.4	[m]
Core length retrieved	1.4	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Silty SAND	Dark grey, loose, sticky, fine grained	
1.0 - 1.3 m	Clayey SAND	Grey, fine grained, clay content incresing	
1.3 - 1.4 m	CLAY	Light brown, stiff	trace gravel
1.4 m	Refusal	Refusal at 1.4 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH18/0-0.5	TBT	Primary + Secondary
BH18/0.5-0.9	TBT	Primary + Secondary
BH18/0.9-1.4	TBT	Primary + Secondary

KBR

Job Number	BEN 557	**Date**	8/12/2015
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	GR & KW		

Sediment Core ID BH19

Sediment Core Location **Eastings** 273583 **Northings** 7436632 **Projection** GDA'94 Zone 56K

Core retrieval method Vibrocorer

Time at site	10:15	[24 hour]
Tide height	2.7	[mLAT]
Measured water depth	3.5	[m]
Bed level	-0.8	[mLAT]
Target core depth	-2.4	[mLAT]
Core length required	1.6	[m]
Core length retrieved	1.7	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Silty Clayey SAND	Grey, fine to medium grained, loose	
1.0 - 1.5 m	Clayey SAND	Grey, fine grained, moderatley firm	
1.5 - 1.7 m	CLAY	Grey/brown, becoming stiff	trace gravel
1.7 m	Refusal	Refusal at 1.7 m on stiff clay	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH19/0-0.5	TBT	Primary + Secondary
BH19/0.5-1.0	TBT	Primary + Secondary
BH19/1.0-1.5	TBT	Primary + Secondary

KBR

Job Number	BEN 557	**Date**	3/03/2016
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	KW & JH		

Sediment Core ID BH9

Sediment Core Location **Eastings** 273718 **Northings** 7436884 **Projection** GDA'94 Zone 56K

Core retrieval method piston

Time at site	8:15	[24 hour]
Tide height	1.5	[mLAT]
Measured water depth	2.7	[m]
Bed level	-1.2	[mLAT]
Target core depth	-1.9	[mLAT]
Core length required	0.7	[m]
Core length retrieved	1	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.7 m	Clayey SAND	Dark grey, very fine grained, loose sticky	-
			-
			-
			-

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory ID
BH9/0-0.7	Basic TBT, Elutriate, Pore Wa	EB1606107

Job Number	BEN 557	**Date**	3/03/2016
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	KW &JH		

Sediment Core ID	BH17						
Sediment Core Location		**Eastings**	273596	**Northings**	7436644	**Projection**	GDA'94 Zone 56K

Core retrieval method	Piston	
Time at site	13:30	[24 hour]
Tide height	1.8	[mLAT]
Measured water depth	2.9	[m]
Bed level	-1.1	[mLAT]
Target core depth	-1.9	[mLAT]
Core length required	0.8	[m]
Core length retrieved	0.8	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.9 m	Clayey SAND	Grey, fine to medium grained, loose, some silt	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH17/0-0.9	TBT	Storage

Job Number	BEN 557	**Date**	3/03/2016
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	KW & JH		

Sediment Core ID	BH18						
Sediment Core Location		**Eastings**	273596	**Northings**	7436639	**Projection**	GDA'94 Zone 56K

Core retrieval method	Piston	
Time at site	12:05	[24 hour]
Tide height	1.5	[mLAT]
Measured water depth	2.5	[m]
Bed level	-1	[mLAT]
Target core depth	-1.9	[mLAT]
Core length required	0.9	[m]
Core length retrieved	0.9	[m]

Interval	Particle Size	Physical Description	Other
0 - 0.9 m	Silty SAND	Dark grey, loose, sticky, fine grained	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH18/0-0.9	TBT	Storage

KBR

Job Number	BEN 557	**Date**	3/03/2016
Job Name	Rosslyn Bay Boat Harbour		
Recorded by	KW & JH		

Sediment Core ID BH19

Sediment Core Location **Eastings** 273583 **Northings** 7436632 **Projection** GDA'94 Zone 56K

Core retrieval method Piston

Time at site	11:00	[24 hour]
Tide height	1.5	[mLAT]
Measured water depth	2.4	[m]
Bed level	-0.9	[mLAT]
Target core depth	-1.9	[mLAT]
Core length required	1	[m]
Core length retrieved	1	[m]

Interval	Particle Size	Physical Description	Other
0 - 1.0 m	Silty Clayey SAND	Grey, fine to medium grained, loose	

Summary of sediment sample collection and analysis

Samples Collected	Analysis Parameters	Laboratory
BH19/0-1.0	TBT	Storage

Appendix E

SEDIMENT CORE PHOTOGRAPHS

Bore Hole 1 - Page 1 of 2


1.3m
1.5m
Max Dredge Depth
MARINE SEDIMENT CORE SAMPLING
PROJECT: ROSSLYN BAY
PROJECT NUMBER: BEN557
CORE NUMBER: BH1
DATE: 24.4.15
TIME: 13:50
CORE LENGTH: 2.4


0.0m
BH2
0.5m
0.7m
1.0m
MARINE SEDIMENT CORE SAMPLING
PROJECT: ROSSLYN BAY
PROJECT NUMBER: BEN557
CORE NUMBER: BH2
DATE: 24.4.15
TIME: 14:45
CORE LENGTH: 1.9

Bore Hole 2 - Page 2 of 2

Bore Hole 3 - Page 1 of 1

Bore Hole 4 - Page 1 of 1

Bore Hole 5 - Page 1 of 1

Bore Hole 6 - Page 1 of 1

Bore Hole 7A - Page 1 of 1

Bore Hole 7B - Page 1 of 1


0.0m
BH7
0.5m
0.7m
1.0m
MAX Dredge Depth
1.3m
MARINE SEDIMENT CORE SAMPLING
PROJECT: ROSSLYN BAY
PROJECT NUMBER: BEN557
CORE NUMBER: BH7C
DATE: 24/09/15
TIME: 13:25
CORE LENGTH: 1.5

Bore Hole 8 - Page 1 of 1

Bore Hole 9 - Page 1 of 1

Bore Hole 10B - Page 1 of 2


5m
0.7m
1.0m
1.3m
1.5m
MARINE SEDIMENT CORE SAMPLING
PROJECT: ROSSLYN BAY
PROJECT NUMBER: BEN557
CORE NUMBER: BH 10B
DATE: 24.4.15
TIME: 13:50
CORE LENGTH: 1.7

Bore Hole 9 - Page 1 of 1

Bore Hole 17 - Page 1 of 1

Bore Hole 18 - Page 1 of 1

Bore Hole 19 - Page 1 of 1

Appendix F

SEDIMENT ANALYSIS STATISTICS

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Full Data Sets from all areas excluding Dredge Compartment F											
2												
3	User Selected Options											
4	Date/Time of Computation			2/02/2016 11:37:05 AM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Remi											
12												
13	General Statistics											
14	Total Number of Observations					35	Number of Distinct Observations					25
15							Number of Missing Observations					0
16	Minimum					0.3	Mean					1.362
17	Maximum					7.33	Median					0.53
18	SD					1.594	Std. Error of Mean					0.269
19	Coefficient of Variation					1.17	Skewness					2.487
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic					0.659	Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value					0.934	Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic					0.271	Lilliefors GOF Test					
25	5% Lilliefors Critical Value					0.15	Data Not Normal at 5% Significance Level					
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
30	95% Student's-t UCL					1.818	95% Adjusted-CLT UCL (Chen-1995)					1.926
31							95% Modified-t UCL (Johnson-1978)					1.837
32												
33	Gamma GOF Test											
34	A-D Test Statistic					2.504	Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value					0.771	Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic					0.3	Kolmogrov-Smirnoff Gamma GOF Test					
37	5% K-S Critical Value					0.152	Data Not Gamma Distributed at 5% Significance Level					
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)					1.277	k star (bias corrected MLE)					1.187
42	Theta hat (MLE)					1.067	Theta star (bias corrected MLE)					1.148
43	nu hat (MLE)					89.41	nu star (bias corrected)					83.08
44	MLE Mean (bias corrected)					1.362	MLE Sd (bias corrected)					1.25
45							Approximate Chi Square Value (0.05)					63.08
46	Adjusted Level of Significance					0.0425	Adjusted Chi Square Value					62.25
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))					1.794	95% Adjusted Gamma UCL (use when n<50)					1.818
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic					0.864	Shapiro Wilk Lognormal GOF Test					
53	5% Shapiro Wilk Critical Value					0.934	Data Not Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic					0.288	Lilliefors Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L
55					5% Lilliefors Critical Value	0.15	Data Not Lognormal at 5% Significance Level					
56	Data Not Lognormal at 5% Significance Level											
57												
58	Lognormal Statistics											
59					Minimum of Logged Data	-1.204					Mean of logged Data	-0.131
60					Maximum of Logged Data	1.992					SD of logged Data	0.88
61												
62	Assuming Lognormal Distribution											
63					95% H-UCL	1.833					90% Chebyshev (MVUE) UCL	1.914
64					95% Chebyshev (MVUE) UCL	2.204					97.5% Chebyshev (MVUE) UCL	2.607
65					99% Chebyshev (MVUE) UCL	3.398						
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data do not follow a Discernible Distribution (0.05)											
69												
70	Nonparametric Distribution Free UCLs											
71					95% CLT UCL	1.805					95% Jackknife UCL	1.818
72					95% Standard Bootstrap UCL	1.812					95% Bootstrap-t UCL	2.112
73					95% Hall's Bootstrap UCL	2.299					95% Percentile Bootstrap UCL	1.837
74					95% BCA Bootstrap UCL	1.955						
75					90% Chebyshev(Mean, Sd) UCL	2.17					95% Chebyshev(Mean, Sd) UCL	2.536
76					97.5% Chebyshev(Mean, Sd) UCL	3.044					99% Chebyshev(Mean, Sd) UCL	4.042
77												
78	Suggested UCL to Use											
79					95% Chebyshev (Mean, Sd) UCL	2.536						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
84	For additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Data Set from within Dredge Compartment F

User Selected Options	
Date/Time of Computation	2/02/2016 11:37:26 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

BR

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	8.91	Mean	27.88
Maximum	48.08	Median	29.85
SD	14.09	Std. Error of Mean	4.455
Coefficient of Variation	0.505	Skewness	-0.0467

Normal GOF Test

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.28	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	36.04	95% Adjusted-CLT UCL (Chen-1995)	35.13
		95% Modified-t UCL (Johnson-1978)	36.03

Gamma GOF Test

A-D Test Statistic	0.512	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.73	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.661	k star (bias corrected MLE)	2.63
Theta hat (MLE)	7.613	Theta star (bias corrected MLE)	10.6
nu hat (MLE)	73.23	nu star (bias corrected)	52.59
MLE Mean (bias corrected)	27.88	MLE Sd (bias corrected)	17.19
		Approximate Chi Square Value (0.05)	36.93
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	34.66

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	39.69	95% Adjusted Gamma UCL (use when n<50)	42.29

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors Lognormal GOF Test**

	A	B	C	D	E	F	G	H	I	J	K	L
55					5% Lilliefors Critical Value	0.28					Data appear Lognormal at 5% Significance Level	
56	**Data appear Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	2.187					Mean of logged Data	3.185
60					Maximum of Logged Data	3.873					SD of logged Data	0.595
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	46.08					90% Chebyshev (MVUE) UCL	44.63
64					95% Chebyshev (MVUE) UCL	52.04					97.5% Chebyshev (MVUE) UCL	62.32
65					99% Chebyshev (MVUE) UCL	82.52						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	35.2					95% Jackknife UCL	36.04
72					95% Standard Bootstrap UCL	34.96					95% Bootstrap-t UCL	35.33
73					95% Hall's Bootstrap UCL	34.05					95% Percentile Bootstrap UCL	34.66
74					95% BCA Bootstrap UCL	35.21						
75					90% Chebyshev(Mean, Sd) UCL	41.24					95% Chebyshev(Mean, Sd) UCL	47.3
76					97.5% Chebyshev(Mean, Sd) UCL	55.7					99% Chebyshev(Mean, Sd) UCL	72.21
77												
78	**Suggested UCL to Use**											
79					95% Student's-t UCL	36.04						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
84	For additional insight the user may want to consult a statistician.											
85												
86	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
87	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
88												

Appendix D - specific EMP attachments

D1 - Dredge Campaign Specific Environmental Management Plan Checklist

D2 - Complaint Record Form

D3 – Incident Report / Corrective Action Request

D4 – Project Contacts List

D5 –Oil Pollution Emergency Plan

D6 - Cyclone Emergency Plan

Appendix D1 - Dredge Campaign Specific Environmental Management Plan Checklist

Purpose
As part of any dredging contract under this EMP the dredge contractor will be required to include the methodologies and procedures they have in place to meet the objects of the Environmental Management Plan. This is an essential element to complete the EMP.

Elements to be included;

- Description of Works (See section 1.5 in the EMP) – scope, equipment specifications, methods, contractor details
- Highlight any environmental risks associated with these methods and how they will be avoided/mitigated.

Address each of the Management Strategies in the EMP –

2.1 Marine flora and fauna

- Detail how strategies will be met for the specific plant

2.2 Water Quality

- Detail how strategies will be met for the specific plant

2.3 Waste management

- Detail how waste will be managed and strategies achieved

2.4 Spill Response and Emergency Procedures

- Provide a detailed Spill Response and Emergency Procedures document (including oil spill and cyclone/storm whether procedures)

2.5 Noise and air quality

- Detail how strategies will be met for the specific plant

2.6 Environmental Management Plan procedures

- Confirm that EMP procedures will be followed via signing off on the document when it is finalised.

Appendix D2 - Complaint and Response Form (EM11)

Date reported:	Time Reported:	Reporting method: (eg phone)
Name of Complainant	Contact details	Staff involved:
(If no details given, note this)		

The Incident:

Description of incident/complaint:
If there is an immediate threat to human health or property, dial 000.
Likely source:
Action taken:
If no action taken, provide reasons.

Follow up:

What contributed to the incident?
Suggestions / Prevention:
Was the person registering the complaint contacted back and what information was given?

Division Manager:	Sign:	Date:
QES:	Sign:	Date:
Managing Director:	Sign:	Date:

This record must be kept for at least four years from the date of the complaint.

APPENDIX D5

Fuel Transfer Procedures (Tanker – Vessel)

Refuelling to only be undertaken during daylight hours,

Safety Issues to be considered:

- Relocation of dredge/barge to wharf, workboat assistance
- Ensure dredge/barge is secure at all times
- Access of tanker to refuelling location
- No smoking

Environmental Issues to be considered:

- Spill kit to be onboard dredge/barge at all times, additional spill kit onshore, check contents
- Maintain grip on the filling nozzle at all times
- Check all hoses and fittings for damage and potential leaks
- Ensure there is sufficient space in the receiving tank for the volume to be transferred

Transfer Procedure

- Dredge/barge to be securely moored during the refuelling procedure.
- Determine the volume to be transferred (confirm with tanker driver), ensure that the dredge/barge tank(s) has sufficient volume for the proposed transfer amount.
- Confirm communication signals for stopping and starting the transfer pump with the truck driver to ensure reliable communication during the transfer. Extend the transfer hose from the tanker to the dredge/barge fuel tank.
- Place the fuel discharge nozzle in the filling pipe of the selected fuel tank. Ensure all hose connections are secure.
- Open the filling nozzle by holding the trigger. Advise the tanker driver to start the fuel transfer pump. Check for any leaks.
- Maintain a constant grip on the filling nozzle. The nozzle is NOT to be left unattended during the fuel transfer.
- Constantly check the amount in the tank. As the tank level approaches the desired volume signal to the driver to slow down the transfer pump.
- Stop the transfer pump when the planned volume has been transferred or the tank reaches its desired maximum operating level.
- When the transfer pump has been stopped, close the fuel nozzle and remove it from the filling pipe. Hold the nozzle upright to prevent spillage. Replace all caps to fuel tanks or other openings.
- On completion of the transfer, return the transfer hose to the tanker holding the nozzle up to prevent any spillage.

Fuel Transfer from Vessel to Vessel.

Refuelling to only be undertaken during day light hours and calm sea state.

Safety Issues to be considered;

- Relocation of vessel, workboat assistance
- Moving around on vessels
- Operation of gen set
- No smoking
- Ensure each vessel is secured at all times

Environmental Issues to be considered;

- Spill kit to be onboard the each vessel, check contents
- Maintain grip on the filling nozzle at all times
- Check all hoses and fittings for damage and potential leaks
- Ensure there is sufficient space in the receiving tank for the volume to be transferred

Transfer Procedure

- Move the vessels and securely moor fore and aft to each other.
- Determine the volume to be transferred, ensure that the receiving vessel tanks have sufficient volume for the proposed transfer amount.
- Determine the volume to be transferred from each tank in the supply vessel.
- Fit transfer pump suction hose to the selected supply tank.
- Place the fuel discharge nozzle in the filling pipe of the selected fuel tank to be filled. Ensure all hose connections are secure. All fuel tank fillings are bunded to capture any spillage or leaks to prevent runoff into waterway.
- Start the fuel transfer pump. Check for any leaks.
- Operate the fuel filling nozzle and maintain a constant grip on the filling nozzle. The nozzle is not to be left unattended during the fuel transfer.
- Constantly check the amount in the tank and confirm volume received from the supply tanks. As the receiving tank level approaches the desired volume slow down the transfer rate.
- Stop the flow by closing the fuel nozzle when the planned volume has been transferred or the tank reaches its desired maximum operating level. Stop the transfer pump. Remove the nozzle from the filling pipe, hold the nozzle upright to prevent spillage and return to the supply vessel.
- Disconnect transfer pump suction hose and stow or secure all equipment.
- Return supply vessel to shore or mooring.

Spill Response Procedures

All spills must be reported to the Site Supervisor.

Spill Kits are located on the Dredge, and at the site compound.

Each Kit contains the following items stored in the dedicated 240L wheelie bin;

- 6 x 3m long connecting floating absorbent booms
- 50 x Oil sorbent pads
- 2 pair of Gloves
- 2 x 20m rolls of poly rope
- 6 x disposal bags

A quick response is critical to prevent environmental damage.

1. Stop the source of the spill.
2. Contain and restrict the spread of the spill.
    - Deploy booms to surround the spill. The booms are absorbent, however if the spill is too large to be absorbed by the booms use sorbent pads to recover the remaining oil within the contained area.
    - Be aware of the effects of wind, and waves on dispersal of the spill.
    - Extra care should be taken when working from boats.

Once initial control is established, or if immediate assistance is required, all spills are to be promptly notified to the Site Supervisor who will notify the Principal's Representative as required.

The best method of spill management is prevention.

All personnel need to be vigilant and careful when refuelling and servicing machinery and equipment.

APPENDIX D6 – Cyclone Emergency Plan

PRE CYCLONE SEASON CHECKS

- Consult with Harbour Controller and Marina Owner regarding their cyclone emergency procedures and how dredging works / equipment will impact on or match in with them.
- Establish relevant storage and vessel mooring areas and what equipment would need to be moved in the event of a cyclone.
- Establish procedures for how to obtain cyclone information and relevant contacts to converse with during any potential or actual event. Keep in prominent visible area of site shed.
- Nominate a point of contact remote from the area as the central contact for all onsite personnel. This to be Birdon Head Office reception.
- Identify safest onsite refuge area to be used if unable to vacate the area. Also identify the escape routes / roads to be used to vacate the area.
- Prepare emergency kit to be held onsite and taken to refuge by any personnel remaining onsite. Kit to contain portable radio, torch, spare batteries, first aid kit, non-perishable food, water, sturdy gloves, waterproof bags, candles and matches.

PROCEDURE AS CYCLONE APPROCAHES

- A **Cyclone Watch** period is issued by Bureau of Meteorology when gales or stronger winds associated with a cyclone are expected to hit within 24 to 48 hours.
- A **Cyclone Warning** is issued by Bureau of Meteorology when gales or stronger winds associated with a cyclone are expected to hit within 24 hours.
- If either a **watch** or **warning** is issued,
  - keep regular checks on the movement and severity of the cyclone.
  - Co-ordinate your activities with those of other harbour users, particularly the Harbour Controller and Mariner Owner.
  - Clean up and secure all loose items and buildings, secure or tape glass windows.
  - Disconnect discharge pontoon and secure discharge pipe end to seabed with anchor.
  - Relocate and securely moor relevant equipment. Including ensuring all pipelines adequately sunk and secure.
  - Prepare to evacuate to site.

DURING A CYCLONE

- As early as possible the decision as to whether to vacate or stay onsite is to be made bearing in mind which is the safest option. Do not attempt to outrun the cyclone.
- Turn off all power supplies.
- If remaining onsite, shelter in the designated refuge area, taking the emergency kit.
- Keep listening to the radio to get updates on what is happening outside.
- BEWARE THE EYE OF THE STORM

AFTER THE CYCLONE

- Remain indoors until advised that it is OK to venture outdoors. Beware of hazards created by the storm.
- Take directions from any emergency services personnel and facility owners / operators.
- Contact your off site central contact (Birdon Head Office) to report your condition and that of others and the site.
- Do not use electrical appliances or power supplies until it is known to be safe to do so.
- Do no drink water supplies until it is known to be safe.

Appendix E - permit conditions

Queensland Government

Department of
Environment and Heritage Protection

03-JUL-2015

To: Department of Transport and Main Roads
PO Box 1549
BRISBANE QLD 4001

Email: chris.j.voisey@tmr.qld.gov.au

Your reference: EPPR03292815
Our reference: 291327

Application details

I refer to the application that was received by the administering authority on 12-JUN-2015.

Land description: Rosslyn Bay Boat Harbour on Lot 105 Plan SP161849 and Lot 106 Plan SP161849.

Activity: 16-(1b) Dredging >10000t but <100000t yr

Decision

Your application has been approved and your environmental authority reference EPPR03292815 is attached.

Should you have any further enquiries, please contact Denise Leon on telephone 07 3330 6097.

Yours sincerely

CMooney	18/9/15.
Signature	Date

Chris Mooney
Department of Environment and Heritage Protection
Delegate of the administering authority
Environmental Protection Act 1994

Denise Leon
ES – Government Organisations and Utilities Assessment – Brisbane
GPO Box 2454
BRISBANE QLD 4001
Phone: 07 3330 6097
Email: denise.leon@ehp.qld.gov.au
Website **www.ehp.qld.gov.au**
ABN 46 640 294 485

Enclosed

Permit - environmental authority reference EPPR03292815

Department of Environment and Heritage Protection

Permit[1]

Environmental Protection Act 1994

Environmental authority

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Permit[1] number: EPPR03292815

Environmental authority takes effect on 18 September 2015.

Annual return date is 18 September.

The first annual fee is payable within 20 business days of the effective date.

Environmental authority holder

Name	Registered address
Department of Transport and Main Roads	Floor 17, 313 Adelaide Street BRISBANE CITY QLD 4000

Environmentally relevant activity and location details

Environmentally relevant activity	Location
16-(1b) Dredging >10000t but <100000t yr	Rosslyn Bay Boat Harbour Lot 105 Plan SP161849 and Lot 106 Plan SP161849

Additional information for applicants

Environmentally relevant activity

The description of any environmentally relevant activity (ERA) for which an environmental authority is issued is a restatement of the ERA as defined by legislation at the time the approval is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an environmental authority as to the scale, intensity or manner of carrying out an ERA, then the conditions prevail to the extent of the inconsistency.

An environmental authority authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the authority specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

[1] Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation

Contaminated land

It is a requirement of the EP Act that if an owner or occupier of land becomes aware a notifiable activity (as defined in Schedule 3 and Schedule 4) is being carried out on the land, or that the land has been, or is being, contaminated by a hazardous contaminant, the owner or occupier must, within 22 business days after becoming so aware, give written notice to the chief executive.

CMooney	18/9/15.
Signature	Date

Chris Mooney
Department of Environment and Heritage Protection
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Denise Leon
ES – Government Oganisations and Utilities
Assessment – BRISBANE
GPO Box 2454
BRISBANE QLD 4001
Phone: 07 3330 6097
Email: denise.leon@ehp.qld.gov.au

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320 - 320G)
- offence of causing serious or material environmental harm (sections 437- 439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Conditions of environmental authority

Location: Within Rosslyn Bay Boat Harbour and adjacent waters.

Relevant activity: ERA 16-1(b) Dredging of 10 000t but not more than 100 000 t in a year.

The ERA conducted at the location as described above must be conducted in accordance with the following site specific conditions of authority.

Agency interest: General	
Condition number	**Condition**
G1	Activities conducted under this environmental authority must be conducted in accordance with approved drawings as specified in *Schedule 1 – Approved Plans* and provided in *Attachment 1.*
G2	All reasonable and practicable **measures** must be taken to minimise the likelihood of environmental harm being caused.
G3	Any breach of a condition of this environmental authority, must be reported to the **administering authority** as soon as practicable, or at most, within 24 hours of **you** becoming aware of the breach. Records must be kept including full details of the breach and any subsequent actions undertaken.
G4	Other than as permitted by this environmental authority, the **release of a contaminant into the environment** must not occur.
G5	All information and records that are required by the conditions of this environmental authority must be kept for a minimum of five (5) years. Environmental monitoring results must be kept until surrender of this environmental authority. All information and records required by the conditions of this environmental authority must be provided to the **administering authority** upon request.
G6	An **appropriately qualified person(s)** must monitor, record and interpret all parameters that are required to be monitored by this environmental authority and in the manner specified by this environmental authority.

G7	All analyses required under this environmental authority must be carried out by a laboratory that has **NATA** certification, or an equivalent certification, for such analyses.
G8	When required by the **administering authority**, monitoring must be undertaken in the manner prescribed by the **administering authority**, to investigate a complaint that is not considered by the **administering authority** to be frivolous or vexatious, of environmental nuisance arising from the **activity**. The monitoring results must be provided to the **administering authority** upon request.
G9	The **activity** must be undertaken in accordance with written procedures that: 1. identify potential risks to the environment from the **activity** during routine operations, closure and an emergency 2. establish and maintain control **measures** that minimise the potential for environmental harm 3. ensure plant, equipment and **measures** are maintained in a proper and effective condition 4. ensure plant, equipment and **measures** are operated in a proper and effective manner 5. ensure that staff are trained and aware of their obligations under the *Environmental Protection Act 1994* 6. ensure that reviews of environmental performance are undertaken at least annually.
G10	Provide to **administering authority** written notification of the date when **dredging** will commence at least five (5) business days prior to establishing a new **dredging activity**.

Agency interest: Air

Condition number	Condition
A1	Odours or airborne contaminants which are **noxious** or **offensive** or otherwise unreasonably disruptive to public amenity or safety must not cause nuisance to any **sensitive place** or **commercial place**.

Agency interest: Water

Condition number	Condition
WT1	The only contaminants to be released to surface waters are sediment extracted from the dredged areas of the Rosslyn Bay Boat Harbour and disposed of to the offshore disposal area in accordance with the relevant drawings specified in condition G1.
WT2	Dredging must not result in a visible sediment plume beyond 500m of the dredging site.
WT3	The offshore disposal of sediment must not result in a visible plume beyond 500m of the placement area.
WT4	In addition to WT1, the release to waters must not: 1. have any other properties at a concentration that is capable of causing environmental harm 2. produce any slick or other visible evidence of oil or grease, nor contain visible floating oil, grease, scum, litter or other visually objectionable matter.

Agency interest: Noise

Condition number	Condition
N1	Noise from the **activity** must not cause environmental nuisance at any **sensitive place** or **commercial place**.
N2	The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's noise measurement manual.
Agency interest: Land	
Condition number	**Condition**
L1	Treatment and management of acid sulfate soils must comply with the current edition of the *Queensland Acid Sulfate Soil Technical Manual.*
Agency interest: Waste	
Condition number	**Condition**
W1	All waste generated in carrying out the **activity** must be reused, recycled or removed to a facility that can lawfully accept the waste.

Definitions

Note that where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations or environmental protection policies must be used. If a word remains undefined it has its ordinary meaning.

Activity means the environmentally relevant activities, whether resource activities or prescribed activities, to which the environmental authority relates.

Administering authority means the Department of Environment and Heritage Protection or its successor or predecessors.

Appropriately qualified person(s) means a person or persons who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.

Background means noise, measured in the absence of the noise under investigation, as L A90,T being the A-weighted sound pressure level exceeded for 90 per cent of the time period of not less than 15 minutes, using Fast response.

Commercial place means a place used as a workplace, an office or for business or commercial purposes and includes a place within the curtilage of such a place reasonably used by persons at that place.

Dredging includes extraction of mud, sand, coral, ballast, shingle, gravel, clay, earth and other material from the bed of Queensland tidal and non-tidal **waters**. Dredging does not include the banks of a waterway.

$L_{Aeq\ adj,T}$ means the adjusted A weighted equivalent continuous sound pressure level measures on fast response, adjusted for tonality and impulsiveness, during the time period T, where T is measured for a period no less than 15 minutes when the activity is causing a steady state noise, and no shorter than one hour when the approved activity is causing an intermittent noise.

$Max_{LpA,T}$ means the maximum A-weighted sound pressure level measured over a time period T of not less than 15 minutes, using Fast response.

Measures has the broadest interpretation and includes plant, equipment, physical objects, bunding, containment systems, monitoring, procedures, actions, directions and competency.

NATA means National Association of Testing Authorities.

Noxious means harmful or injurious to health or physical well-being.

Offensive means causing offence or displeasure; is unreasonably disagreeable to the sense; disgusting, nauseous or repulsive.

Prescribed contaminants means contaminants listed within Schedule 9 of the *Environmental Protection Regulation 2008*.

Release of a contaminant into the environment means to:

- deposit, discharge, emit or disturb the contaminant
- cause or allow the contaminant to be deposited, discharged, emitted or disturbed

- fail to prevent the contaminant from being deposited, discharged emitted or disturbed
- allow the contaminant to escape
- fail to prevent the contaminant from escaping.

Sensitive place includes the following and includes a place within the curtilage of such a place reasonably used by persons at that place:
- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- a kindergarten, school, university or other educational institution; or
- a medical centre or hospital; or
- a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 1992* or a World Heritage Area; or
- a public thoroughfare, park or gardens; or
- for noise, a place defined as a sensitive receptor for the purposes of the Environmental Protection (Noise) Policy 2008.

Substantial low frequency noise means a noise emission that has an unbalanced frequency spectrum shown in a one-third octave band measurement, with a predominant component within the frequency range 10 to 200Hz. It includes any noise emission likely to cause an overall sound pressure level at a sensitive place exceeding 55dB(Z).

Waters includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water, natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater and any part thereof.

You means the holder of the environmental authority.

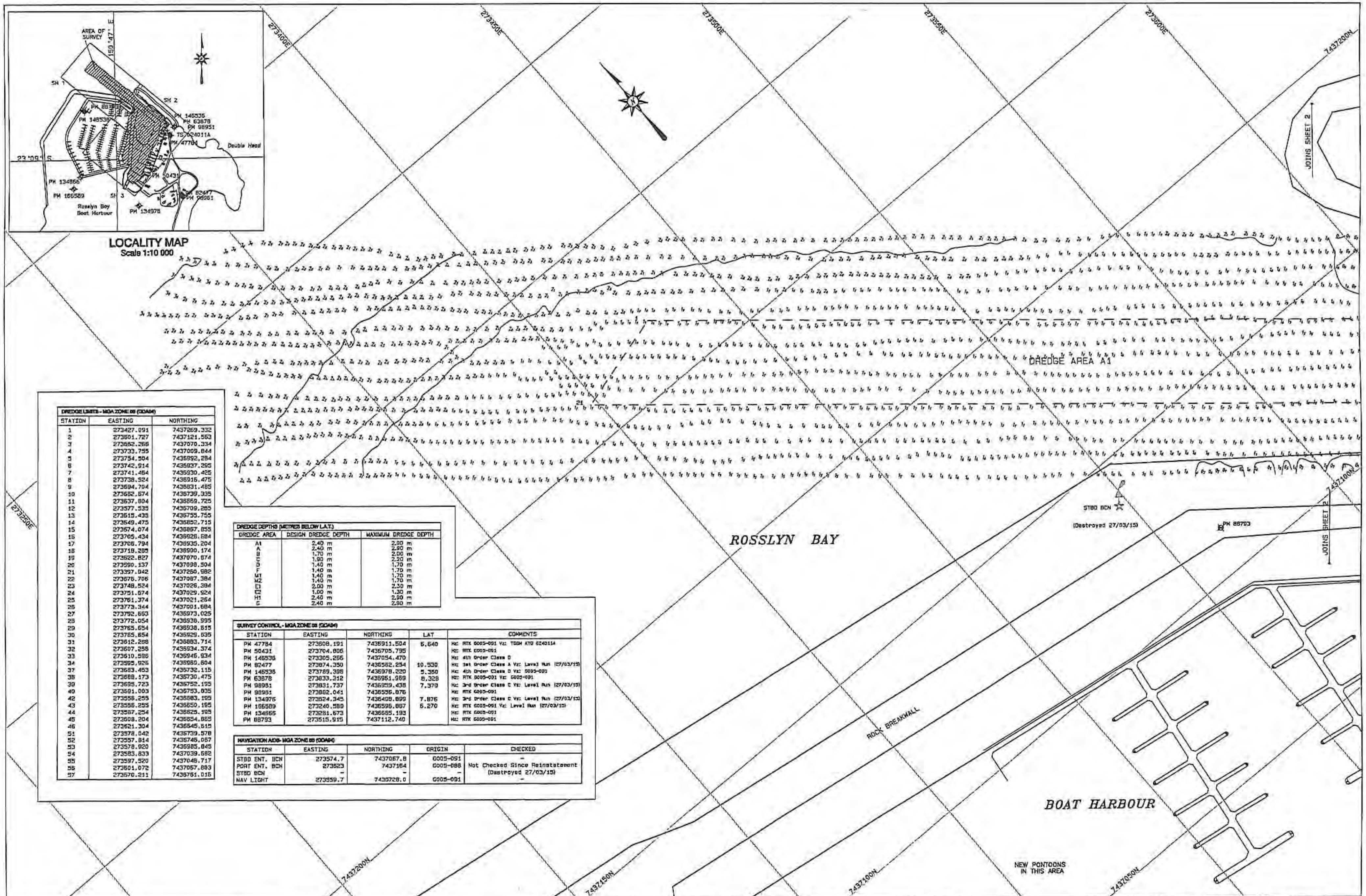
Schedule 1—Approved plans

Activities conducted under this environmental authority must be conducted in accordance with the following approved drawings.

a. Job Number RK040034, Plan Number G005-093, titled 'Post–Cyclone Hydrographic Survey', prepared by PMD for Department of Transport and Main Roads, dated 27 March 2015, Sheet 1 of 3.
b. Job Number RK040034, Plan Number G005-093, titled 'Post–Cyclone Hydrographic Survey', prepared by PMD for Department of Transport and Main Roads, dated 27 March 2015, Sheet 2 of 3.
c. Job Number RK040034, Plan Number G005-093, titled 'Post–Cyclone Hydrographic Survey', prepared by PMD for Department of Transport and Main Roads, dated 27 March 2015, Sheet 3 of 3.
d. File Number 467/00222, Contract Number QT12-132, Drawing Number Sketch 1, titled 'Maintenaance Dredging (LV70) – 2012 Dredge Area Layout'.
e. Job Number RK020021, Plan Number G005-069, titled Spoil Ground Pre-Dredge Hydrographic Survey', prepared by Transport Infrastructure Branch Queensland Government, dated 19-22 April 2006.

END OF PERMIT

Attachment 1 – Drawings as specified in Schedule 1 of this environmental authority.



DREDGE LIMITS - MGA ZONE 56 (GDA94)

STATION	EASTING	NORTHING
1	273427.091	7437269.332
2	273601.727	7437121.563
3	273662.266	7437070.334
4	273733.755	7437009.844
5	273754.504	7436992.284
6	273742.914	7436937.295
7	273741.464	7436930.425
8	273738.524	7436916.475
9	273694.704	7436831.485
10	273662.674	7436739.335
11	273637.804	7436669.725
12	273577.535	7436709.285
13	273615.435	7436755.755
14	273649.475	7436852.715
15	273674.074	7436867.855
16	273705.434	7436928.684
17	273706.794	7436935.204
18	273718.285	7436900.174
19	273622.827	7437070.874
20	273590.137	7437098.504
21	273397.042	7437260.982
22	273676.706	7437087.384
23	273748.524	7437026.384
24	273751.674	7437029.924
25	273761.374	7437021.264
26	273773.344	7437001.684
27	273792.663	7436973.025
28	273772.054	7436938.995
29	273765.654	7436938.615
30	273765.654	7436929.635
31	273612.288	7436883.714
32	273607.256	7436934.374
33	273610.596	7436946.934
34	273595.926	7436969.604
37	273683.453	7436732.115
38	273688.173	7436730.475
39	273695.723	7436752.195
40	273691.003	7436753.835
42	273556.255	7436683.195
43	273556.255	7436650.195
44	273587.254	7436625.195
45	273608.204	7436654.865
46	273621.304	7436645.615
51	273578.042	7436739.578
52	273557.814	7436746.067
53	273578.020	7436985.845
54	273583.833	7437039.682
55	273597.520	7437048.717
56	273601.072	7437057.803
57	273670.211	7436761.016

DREDGE DEPTHS (METRES BELOW L.A.T.)

DREDGE AREA	DESIGN DREDGE DEPTH	MAXIMUM DREDGE DEPTH
A1	2.40 m	2.90 m
A	2.40 m	2.90 m
B	1.70 m	2.00 m
C	1.90 m	2.20 m
D	1.40 m	1.70 m
F	1.40 m	1.70 m
M1	1.40 m	1.70 m
M2	1.40 m	1.70 m
E1	2.00 m	2.30 m
E2	1.00 m	1.30 m
H1	2.40 m	2.90 m
G	2.40 m	2.90 m

SURVEY CONTROL - MGA ZONE 56 (GDA94)

STATION	EASTING	NORTHING	LAT	COMMENTS
PM 47784	273808.191	7436911.504	5.640	Hz: RTK G005-091 Vz: TGDM ATG 0240114
PM 50431	273704.806	7436705.795		Hz: RTK G005-091
PM 146536	273305.266	7437054.470		Hz: 4th Order Class D
PM 82477	273874.350	7436582.254	10.530	Hz: 1st Order Class A Vz: Level Run (27/03/15)
PM 146536	273789.398	7436978.220	5.360	Hz: 4th Order Class D Vz: G005-091
PM 63878	273833.312	7436961.969	8.328	Hz: RTK G005-091 Vz: G005-091
PM 98951	273831.737	7436959.438	7.370	Hz: 3rd Order Class C Vz: Level Run (27/03/15)
PM 98961	273802.041	7436556.076		Hz: RTK G005-091
PM 134976	273524.345	7436408.899	7.876	Hz: 3rd Order Class C Vz: Level Run (27/03/15)
PM 165589	273240.589	7436596.887	6.270	Hz: RTK G005-091 Vz: Level Run (27/03/15)
PM 134666	273281.673	7436665.193		Hz: RTK G005-091
PM 88793	273515.915	7437112.740		Hz: RTK G005-091

NAVIGATION AIDS - MGA ZONE 56 (GDA94)

STATION	EASTING	NORTHING	ORIGIN	CHECKED
STBD ENT. BCN	273574.7	7437067.8	G005-091	-
PORT ENT. BCN	273623	7437164	G005-088	Not Checked Since Reinstatement
STBD BCN	-	-	-	(Destroyed 27/03/15)
NAV LIGHT	273959.7	7436728.0	G005-091	-

NOTES:
1) This survey meets the mandatory class requirements as outlined in the MSQ document "Standards for for Hydrographic Surveys within Queensland Waters v1.3".
2) Contours are computer generated to Hydrographic Standard (inclusive)
3) Soundings coloured for clearance purposes to the design dredge depths as shown in the table on sheet 1. Marina area critical depth 1.4m LAT.
4) Coastline digitised from aerial photography is approximate only
5) Dredge limits updated from plan RD-1-38-1 A, Contract No. QT10-130 (2012)
6) Position and height check carried out over 1st order survey mark PM 82477
7) Coordinates shown on survey control table taken from plan no G005-091 unless otherwise stated.

Horizontal Datum	MGA Zone 56 (GDA94)		
Base Station	PM 146536	Easting 273789.396	Northing 7436978.220
Vertical Datum	LAT	based on	PM 47784 RL 5.640m
Tide Notes	Soundings reduced to datum using Hypack and RTK-GPS survey systems. Vertical control referenced to PM 146536 RL 5.360m LAT		
Depth Tolerance 0.2m	Horizontal Tolerance 1.5m	Weather	5 - 10 kts SE

Vessel	QG Midge
Echo Sounder	Ceescope 100
Heave sensor	Novatel 628 RTK-GPS
Horizontal Positioning	Novatel 628 RTK-GPS (Rover) Leica GS10 RTK-GPS (Base)
Data Collection/Processing	Hypack 2014 Terramodel v10.61J
Tidal Reference Station	ATG 0240114

SOUNDINGS (m): Z_5 below datum, $\underline{0}_7$ above datum
LEVELS (m): above datum, below datum

SCALE 1 : 800 AT A1
0 5 25 50

CLASS C *See Notes
CLIENT **PMD**

Signature Hydrographic Surveyor	
Surveyor	P FINGER
Checked	D NING

Queensland Government
HYDROGRAPHIC SERVICES

ROSSLYN BAY
BOAT HARBOUR
POST-CYCLONE MARCIA HYDROGRAPHIC SURVEY
27 MARCH 2015

File No. G005093P1.PDF
Job No. RK040034
Plan No. **G005-093**
SHEET 1 OF 3

NOTES:

1) This survey meets the mandatory class requirements as outlined in the MSQ document "Standards for for Hydrographic Surveys within Queensland Waters v1.3".
2) Contours are computer generated to Hydrographic Standard (inclusive)
3) Soundings coloured for clearance purposes to the design dredge depths as shown in the table on sheet 1. Marina area critical depth 1.4m LAT.
4) Coastline digitised from aerial photography to approximate only
5) Dredge limits updated from plan RB-1-30-1 A. Contract No. DT10-437 (2010)
6) Position and height check carried out over 1st order survey mark PM 92477
7) Coordinates shown on survey control table taken from plan no G005-091 unless otherwise stated.

Horizontal Datum	MGA Zone 56 (GDA94)		
Base Station		Easting	Northing
PM 140536		273760.396	7436970.220
Vertical Datum	LAT	based on	PM 47784 RL 6.640m
Tide Notes	Soundings reduced to datum using Hypack and RTK-GPS survey systems. Vertical control referenced to PM 140536 RL 5.360m LAT		
Depth Tolerance 0.2m	Horizontal Tolerance 1.5m	Weather	5 – 10 kts

Vessel	DC Midge
Echo Sounder	Ceescope 100
Heave sensor	Novatel 628 RTK-GPS
Horizontal Positioning	Novatel 628 RTK-GPS (Rover) Leica GS10 RTK-GPS (Base)
Data Collection/Processing	Hypack 2014 Terramodel v10.61J
Reference Station	ATS 024011A

SOUNDINGS (m): 2_5 below datum; 0_7 above datum
LEVELS (m): above datum; below datum

SCALE 1 : 500 AT A1 — 0 5 25 50

CLASS: C (See Notes) | CLIENT: PMD

Signature Hydrographic Surveyor	
Surveyor	P FINGER
Checked	D NING

Queensland Government
HYDROGRAPHIC SERVICES
Ph: (07) 3066 3300
Email: hydro@msq.qld.gov.au

ROSSLYN BAY
BOAT HARBOUR
POST-CYCLONE MARCIA HYDROGRAPHIC SURVEY
27 MARCH 2015

Plot File: G005093P2.PDF
Job No. RK040034
Plan No. **G005-093**
SHEET 2 OF 3

NOTES:

1) This survey meets the mandatory class requirements as outlined in the MSQ document "Standards for for Hydrographic Surveys within Queensland Waters v1.3".
2) Contours are computer generated to Hydrographic Standard (inclusive)
3) Soundings coloured for clearance purposes to the design dredge depths as shown in the table on sheet 1. Marina area critical depth 1.4m LAT.
4) Coastline digitised from aerial photography is approximate only
5) Dredge limits updated from plan RG-1-30-1 A, Contract No. 0712-137 (2013)
6) Position and height check carried out over 1st order survey mark PM 02477
7) Coordinates shown on survey control table taken from plan No G005-091 unless otherwise stated.

Horizontal Datum	MGA Zone 56 (GDA94)		
Base Station		Easting	Northing
PM 140536		273789.395	7436970.220
Vertical Datum	LAT	based on	PM 47784 RL 5.540m
Tide Notes	Soundings reduced to datum using Hypack and RTK-GPS survey systems. Vertical control referenced to PM 140536 RL 5.380m LAT		
Depth Tolerance 0.2m	Horizontal Tolerance 1.5m	Weather	5 - 10 kts SE

Vessel	GC Midge
Echo Sounder	Ceescope 100
Heave sensor	Novatel 628 RTK-GPS
Horizontal Positioning	Novatel 628 RTK-GPS (Rover) Leica GS10 RTK-GPS (Base)
Data Collection/Processing	Hypack 2014 Terramodel v10.61J
Tidal Reference Station	ATG 024011A

SOUNDINGS (m)
Z_5 below datum
0_7 above datum

LEVELS (m)
4.95 above datum
.133 below datum

SCALE 1 : 500 AT A1
0 5 25 50

CLASS
C
+See Notes

CLIENT
PMD

Signature Hydrographic Surveyor	
Surveyor	P FINGER
Checked	D NING

Queensland Government
HYDROGRAPHIC SERVICES
Ph: (07) 3008 3800
Email: hydro@msq.qld.gov.au

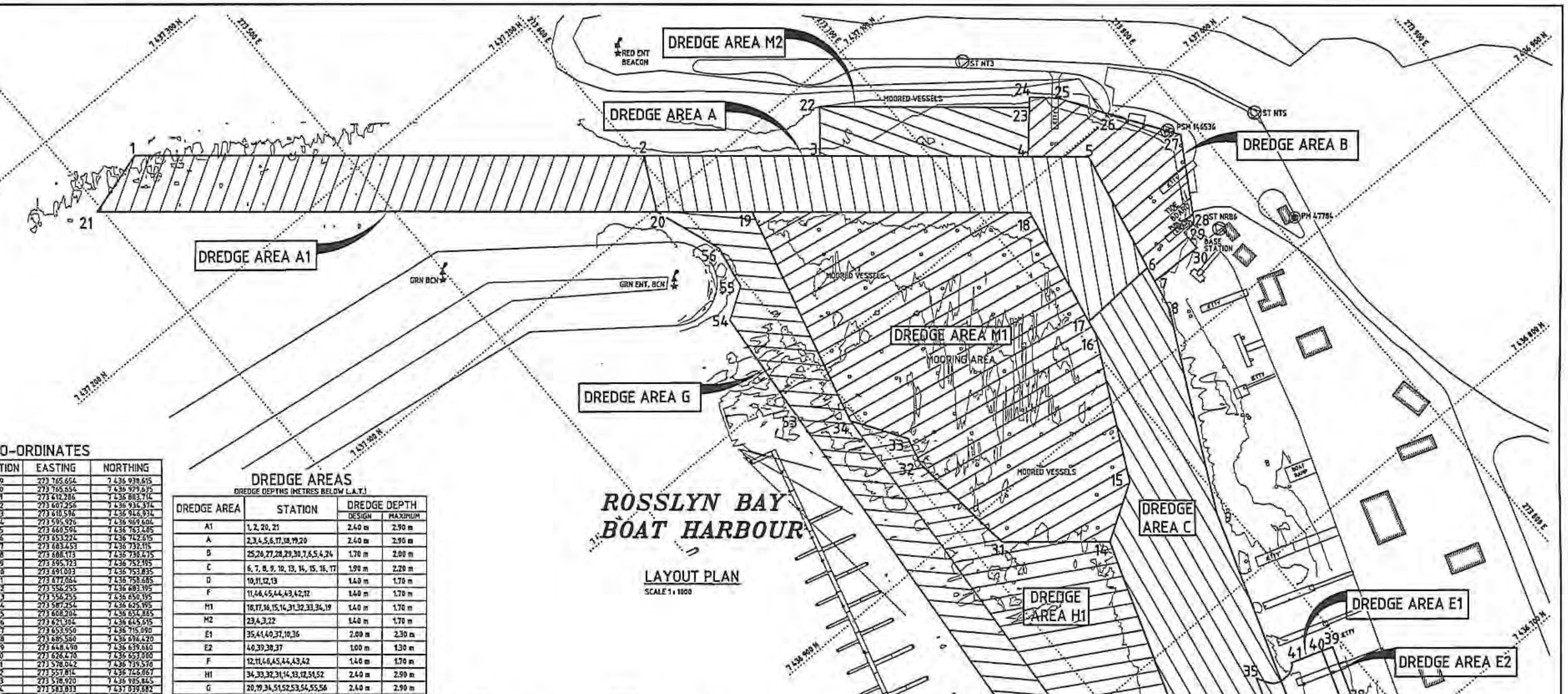
ROSSLYN BAY
BOAT HARBOUR
POST-CYCLONE MARCIA HYDROGRAPHIC SURVEY
27 MARCH 2015

Plot File. G005003P3.PDF
Job No. RK040034
Plan No.
G005-093
SHEET 3 OF 3

ROSSLYN BAY BOAT HARBOUR

LAYOUT PLAN

SCALE 1 : 1000



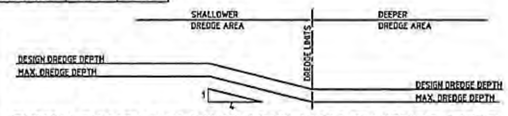
DREDGE LIMIT CO-ORDINATES

STATION	EASTING	NORTHING	STATION	EASTING	NORTHING
1	273 427,091	7 437 269,332	29	273 765,654	7 436 938,615
2	273 601,727	7 437 121,563	30	273 765,654	7 436 929,635
3	273 662,266	7 437 070,334	31	273 612,286	7 436 803,714
4	273 733,755	7 437 009,844	32	273 607,256	7 436 934,374
5	273 754,504	7 436 992,284	33	273 610,596	7 436 946,934
6	273 742,914	7 436 937,295	34	273 595,926	7 436 969,604
7	273741,464	7 436 930,425	35	273 660,596	7 436 763,405
8	273 738,524	7 436 916,475	36	273 653,224	7 436 742,615
9	273 694,704	7 436 831,485	37	273 683,453	7 436 732,115
10	273 662,674	7 436 739,335	38	273 688,173	7 436 730,475
11	273 637,804	7 436 669,725	39	273 695,723	7 436 752,195
12	273 577,535	7 436 709,285	40	273 691,003	7 436 753,835
13	273 615,435	7 436 755,755	41	273 677,064	7 436 758,685
14	273 649,475	7 436 852,715	42	273 556,255	7 436 683,395
15	273 674,074	7 436 867,855	43	273 556,255	7 436 650,195
16	273 705,434	7 436 928,684	44	273 587,254	7 436 625,195
17	273 706,794	7 436 935,204	45	273 608,204	7 436 654,865
18	273 718,285	7 436 990,174	46	273 621,304	7 436 645,615
19	273 622,827	7 437 070,874	47	273 653,950	7 436 715,090
20	273 590,137	7 437 098,504	48	273 685,560	7 436 696,470
21	273 397,942	7 437 260,982	49	273 648,490	7 436 639,660
22	273 676,706	7 437 087,384	50	273 626,470	7 436 653,000
23	273 748,524	7 437 026,384	51	273 578,042	7 436 739,578
24	273 751,674	7 437 029,974	52	273 557,814	7 436 746,067
25	273 761,374	7 437 021,264	53	273 578,920	7 436 985,845
26	273 773,344	7 437 001,684	54	273 583,033	7 437 039,682
27	273 792,663	7 436 973,025	55	273 597,520	7 437 048,717
28	273 772,054	7 436 938,995	56	273 601,072	7 437 067,003

DREDGE AREAS

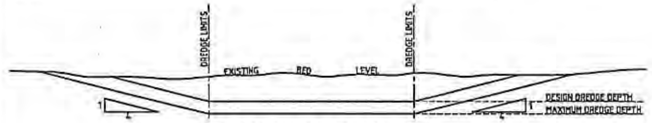
DREDGE DEPTHS (METRES BELOW L.A.T.)

DREDGE AREA	STATION	DREDGE DEPTH	
		DESIGN	MAXIMUM
A1	1, 2, 20, 21	2.40 m	2.90 m
A	2,3,4,5,6,17,18,19,20	2.40 m	2.90 m
B	25,26,27,28,29,30,7,6,5,4,24	1.70 m	2.00 m
C	6, 7, 8, 9, 10, 13, 14, 15, 16, 17	1.90 m	2.20 m
D	10,11,12,13	1.40 m	1.70 m
F	11,46,45,44,43,42,12	1.40 m	1.70 m
M1	18,17,16,15,14,31,32,33,34,19	1.40 m	1.70 m
M2	23,4,3,22	1.40 m	1.70 m
E1	35,41,40,37,10,36	2.00 m	2.30 m
E2	40,39,38,37	1.00 m	1.30 m
F	12,11,46,45,44,43,42	1.40 m	1.70 m
H1	34,33,32,31,14,13,12,51,52	2.40 m	2.90 m
G	20,19,34,51,52,53,54,55,56	2.40 m	2.90 m



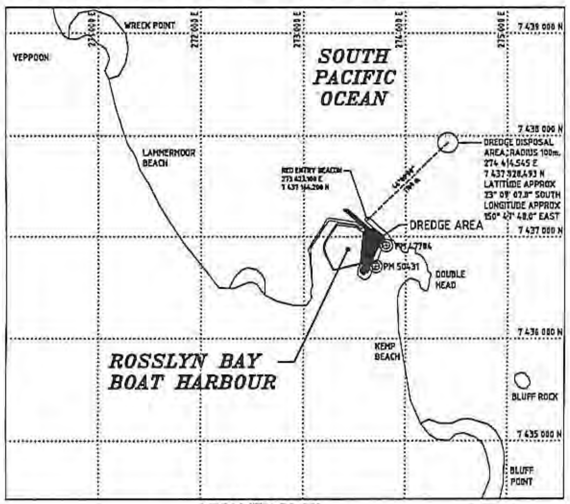
TYPICAL DREDGE SECTION BETWEEN ADJACENT DREDGE AREAS

NOT TO SCALE



TYPICAL DREDGE SECTION

NOT TO SCALE



LOCALITY PLAN

SCALE 1 : 25 000

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. ALL LEVELS AND SOUNDINGS ARE IN METRES AND HAVE BEEN REDUCED TO LOWEST ASTRONOMICAL TIDE (LAT).
3. VERTICAL DATUM FOR LEVELS ESTABLISHED FROM PM 47784 RL 6.640 LAT. SOUNDINGS HAVE BEEN REDUCED TO DATUM USING TIDES AS READ FROM ATG AT ROSSLYN BAY.
4. SOUNDINGS SHOWN THUS e.g. 2_4 INDICATE METRES BELOW LAT.
5. SOUNDINGS SHOWN THUS e.g. $\underline{1}_9$ INDICATE METRES ABOVE LAT.
6. ALL CO-ORDINATES ARE IN METRES AND ARE TO MGA. HORIZONTAL DATUM IS GDA94 ZONE 56. AMSA GLADSTONE (STATION ID 706 FREQUENCY 313 kHz).
7. SURVEY INFORMATION WAS DERIVED FROM MARITIME SAFETY QUEENSLAND HYDROGRAPHIC SERVICES PLAN No.'s G005-081 SHEETS 1, 2 & 3. DATE OF SURVEY: 26 OCTOBER 2011.
8. DESIGN DREDGE DEPTH IS THE MINIMUM TO BE ACHIEVED.
9. MAXIMUM DREDGE DEPTH IS THE MAXIMUM PAYABLE.

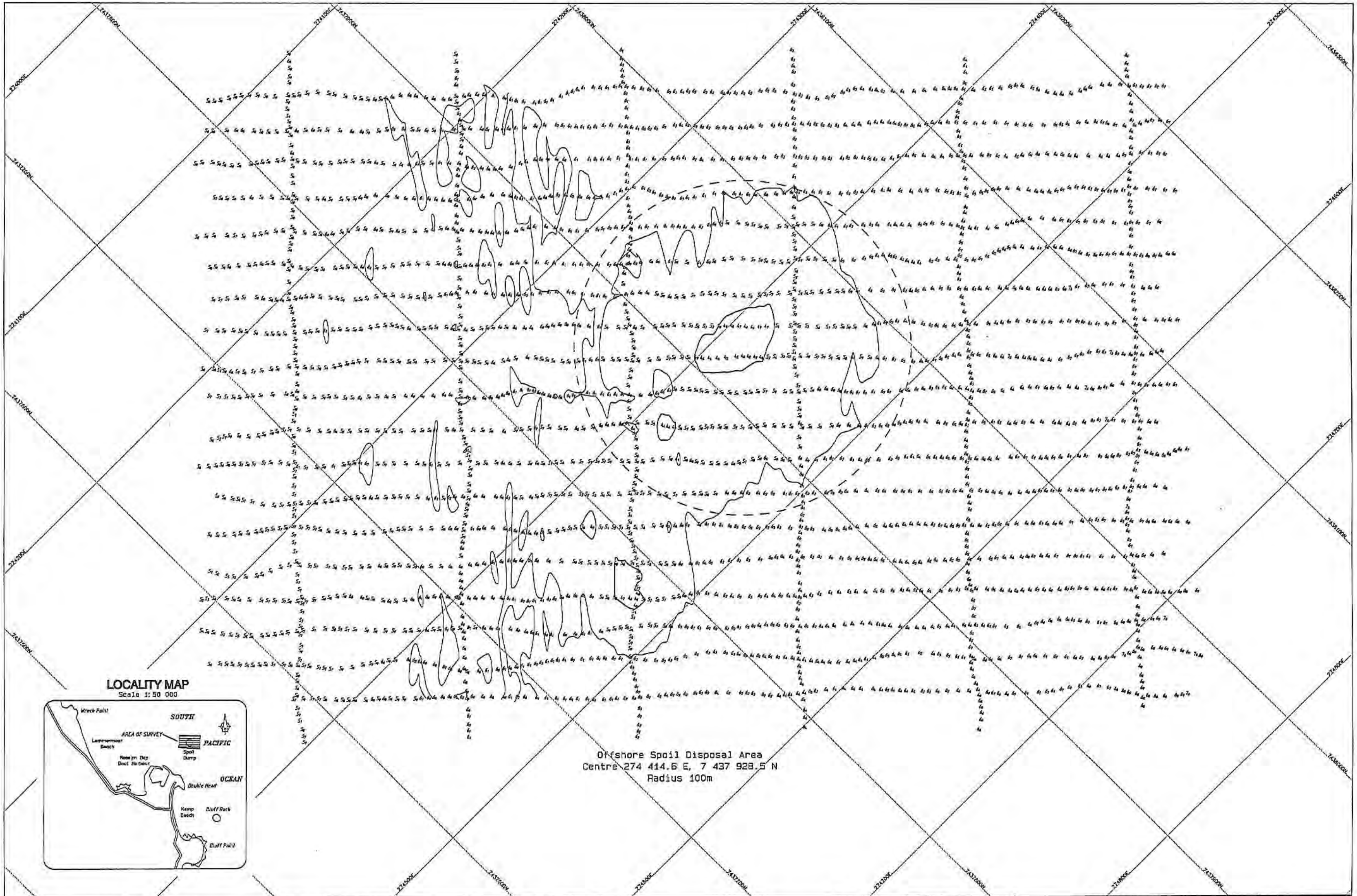
467/00222 File No	J.W.RICHARDS Drafting	Drafting Chd	Examined
QT12-132 Contract No	Design	Design Chd	Approved
	Date	R.P.E.Q. No.	Certified

Queensland Government

ROSSLYN BAY BOAT HARBOUR
MAINTENAANCE DREDGING (LV70) - 2012
DREDGE AREA LAYOUT

SKETCH 1

A1



NOTES:
1) Contours are computer generated to Hydrographic Standard (inclusive)
2) Soundings coloured for clearance purposes
3) Marine infrastructure and land detail digitised from existing plans

MGA GDA94 Zone 56		Vessel	QG BRAMBLE
Base Station	GLADSTONE AMSA DGPS BROADCAST SERVICE – FREQUENCY 313 kHz	Echo Sounder	DESO 300
LAT	based on PSM 47764 (RL 6.540m LAT)	Heave meter	NOT USED
Tide Notes	SOUNDINGS REDUCED TO DATUM USING TIDES AS READ FROM ATG AT ROSSLYN BAY	Horizontal Positioning	ASHTECH G-12
		Data Collection/Processing	GEONAV/TERRAMODEL
Depth Tolerance +/-0.16m	Horizontal Tolerance <1.5m Weather 0-12 KN SE	Tidal Reference Station	TDN 03011A

SCALE 1 : 1000 AT A1

CLASS C — CLIENT: TRANSPORT INFRASTRUCTURE BRANCH

Hydrographic Surveyor	R MARTIN
Drawn By	B GOWNE
Checked	R MARTIN

Original Signed and Filed Roy Strauss
Principal Manager

Queensland Government
Maritime Safety Queensland
HYDROGRAPHIC SERVICES

ROSSLYN BAY
SPOIL GROUND
PRE-DREDGE HYDROGRAPHIC SURVEY
19-22 APRIL 2006

Plot File. 0005060.PLT
Job No. RK028021
Plan No. G005-069

On notice
Notice
on notice
nt

RECEIVED 03 NOV 2011 BY:

Notice

Decision notice

...ued by the Department of Environment and Resource Management pursuant to section 334 (decision ... Sustainable Planning Act 2009 ("the Act").

...artment of Transport and Main Roads
PO Box 2595
Brisbane Qld 4000

Att. Chris Voisey

cc. Rockhampton Regional Council
PO Box 1860
Rockhampton Qld 4700

RECEIVED 30 NOV 2011 BY:

Our reference: 291327

Re: Application for development approval

1. **Application Details**

Date application made to DERM:

09 November 2011

Development approval applied for:

Development Permit

Aspect of development:

Material change of use of premises – For an environmentally relevant activity under the *Sustainable Planning Regulation 2009* - Schedule 3, Part 1, Table 2, item 1

Development description:

ERA 16 Extractive and screening activities 1(c) Dredging material: >1000,000-1 million t/yr.

Property/Location description:

Rosslyn Bay Boat Harbour
Lot 105 & 106 on SP161849

2. The name and address of each referral agency is as follows:

Nil

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485
Queensland Government

3. The Chief Executive, Department of Environment and Resource Management (DERM) decision notice for the aspect of development involved with the application the subject of this Notice is as follows.

(a) The application was decided on 22 November 2011 and is approved subject to conditions.

4. Information about the rights of appeal for the applicant any submitters are attached to this Notice.

SJFlanagan

Delegate
Sandra Flanagan
Delegate, Chief Executive
administering the *Environmental Protection Act 1994*
Department of Environment and Resource Management
22 November 2011

Enquiries:
Phil Steer
Principal Environmental Officer
Department of Environment and Resource Management
61 Yeppoon Road (E Block)
PO Box 3130 Red Hill
Rockhampton Qld 4701
Phone: 4936 0536
Fax: 4936 0508
Email: Philip.steer@derm.qld.gov.au

Attachments

DERM Permit No. SPDE03383211
Information Sheet – Appeals – *Sustainable Planning Act 2009* (extract from the *Sustainable Planning Act 2009*)

Department of Environment
and Resource Management

Sustainable Planning Act 2009

DERM Permit [1] number: SPDE03383211

Assessment manager reference:	479684 – DERM Permit No SPDE03383211
Date application received:	09 November 2011
Permit type:	Development Permit
Date of decision:	22 November 2011
Decision:	The application is approved subject to conditions, and the assessment manager's conditions are stated in this permit, and any concurrence agency conditions are attached to this permit in the exact form given by the concurrence agency named on the attachment
Relevant laws and policies:	*Environmental Protection Act 1994* and any related statutory instruments and subordinate legislation
Jurisdiction(s):	Material change of use of premises – For an environmentally relevant activity under the *Sustainable Planning Regulation 2009* - Schedule 3, Part 1, Table 2, item 1

Development Description(s)

Property/Location		Development
Rosslyn Bay Boat Harbour	Lot 105 & 106 on SP161849	ERA 16 Extractive and screening activities 1(c) Dredging material: >1000,000-1 million t/yr.

[1] Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the Department of Environment and Resource Management.

Reason(s) for inclusion of conditions

In accordance with section 289 of the *Sustainable Planning Act 2009*, the reason(s) for inclusion of conditions stated in this permit required by the assessment manager response for the application are as follows:

The conditions are included pursuant to section 73B of the Environmental Protection Act 1994.

S Flanagan

Delegate
Sandra Flanagan
Delegate, Chief Executive
administering the *Environmental Protection Act 1994*
Department of Environment and Resource Management
22 November 2011

CONDITIONS

This development permit consists of the following schedules of conditions:
- Schedule A – Activity
- Schedule B – Air
- Schedule C – Noise
- Schedule D – Social
- Schedule E – Water
- Schedule F - Definitions

Schedule A – Activity

A1a Maximum Dredge Volume

This approval is for a maximum dredge volume of 100,000 cubic metres per annum.

A1 Prevent and/or minimise likelihood of environmental harm.

In carrying out an ERA to which this approval relates, all reasonable and practicable measures must be taken to prevent and / or to minimise the likelihood of environmental harm being caused.

A2 Maintenance of Measures, Plant and Equipment

The operator of an ERA to which this approval relates must:
(a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this approval; and
(b) maintain such measures, plant and equipment in a proper and efficient condition; and
(c) operate such measures, plant and equipment in a proper and efficient manner.

A3 Site Based Management Plan.

From commencement of an ERA to which this approval relates, a site based management plan (SBMP) must be implemented. The SBMP must identify all sources of environmental harm, including but not limited to the actual and potential release of all contaminants, the potential impact of these sources and what actions will be taken to prevent the likelihood of environmental harm being caused. The SBMP must also provide for the review and 'continual improvement' in the overall environmental performance of all ERAs that are carried out.

The SBMP must address the following matters:

(a) Environmental commitments - a commitment by senior management to achieve specified and relevant environmental goals.
(b) Identification of environmental issues and potential impacts.
(c) Control measures for routine operations to minimise likelihood of environmental harm.
(d) Contingency plans and emergency procedures for non-routine situations.
(e) Organisational structure and responsibility.
(f) Effective communication.
(g) Monitoring of contaminant releases.
(h) Conducting environmental impact assessments.
(i) Staff training.
(j) Record keeping.
(k) Periodic review of environmental performance and continual improvement.

A4 Experience and Qualifications

Components (b), (c), (g) and (h) of condition General 3 above, must be carried out by a person holding appropriate experience and qualifications.

A5 Notification.

Telephone DERM's Pollution Hotline or local office as soon as practicable, but no later than 24 hours after becoming aware of any release of contaminants not in accordance with the conditions of this approval.

A6 Monitoring.

Any monitoring required by this approval must be conducted by an appropriately qualified person.

A7 Equipment Calibration.

All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this approval must be calibrated, and appropriately operated and maintained.

A8 Spill Kit

An appropriate spill kit, personal protective equipment and relevant operator instructions/emergency procedure guides for the management of wastes and chemicals associated with the ERA must be kept at the site, and in each vehicle used if the activity is a mobile ERA.

A9 Spill Kit Training

Anyone operating under this approval must be trained in the use of the spill kit.

A10 Dredge Area

Dredging may only take place in the Rosslyn Bay Boat Harbour and the associated harbour entrance.

Schedule B – Air

B1 Nuisance.

The release of noxious or offensive odours or any other noxious or offensive airborne contaminants resulting from the activity must not cause a nuisance at any nuisance sensitive or commercial place.

B2 Dust Nuisance.

The release of dust and/or particulate matter resulting from the ERA must not cause an environmental nuisance at any nuisance sensitive or commercial place.

Schedule C – Noise

C1 Noise Nuisance.

Noise from the ERA must not cause an environmental nuisance at any nuisance sensitive place or commercial place

C2

All noise from activities must not exceed the levels specified in Table [1] - Noise limits at any nuisance sensitive or commercial place.

C3 Noise Monitoring.

When requested by the administering authority, noise monitoring must be undertaken to investigate any complaint of noise nuisance, and the results notified within 14 days to the administering authority. Monitoring must include:
- LA 10, adj, 10 mins
- LA 1, adj, 10 mins
- the level and frequency of occurrence of impulsive or tonal noise;
- atmospheric conditions including wind speed and direction;
- effects due to extraneous factors such as traffic noise; and
- location, date and time of recording.

C4 Noise Measurement Method

The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's Noise Measurement Manual or an equivalent document approved by the administering authority.

Schedule D – Social

D1 Complaint Response.

The operator of the ERA must record the following details for all complaints received and provide this information to the administering authority on request:

a) Time, date, name and contact details of the complainant;
b) reasons for the complaint;
c) any investigations undertaken;
d) conclusions formed; and
e) any actions taken.

Schedule E – Water

E1

Measures must be taken to prevent or minimise the transport of suspended sediment material beyond the immediate area of the dredge. The measures must be continually in place and maintained when dredging is being undertaken.

E2

Any release to waters must not contain any contaminants in sufficient concentration to result in environmental harm.

E3

The disposal of dredge spoil into waters must be carried out using all measures that are reasonable and practicable in the circumstances to limit the environment impact of the disposal.

For the purposes of this condition, examples of reasonable and practicable measures could include the following:

a) where spoil is dumped directly from the dredge or a barge, carefully position the dredge at a suitable location up-current of the disposal area before releasing the spoil so as to promote deposition within the designated disposal area; and

b) where the spoil is discharged from a pipeline, locate the discharge as close as practicable to the sea bed; and

c) Avoiding discharge or dumping during weather conditions likely to promote dispersion of spoil through surface water.

Table 1 – Noise limits at any nuisance sensitive or commercial place

Time period	Noise level at a 'Noise sensitive place' measured as the Adjusted Maximum Sound Pressure Level $L_{A,\ max\ adj\ T}$ Note 1
7am - 6pm	Background noise level plus 5 dB(A)
6pm - 10pm	Background noise level plus 5 dB(A)
10pm - 7am	Background noise level plus 3 dB(A)
Time period	**Noise level at a 'Commercial place' measured as the Adjusted Maximum Sound Pressure Level $L_{A,\ max\ adj\ T}$**
7am - 6pm	Background noise level plus 10 dB(A)
6pm - 10pm	Background noise level plus 10 dB(A)
10pm - 7am	Background noise level plus 8 dB(A)

Note 1: $L_{A\ 10,\ adj,\ 15\ mins}$ levels may be substituted for $L_{Amax,\ adj,\ 15\ mins}$ levels if evidence is provided that $L_{A\ 10,\ adj,\ 15\ mins}$ levels are representative of component noise levels from source(s)/premises under investigation.

Schedule F – Definitions

Words and phrases used throughout this permit[1] are defined below. Where a definition for a term used in this permit[1] is sought and the term is not defined within this permit[1] the definitions provided in the relevant legislation shall be used.

"administering authority" means the Department of Environment and Resource Management (DERM) or it's successor.

"annual return" means the return required by the annual notice (under section 316 of the *Environment Protection Act 1994*) for the section 73F registration certificate that applies to the development approval.

"approval" means 'notice of development application decision' or 'notice of concurrence agency response' under the *Sustainable Planning Act 2009.*

"approved plans" means the plans and documents listed in the approved plans section in the notice attached to this development approval.

"authorised place" means the place authorised under this development approval for the carrying out of the specified environmentally relevant activities.

"canal" means an artificial waterway surrendered to the State. A canal is an artificial waterway connected, or intended to be connected, to tidal water; and from which boating access to the tidal water is not hindered by a lock, weir or similar structure.
"coastal dune" means a ridge or hillock of sand or other material on the coast and built up by the wind.
"commercial place" means a place used as an office or for business or commercial purposes.

"dredge spoil" means material taken from the bed or banks of waters by using dredging equipment or other equipment designed for use in extraction of earthen material.

"dwelling" means any of the following structures or vehicles that is principally used as a residence –
- a house, unit, motel, nursing home or other building or part of a building;
- a caravan, mobile home or other vehicle or structure on land;
- a water craft in a marina.

"Department of Environment and Resource Management" means the department or agency (whatever called) administering the *Coastal Protection and Management Act 1995* or the *Environmental Protection Act 1994.*

"erosion prone area" means an area declared to be an erosion prone area under section 70(1) of the *Coastal Protection and Management Act 1995.*

"high water mark" means the ordinary high water mark at spring tides.

"intrusive noise" means noise that, because of its frequency, duration, level, tonal characteristics, impulsiveness or vibration –

- is clearly audible to, or can be felt by, an individual; and
- annoys the individual.
- In determining whether a noise annoys an individual and is unreasonably intrusive, regard must be given to Australian Standard 1055.2 – 1997 Acoustics – Description and Measurement of Environmental Noise Part 2 – Application to Specific Situations.

"$L_{A\,10,\,adj,\,10\,mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

"$L_{A\,1,\,adj,\,10\,mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response.

"$L_{A,\,max\,adj,\,T}$" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

"land" in the "land schedule" of this document means land excluding waters and the atmosphere.

"mg/L" means milligrams per litre.

"noxious" means harmful or injurious to health or physical well being.

"NTU" means nephelometric turbidity units.

"nuisance sensitive place" includes –

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- a kindergarten, school, university or other educational institution; or
- a medical centre or hospital; or
- a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 1992* or a World Heritage Area; or
- a public thoroughfare, park or gardens; or
- a place used as a workplace, an office or for business or commercial purposes and includes a place within the curtilage of such a place reasonably used by persons at that place.

"offensive" means causing offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive.

"protected area" means –

- a protected area under the *Nature Conservation Act 1992*; or
- a marine park under the *Marine Parks Act 1992*; or
- a World Heritage Area.

"regulated waste" means non-domestic waste mentioned in Schedule 7 of the *Environmental Protection Regulation 1998* (whether or not it has been treated or immobilised), and includes -

- for an element - any chemical compound containing the element; and
- anything that has contained the waste.

"site" means land or tidal waters on or in which it is proposed to carry out the development approved under this development approval.

"tidal water" means the sea and any part of a harbour or watercourse ordinarily within the ebb and flow of the tide at spring tides.

"watercourse" means a river, creek or stream in which water flows permanently or intermittently-

- in a natural channel, whether artificially improved or not; or
- in an artificial channel that has changed the course of the watercourse.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater and any part-thereof.

"works" or "operation" means the development approved under this development approval.

"you" means the holder of this development approval or owner / occupier of the land which is the subject of

END OF CONDITIONS

Facility ID	LV96
Date of Search	27/02/2006
Location	Rosslyn Bay Boat Harbour - Dredging Cannel
Works Description	Dredging Channel
Date of Application	
Date of Sanction	01/08/1996
Drawing Numbers	RS-1-19-5A RS-1-19-6 RS-1-19-7 RS-1-19-8 RS-1-19-9

Queensland Department of Environment ~~and Heritage~~

Central Coast Region • Corner Yeppoon and Norman Roads, North Rockhampton Qld 4701 • PO Box 3130 ROCKHAMPTON SHOPPING FAIR QLD 4701
Telephone (079) 36 0511 • Facsimile (079) 36 2212

Enquiries to	Mrs. J Chappell
Telephone	(079) 36 0511
Your Reference	410-21-327
Our Reference	CR2013 JC:JC

5 August 1996

Minister for Transport and Main Roads
Department of Transport
Marine Business Centre
6th Floor
Spring Hill Complex
477 Boundary Street
SPRING HILL QLD 4000

Attention: Mr R.S. Atkinson

Dear Sir

Re: Maintenance Dredging at Rosslyn Bay Boat Harbour

I am directed to inform you that in pursuance of the provisions of section 86 of the Harbours Act 1955, sanction was given on the 1 August 1996, to the plans deposited for:

- maintenance dredging;
- in Rosslyn Bay Boat Harbour;

subject to the following conditions:

1. The constructing authority must inform the Regional Harbour Master, Department of Transport, Gladstone and the Boat Harbour Controller (Rosslyn Bay) of the following, at least 14 days prior to commencement of the works so that a Notice to Mariners can be issued:

   a) the proposed date of the commencement of the works or the establishment of plant on the site;

   b) the proposed timetable associated with the works;

   c) the name and address of the on-site contractor undertaking the works;

   d) the name and telephone number of a contact for the on-site contractor.

2. The constructing authority must inform the Regional Harbour Master, Gladstone and the Boat Harbour Controller (Rosslyn Bay) of the completion of the works within 14 days of practical completion.

3. The constructing authority must issue any notices required by the Regional Harbour Master, Gladstone.

4. The constructing authority must issue advice at a time specified by the Regional Harbour Master, Gladstone, prior to when dredging will commence in boat mooring areas so that vessel owners can be advised to move their vessels.

5. All spoil material is to be disposed of in an approved offshore spoil disposal area.

6. All marine plant and equipment used by the constructing authority must:

   a) carry the requisite signals as specified by the "Queensland Marine (Prevention of Collisions) Regulation 1992" and approved by the Regional Harbour Master, Gladstone. All floating plant must meet Department of Transport (Maritime Division) survey and crewing requirements;

   b) be fitted with effective silencing devices by the constructing authority to keep noise to a minimum;

   c) be maintained by the constructing authority to minimise discharge of noxious fumes and unburnt carbon from exhausts;

   d) be in current Queensland Transport Registration.

7. Dredgers and associated plant shall each have a current appropriate certificate of survey.

8. Equipment operators shall each hold the appropriate Marine Certificates of Competency.

9. If any snags or obstructions are encountered during the carrying out of the works, the constructing authority must at its cost and expense remove and dispose of them as directed by the Regional Harbour Master, Gladstone.

10. All floating plant and moorings for such plant shall be kept clear of navigation channels when working in areas outside the navigation channel or moored, and the moorings shall be marked and lit in accordance with the requirements of the Regional Harbour Master, Gladstone or his representative.

11. The constructing authority shall supply and install any warning signs as may be required by the Regional Harbour Master, Gladstone.

12. The constructing authority shall, within 3 months of the date of practical completion of the works, submit to the Coastal Development Section of this Department, a letter from a Registered Professional Engineer of Queensland certifying that the works have been constructed in accordance with the approved drawings and these conditions.

13. Any material which is deposited outside the alignment of the works shown on the sanctioned plans or any debris which falls or is deposited on tidal lands or into tidal waters during the construction of the works shall be removed by the constructing authority at its cost and expense prior to the practical completion of the works, to the satisfaction of the Regional Harbour Master, Gladstone.

14. If, as a result of removal of material, or any other cause attributable to the constructing authority, any bank or structure is displaced, the constructing authority at its cost and expense shall restore the bank or structure to its former condition and take such other action as is necessary to ensure the stability of the bank or structure to the satisfaction of the Regional Harbour Master, Gladstone.

15. The constructing authority must supply, install and maintain, at its own cost, any navigation lights, buoys, marks and any warning signs which the Regional Harbour Master, Gladstone considers necessary. All lights, marks, buoys and signs must be in accordance with the requirements of the Department of Transport (Maritime Division).

16. All lighting from the structures and surrounds must be shielded to seaward to the satisfaction of Regional Harbour Master, Gladstone so as not to cause a navigation hazard or problem.

17. The constructing authority must at its own cost, ensure that all appropriate and necessary safeguards, in and around the whole of the structure, are undertaken and maintained at all times, to ensure the safety of the public.

18. The constructing authority must ensure that all materials and workmanship are in accordance with all appropriate Australian Standards, and that all works are designed in accordance with Australian Standards and are constructed in accordance with standard building practice.

19. The hours of operation for the construction (or demolition) of the works (ie. operation of any machinery and/or other equipment) shall be restricted to between 0800 and 1800 Monday to Saturday. No works shall be undertaken on Sundays or public holidays. Any variations to these times may be authorised by the Livingstone Shire Council.

20. All the relevant requirements of the Transport Operations (Marine Safety) Act 1994 and the Transport Operations (Marine Safety) Regulations 1995 are to be complied with at all times.

Copies of the sanctioned plans are returned herewith.

I wish to point out that the sanction or conditions do not constitute a ruling on structural safety and you must make your own arrangements to ensure adequacy of design and work.

Please advise the Coastal Management Section of this Department, of the proposed date of commencement of the works and when the works have been completed.

The granting of this sanction pursuant to the Harbours Act does not remove the need to obtain any further approval for this work which may be required pursuant to other legislation, both State and Commonwealth. Applicants are advised to check with all relevant statutory authorities for such approvals as may be required. Your attention is drawn to the provisions of the Native Title Act 1993 (Commonwealth) insofar as it may affect your right to construct these works on the subject land.

Yours faithfully

W.J. Fisher
Regional Director
(Central Coast)

Facility ID	LV96
Date of Search	27/02/2006
Location	Rosslyn Bay Boat Harbour
Works Description	Dredging Channel
Date of Application	11/02/1997
Date of Sanction	23/05/1997
Drawing Numbers	RS-1-19-5B

(809)

QUEENSLAND GOVERNMENT

Department of Environment

Central Coast Regional Office • Corner Yeppoon and Norman Roads, North Rockhampton Qld 4701
PO Box 3130 ROCKHAMPTON SHOPPING FAIR QLD 4701
Telephone (079) 36 0511 • Facsimile (079) 36 2212

Enquiries to	Mrs J. Chappell
Telephone	(079) 36 0511
Your Reference	410-21-327-1-A
Our Reference	CR2013 JC:JC

COPY

26 May 1997

Minister for Transport and Main Roads
Department of Transport
Maritime Division
Floor 26
Mineral House
41 George Street
BRISBANE QLD 4000

Attention: **Mr R.S. Atkinson**

Dear Sir

Re: Maintenance dredging at Rosslyn Bay Boat Harbour

I wish to advise you that in pursuance of the provisions of section 86 of the *Harbours Act 1955*, sanction was given on the 23 May 1997 to the plans deposited for:

- an amendment to the previous sanction given on the 1 August 1996 to include three additional dredge areas, being areas E1, E2 and F on drawing RS-1-19-5B;
- in Rosslyn Bay Boat Harbour;
- the disposal of the dredge material at sea in the location given on approved drawing RS-1-19-9;
- drawing RS-1-19-5B supersedes previously approved drawing RS-1-19-5A.

This approval is subject to the conditions specified in the previous letter of sanction dated 5 August 1996 and the following additional condition:

1. On completion of the maintenance dredging and spoil disposal the constructing authority shall submit to the Regional Director, Department of Environment, Rockhampton a hydrographic survey of the harbour and the spoil disposal site.

.../2

Copies of the sanctioned plans are returned herewith.

I wish to point out that the sanction or conditions do not constitute a ruling on structural safety and you must make your own arrangements to ensure adequacy of design and work.

The granting of this sanction pursuant to the Harbours Act does not remove the need to obtain any further approval for this work which may be required pursuant to other legislation, both State and Commonwealth. Applicants are advised to check with all relevant statutory authorities for such approvals as may be required. Your attention is drawn to the provisions of the *Native Title Act 1993 (Commonwealth)* insofar as it may affect your right to construct these works on the subject land.

If you have any queries please contact Engineering Associate, Jacqueline Chappell on (079) 36 0511.

Yours faithfully

W.J. Fisher
Regional Director
(Central Coast)

B/c: Executive Director (Maritime)
Department of Transport
Transport Infrastructure Branch
Level 1
Dickens Street
SPRING HILL QLD 4000

This copy is provided for your information. Previous correspondence from Mr Tony Giufre refers.

Regional Director
~~for~~ (Central Coast)

Noted, T. Giufre 30/5

DREDGE LIMITS

NUMBER	EASTING	NORTHING
10	273 554 42	7 436 554.14
11	273 529 55	7 436 484.53
12	273 469 28	7 436 524.09
13	273 507 18	7 436 570.56
14	273 541 22	7 436 667.52
31	273 504.03	7 436 698.52
35	273 552.34	7 436 578.21
36	273 544.97	7 436 557.42
37	273 575.20	7 436 546.92
38	273 579.92	7 436 545.28
39	273 587.48	7 436 567.00
40	273 582.75	7 436 568.64
41	273 568.81	7 436 573.49
42	273 448 00	7 436 498.00
43	273 448 00	7 436 465.00
44	273 479.00	7 436 440.00
45	273 499.95	7 436 469.67
46	273 513.05	7 436 460.42

A

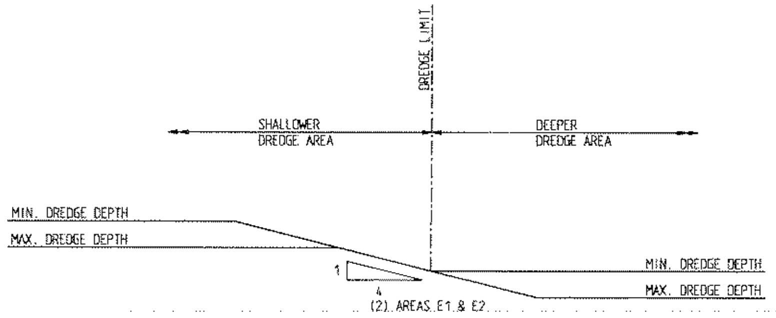
AMG COORDINATES AGD84 Zone 56

STATION	EASTING	NORTHING	REMARKS
PM 50431	273 596.55	7 436 520.60	Standard
T1	273 461.22	7 436 401.64	Peg

DREDGE DEPTHS & VOLUMES (METRES BELOW L.A.T.)

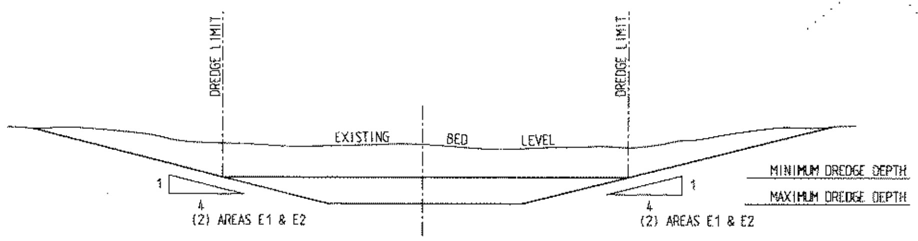
DREDGE AREA	MINIMUM DREDGE DEPTH	MAXIMUM DREDGE DEPTH	MINIMUM DREDGE VOLUME
E1	2.00 m	2.30 m	895 m³
E2	1.00 m	1.30 m	255 m³
F	1.40 m	1.70 m	900 m³

A



TYPICAL SECTION BETWEEN ADJACENT DREDGE AREAS (A)

NOT TO SCALE



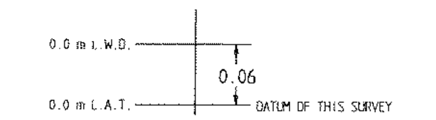
TYPICAL DREDGE SECTION (A)

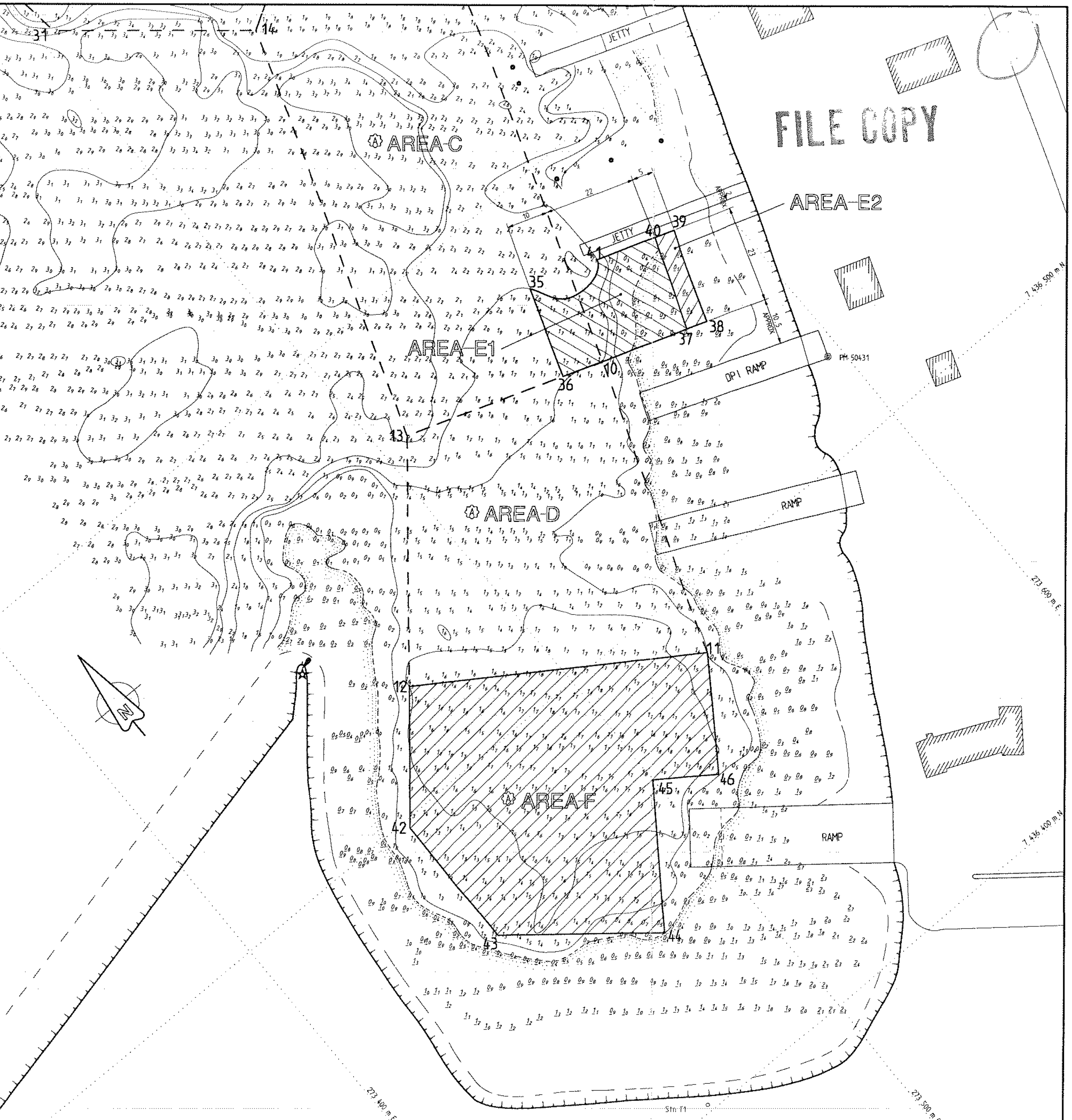
NOT TO SCALE

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. ALL LEVELS AND SOUNDINGS ARE IN METRES AND HAVE BEEN REDUCED TO LOW ASTRONOMICAL TIDE (L.A.T.).
3. VERTICAL DATUM FOR LEVELS ESTABLISHED FROM PM 47784 RL 6.64 L.A.T.
4. SOUNDINGS SHOWN THUS eg. 6_7 INDICATE METRES BELOW L.A.T
   SOUNDINGS SHOWN THUS eg. $\underline{2}_4$ INDICATE METRES ABOVE L.A.T.
5. SOUNDING INFORMATION ON THIS DRAWING WAS DERIVED FROM QUEENSLAND TRANSPORT DRAWING NUMBER G005-047 (DATED FEBRUARY 1996).
6. THE BASE OF THIS DRAWING WAS DERIVED FROM QUEENSLAND TRANSPORT DRAWING NUMBER RS-1-19-8.
7. ALL COORDINATES ARE IN METRES AND ARE TO THE AUSTRALIAN MAPPING GRID. HORIZONTAL DATUM IS AGD 84 ZONE 56.
   BASE STATION: BOAT SHED
   EASTING: 273 671.6
   NORTHING: 7 436 739.5

TIOAL DATUM NOTE





Drawing No	Associated Drawings	Amend	Description	Date	Approved
RS-1-19-5	LAYOUT, SECTIONS, SITE PLAN AND NOTES	A	AREAS C & D IDENTIFIED, AREA F ADDED, SECTIONS ALTERED, DREDGE TABLES CHANGED	10/4/97	T J.G.

410-21-327
File No

MT12-25
Contract No

Ratio Scales (Before Reduction) mm

D HEAZLEWOOD Drafting | Drafting Ckd | Examined D.S. HEAZLEWOOD Snr Co-ord. (Tech & Admin)

T J.G. Design | Design Ckd | Approved

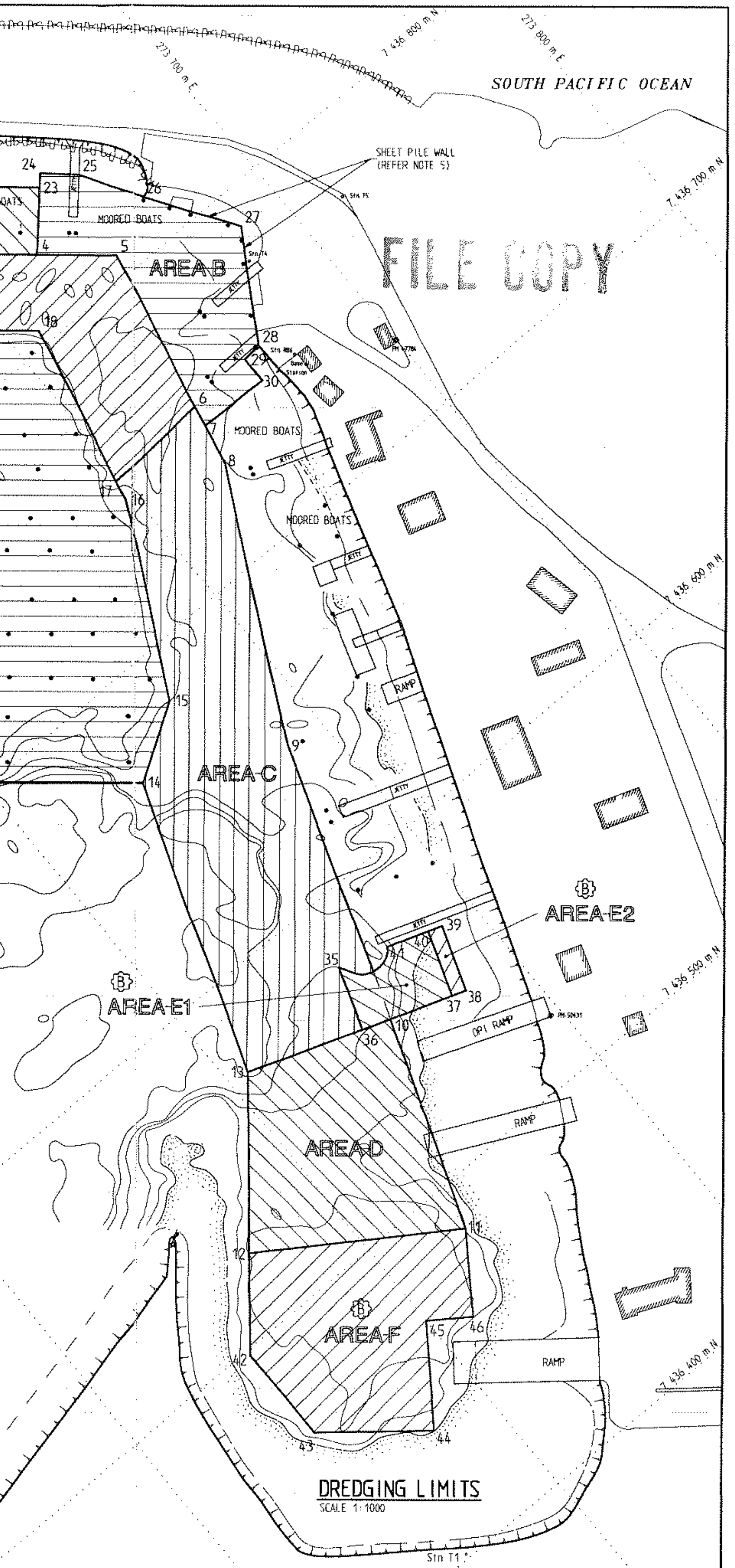
Certified R.P.E.Q. No. 2323 L.J. ANDERSEN Engineering Manager 10/4/97 Date

QUEENSLAND TRANSPORT
Queensland Department of Transport
Integrated Transport Planning Division
Transport Infrastructure Branch

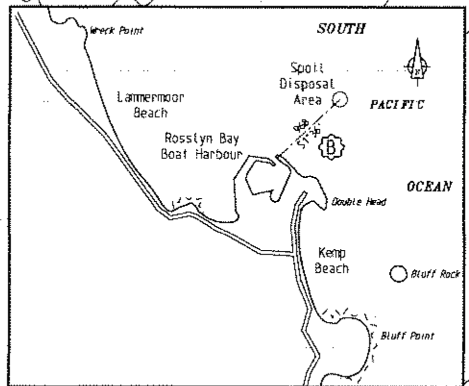
ROSSLYN BAY BOAT HARBOUR
ADDITIONAL DREDGING 1996 - FOR DEPARTMENTS OF ENVIRONMENT, PRIMARY INDUSTRIES, AND QLD POLICE
DETAILS

RS-1-19-10A
Drawing Number

NOTE:
DREDGING SEAWARD EXTENDS TO THE RL 2.4m CONTOUR (L.A.T.)
CHANNEL COORDINATES '1' AND '21' HAVE BEEN DETERMINED FROM QUEENSLAND TRANSPORT DRAWING No. G005-047 FOR TENDER PURPOSES ONLY. THE COORDINATES OF '1' AND '21' FOR CONTRACT PURPOSES SHALL BE DETERMINED FROM THE RL 2.4m CONTOUR (L.A.T.) TO BE SHOWN ON THE PRE-DREDGING SURVEY PLAN.



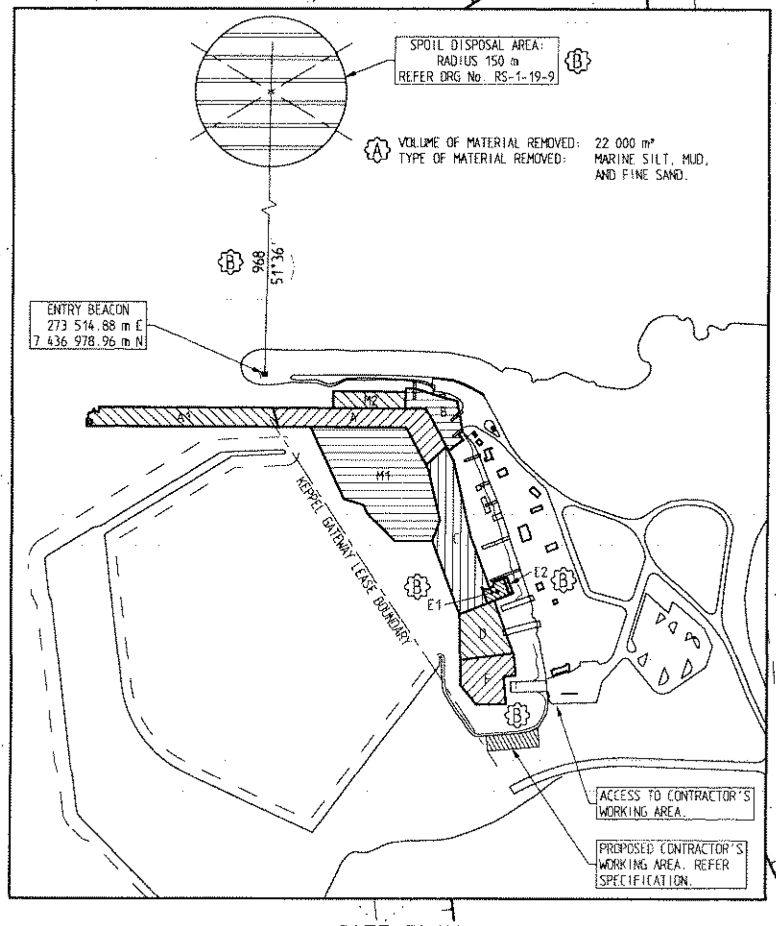
DREDGING LIMITS
SCALE 1:1000



LOCALITY PLAN
SCALE 1:50 000

AMG COORDINATES AGD84 Zone 56

STATION	EASTING	NORTHING	REMARKS
PM 47784	273 699.97	7 436 726.33	Standard
PM 50431	273 596.55	7 436 520.60	Standard
Disposal Centre	274 306.3	7 437 743.3	
T1	273 461.22	7 436 401.64	Peg
T2	273 134.87	7 436 830.88	Peg
T3	273 630.62	7 436 876.44	Peg (gone)
T4	273 679.32	7 436 777.20	GI nail
T5	273 716.30	7 436 774.03	Hilti nail (gone)
RB6	273 670.73	7 436 744.48	Hilti nail
NAV AIDS			
Green Ent. Bcn.	273 466.4	7 436 882.5	
Red Ent. Bcn.	273 514.88	7 436 978.96	
Nav Light	273 451.48	7 436 542.76	
Yellow Buoy	273 516	7 436 521	

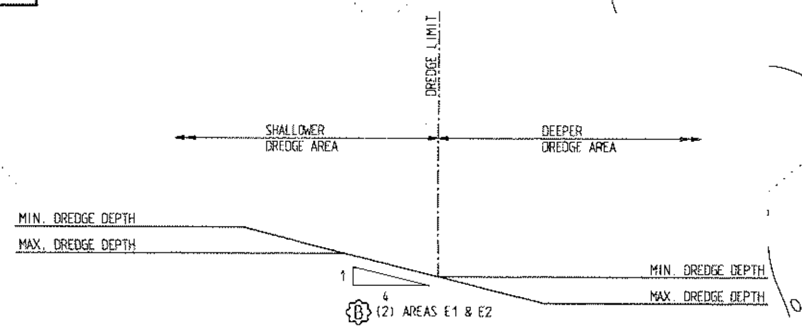


SITE PLAN
SCALE 1:5000

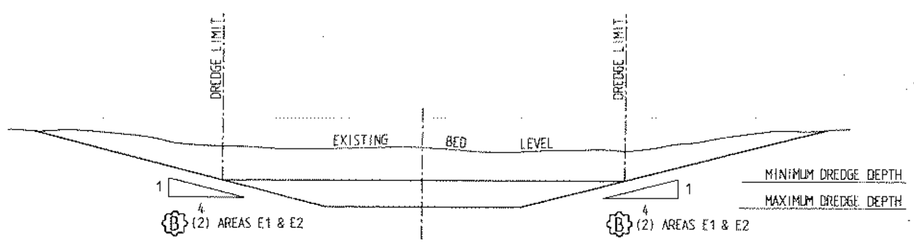
DREDGE LIMITS

NUMBER	EASTING	NORTHING
1	273 318.83	7 437 084.14
2	273 493.47	7 436 936.37
3	273 554.01	7 436 885.14
4	273 625.50	7 436 824.65
5	273 646.25	7 436 807.09
6	273 634.64	7 436 752.02
7	273 633.21	7 436 745.23
8	273 630.27	7 436 731.28
9	273 586.45	7 436 646.29
10	273 554.42	7 436 554.14
11	273 529.55	7 436 484.53
12	273 469.28	7 436 524.09
13	273 507.18	7 436 570.56
14	273 541.22	7 436 667.52
15	273 565.82	7 436 682.66
16	273 597.18	7 436 743.49
17	273 598.53	7 436 749.95
18	273 610.03	7 436 804.98
19	273 514.57	7 436 885.68
20	273 481.88	7 436 913.31
21	273 289.68	7 437 075.79
22	273 568.45	7 436 902.19
23	273 640.27	7 436 841.19
24	273 643.42	7 436 844.73
25	273 653.12	7 436 836.07
26	NORTHERN END	OF SHEET PILE WALL
27	INTERSECTION	OF SHEET PILE WALLS
28	SOUTHERN END	OF SHEET PILE WALL
29	273 657.40	7 436 753.42
30	273 657.40	7 436 744.44
31	273 504.03	7 436 698.52
32	273 499.00	7 436 749.18
33	273 502.34	7 436 761.74
34	273 487.67	7 436 784.41

(B) FOR DREDGE LIMITS IN AREAS E1, E2 & F, REFER DRG. No. RS-1-19-10.



TYPICAL SECTION BETWEEN ADJACENT DREDGE AREAS
NOT TO SCALE



TYPICAL DREDGE SECTION
NOT TO SCALE

NOTES

1. ALL DIMENSIONS ARE IN METRES
2. ALL LEVELS AND SOUNDINGS ARE IN METRES AND HAVE BEEN REDUCED TO LOW ASTRONOMICAL TIDE (L.A.T.).
3. VERTICAL DATUM FOR LEVELS ESTABLISHED FROM PM 47784 RL 6.64 L.A.T.
4. ALL COORDINATES ARE IN METRES AND ARE TO THE AUSTRALIAN MAPPING GRID. HORIZONTAL DATUM IS AGD 84 ZONE 56.
   BASE STATION: BOAT SHED
   EASTING: 273 671.6
   NORTHING: 7 436 739.5
5. DREDGE DEPTH SHALL BE MAINTAINED UP TO 1 METRE FROM SHEET PILE WALL.
6. PILES IN THE HARBOUR IDENTIFIED THUS •.

DREDGE DEPTHS (METRES BELOW L.A.T.)

DREDGE AREA	MINIMUM DREDGE DEPTH	MAXIMUM DREDGE DEPTH
A1	2.40 m	2.90 m
A	2.40 m	2.90 m
B	1.70 m	2.00 m
C	1.90 m	2.20 m
D	1.40 m	1.70 m
M1	1.40 m	1.70 m
M2	1.40 m	1.70 m

(B) FOR DREDGE DEPTHS IN AREAS E1, E2 & F, REFER DRG. No. RS-1-19-10.

Drawing No	Associated Drawings
RS-1-19-9	OFFSHORE SPOIL DISPOSAL AREA
RS-1-19-8	DREDGING DETAILS - SHEET 3 OF 3
RS-1-19-7	DREDGING DETAILS - SHEET 2 OF 3
RS-1-19-6	DREDGING DETAILS - SHEET 1 OF 3

Amend.	Description	Date	Approved
B	AREAS E1, E2 & F ADDED, DREDGE NOTE ADDED, SPOIL DISPOSAL AREA BEARING AND DISTANCE ALTERED, BASE PLAN ALTERED - PILES 12 TO 22 REMOVED	10/4/97	T.J.G
A	VOLUME AND TYPE OF MATERIAL REMOVED-NOTE ADDED	5/7/96	T.J.G

File No: 410-21-327
Contract No: MT12-25

Ratio Scales (Before Reduction) mm
1:1 0 10 20 30 40 50 60
1:2 0 20 40 60 80 100 120
1:2.5 0 50 100 150
1:5 0 100 200 300

JAS-ANZ
QUALITY SYSTEM CERTIFIED TO AS 3901/ISO 9001 REGN. NO. 913

Drafting: K.S. SUNDHOLM
Drafting Ckd: D.S.H.
Design: R.S.A.
Design Ckd: R.S.A.
Examined: D.HEAZLEWOOD Mgr Co-ord. (Tech & Admin)
Approved:
Certified: L.J. ANDERSEN, R.P.E.Q. No. 2323, Engineering Manager
Date: 10/4/97

QUEENSLAND TRANSPORT
Queensland Department of Transport
Integrated Transport Planning Division
Transport Infrastructure Branch

ROSSLYN BAY BOAT HARBOUR
DREDGING 1996
LAYOUT, SECTIONS, SITE PLAN AND NOTES

Drawing Number: RS-1-19-5B

Department of Environment
and Resource Management

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I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed: M Flanagan
Name: Sandra Joy Flanagan
Date: 12/01/12

COMMISSIONER FOR DECLARATIONS
Reg. No 8880
DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

RECEIVED
DATE 16/1/12 BY

Notice

Decision notice

This notice is issued by the Department of Environment and Resource Management pursuant to section 334 (decision notice) of the Sustainable Planning Act 2009 ("the Act").

The Department of Transport and Main Roads
GPO Box 2595
BRISBANE QLD 4000
Attn: Naomi Cleaves
Ref: 215/1250

cc. Maritime Safety Queensland
PO Box 123
GLADSTONE QLD 4680
Attn: Mike Lutze
Ref: P15927

Our reference: ROK6325

Chris for filing. 16/1/12

Re: Application for development approval

1. **Application Details**

Date application made to DERM: 25 August 2011

Development approval applied for: Development Approval

Aspect of development:

Operational work – For tidal works or work within a coastal management district	***Sustainable Planning Regulation 2009* - Schedule 3, Part 1, Table 4, item 5**	**DERM ref. no.: 291327** **DERM Permit No: SPDC02622311**

Development description: Dredging within the Rosslyn Bay Harbour for a navigational channel and disposal of the dredge material offshore.

Property/Location description:
Development Location: Lot 105 SP161849
Disposal Location: 100 metres radius from the centre point of:
274 414.6 E
437 928.5 N

2. The name and address of each referral agency is as follows.

Concurrence Agency	Concurrence Agency Ref. Number
Maritime Safety Queensland PO Box 123 GLADSTONE QLD 4680	P15927

3. The Chief Executive, Department of Environment and Resource Management (DERM) decision notice, for the aspect of development involved with the application the subject of this Notice is as follows.

The application was decided on 8 December 2011 and is approved subject to conditions.

4. **Approved plans and specifications**

RECEIVED BY DATE

Document No.	Document Name	Date
RS-1-19-9	Offshore Disposal Area	2-5-96
RBBH- TW- 001	Tidal Works Layout – Area H	15-8-11

S Flanagan

Delegate
Sandra Flanagan
Chief Executive administering *Coastal Protection and Management Act 1995*
Department of Environment and Resource Management
8 December 2011

Attachments
DERM Permit No. SPDC02622311
Information Sheet – Appeals – *Sustainable Planning Act 2009* (extract from the *Sustainable Planning Act 2009*)
Approved plans and specifications
Concurrence agency conditions – Maritime Safety Queensland

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I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed: S Flanagan
Name: Sandra Joy Flanagan
Date: 2/01/12

COMMISSIONER FOR DECLARATIONS
Reg. No. 8880
DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

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I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed: M Flanagan
Name: Sandra Joy Flanagan
Date: 12/01/12

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Reg. No. 8880
DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

Department of Environment
and Resource Management

Sustainable Planning Act 2009

DERM Permit [1] number: SPDC02622311

Date application received:	25 August 2011
Permit type:	**Development Approval**
Date of decision:	8 December 2011
Decision:	For a **decision notice** the application is **approved subject to conditions**, and the assessment manager's conditions are stated in this permit, and any **concurrence agency conditions are attached to this permit** in the exact form given by the concurrence agency named on the attachment
Relevant laws and policies:	*Sustainable Planning Act 2009* *Coastal Protection and Management Act 1995*
Jurisdiction(s):	

Operational work – For tidal works or work within a coastal management district	*Sustainable Planning Regulation 2009* - Schedule 3, Part 1, Table 4, item 5	DERM ref. no.: 291327 DERM Permit No.: SPDC02622311

Development Description(s)

Property/Location		Development
Development Location Lot 105 SP161849	Tidal works in, on, or above tidal waters	Dredging within the Rosslyn Bay Harbour for a navigational channel and disposal of the dredge material offshore.
Disposal Location 100m radius from the centre point of: 274 414.6 E 437 928.5 N As shown on plan RS-1-19-9	Disposing of dredge spoil or other solid waste material in tidal waters (other than under an allocation notice under the *Coastal Protection and Management Act 1995*)	

Reason(s) for inclusion of conditions

In accordance with section 289 of the *Sustainable Planning Act 2009*, the reason(s) for inclusion of conditions stated in this permit required by the concurrence agency response for the application are as follows:

The Department of Environment and Resource Management (DERM) is the assessment manager pursuant to Schedule 4, Table 4, Item 1 Sustainable Planning Regulation 2009 for the development and assesses the

[1] Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the Department of Environment and Resource Management.

application against the *Coastal Protection and Management Act 1995* pursuant to Schedule 6, Table 4, Item 1 of the *Sustainable Planning Regulation 2009* and can impose conditions pursuant to section 106 of the *Coastal Protection and Management Act 1995.*

The activity for which this development approval is issued is simply a reinstatement of the activity as prescribed in the legislation at the time of issuing this development approval. Where there is any conflict between the above description of the activity for which this development approval is issued and the conditions as specified in the development approval as to the scale, intensity or manner of carrying out of the activity, then such conditions prevail to the extent of the inconsistency.

This development approval authorises the activity. It does not authorise environmental harm unless a condition within this development approval explicitly authorises that harm. Where there is no condition or the development approval is silent on a matter, the lack of condition or silence shall not be construed as authorising harm

This approval does not remove the need to obtain any further approval for this development, which may be required pursuant to this or other legislation, both State and Commonwealth. Applicants are advised to check with all relevant statutory authorities for such approvals as may be required.

Appeal Rights

Chapter 7, Part 1, Division 8 of the *Sustainable Planning Act 2009* details your appeal rights reagarding this decision. Please find attached as Attachment 1.

Effectiveness periods

This development approval takes effect -

- From the time the decision notice is given, if there is no submitter and the applicant does not appeal the decision to the court; or
- When the submitter's appeal period ends, if there is a submitter and the applicant does not appeal the decision to the court; or
- Subject to the decision of the court, when the appeal is finally decided, if an appeal is made to the court

Currency periods

Subject to section 341 of the *Sustainable Planning Act 2009,* the development approval will lapse unless the development is substantially started before **8 December 2013.**

Delegate
Sandra Flanagan
Chief Executive administering *Coastal Protection and Management Act 1995,*
Department of Environment and Resource Management
8 December 2011

CERTIFIED COPY
I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed:
Name: Sandra Joy Flanagan
Date: 12/01/12

COMMISSIONER FOR DECLARATIONS
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DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

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Signed: Mflanagan
Name: Sandra Joy Flanagan
Date: 12/01/12

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CONDITIONS

General

1. The extractive operations must be confined to 'Area H' and the maximum quantity to be removed from 'Area H' is 30 000 cubic meters.
2. All dredge spoil must be deposited within a 100 metre radius of the central point of 274 414.6 E, 437 928.5 N.
3. Any material subject to this application that is deposited outside of the approved location specified in Condition 3 must be removed.

Start of Works

4. The DERM is to be advised, by written communication, of the date of work commencement at least five (5) business days prior to the commencement date.

Construction

5. Construction of the works shall be carried out using suitable plant and equipment consistent with meeting the requirements of conditions of this approval and with preventing environmental harm.
6. Excavation must not extend past -2.9 metres below Lowest Astronomical Tide (LAT).
7. Contaminants must not be released or discharged directly or in-directly to any bed or banks of any watercourses or marine waters, groundwater or stormwater systems, including silt run-off, oil and grease spills from machinery, concrete truck washout and alike, unless otherwise permitted through this permit (e.g. wastewaters during disposal).
8. The chief executive administering the *Coastal Protection and Management Act 1995* may order the applicant to take reasonable action or cease works if the delegate deems the operations are causing adverse effects on coastal management or adjoining ecological habitats.

Acid Sulfate Soils

9. If acid sulphate soils are found to be present in areas subject to excavation, or sediments within the dredge spoil, then the works must be managed to prevent release of acidic drain water to any natural waters in accordance with procedures outlined in the following documents:
   a. State Planning Policy 2/02 Guideline: Acid Sulfate Soils;
   b. Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland 1998; and
   c. Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines, 2002
10. Construction activities shall not directly or indirectly cause the release of acidic water (pH less than 6.5) from the site to waters as a result of oxidation of potential acid sulfate soils resulting from excavation or displacement.

Water Pollution

11. All excavation and disposal activities must be conducted so that changes in water chemistry will not impact on surrounding ecological values.
12. Disposal operations must be carried out taking all suitable measures necessary to minimise the concentration of suspended solids released.

13. Where there are any signs of turbidity, suitable measures must be implemented to maintain water quality (e.g. silt booms) such that any suspended sediments and resulting contaminated water is prevented from dispersing through the tidal waters.

14. The dredge spoil must;

    a. not have any properties which are capable of causing environmental harm; and

    b. not produce any slick or other visible evidence of oil or grease, nor contain any visible floating oil, grease, scum, litter or other offensive matter.

15. The disposal operations must not result in a visible increase in water turbidity beyond the disposal site, being the 100 metres radius of central point of 274 414.6 E, 437 928.5 N.

16. If water turbidity extends past the 100 metres radius of central point of 274 414.6 E, 437 928.5 N, then the DERM is to be notified and action is to be taken to reduce turbidity plumes, which may include decreasing disposal frequency or ceasing disposal operations.

Monitoring

17. Water quality monitoring must be conducted in accordance with the methods prescribed in the *DERM Monitoring and Sampling Manual 2009* or more recent editions or supplements to that document as such become available

18. Water quality monitoring results provided to DERM on a monthly basis for the duration of the works approved under this permit.

19. Daily visual monitoring and weekly photographic monitoring of the water quality originating at the excavation and disposal locations is to be undertaken and records retained at least for the period of the works. These photographs must be provided to DERM every fortnight.

Post-Construction

20. The DERM is to be advised within ten (10) days following completion of the works.

21. The permit holder must, within three (3) months of the completion of the works, submit to the DERM documents evidencing:-

    a. The works have been constructed in accordance with the approved drawings and the conditions of this development approval;

    b. The works are adequate for anticipated usage;and

    c. Cross sectional bed level surveys of 'Area H' and the disposal location.

Maintenance

22. The chief executive administering the *Coastal Protection and Management Act 1995* may order the works to be modified, within a reasonable time, if the works have or are likely to have a significant effect on coastal management.

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Name: Sandra Joy Flanagan
Date: 12/01/12

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DEFINITIONS

Words and phrases used throughout this permit[1] are defined below. Where a definition for a term used in this permit[1] is sought and the term is not defined within this permit[1] the definitions provided in the relevant legislation shall be used.

"administering authority" means the DERM or its successor.

"approval" means 'notice of development application decision' or 'notice of concurrence agency response' under the *Sustainable Planning Act 2009.*

"approved plans" means the plans and documents listed in the approved plans section in the notice attached to this concurrence response.

"artificial waterway" means an artificial channel, lake or other body of water. Artificial waterway includes –
- an artificial channel that is formed because the land has been reclaimed from tidal water and is intended to allow boating access to allotments on subdivided land;
- other artificial channels subject to the ebb and flow of the tide; and
- any additions or alterations to an artificial waterway.

"canal" means an artificial waterway surrendered to the State. A canal is an artificial waterway connected, or intended to be connected, to tidal water; and from which boating access to the tidal water is not hindered by a lock, weir or similar structure.

"coastal dune" means a ridge or hillock of sand or other material on the coast and built up by the wind.

"commercial place" means a place used as an office or for business or commercial purposes.

"dredge spoil" means material taken from the bed or banks of waters by using dredging equipment or other equipment designed for use in extraction of earthen material.

"dwelling" means any of the following structures or vehicles that is principally used as a residence –
- a house, unit, motel, nursing home or other building or part of a building;
- a caravan, mobile home or other vehicle or structure on land;
- a water craft in a marina.

"Department of Environment and Resource Management (DERM)" means the department or agency (whatever called) administering the *Coastal Protection and Management Act 1995* or the *Environmental Protection Act 1994.*

"erosion prone area" means an area declared to be an erosion prone area under section 70(1) of the *Coastal Protection and Management Act 1995.*

"high water mark" means the ordinary high water mark at spring tides.

"land" in the "land schedule" of this document means land excluding waters and the atmosphere.

"permit" includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the DERM and the Queensland Parks and Wildlife.

"ponded pasture" means a permanent or periodic pondage of water in which the dominant plant species are pasture species used for grazing or harvesting.

"protected area" means –
- a protected area under the *Nature Conservation Act 1992*; or
- a marine park under the *Marine Parks Act 1992*; or
- a World Heritage Area.

"quarry material" means material on State coastal land, other than a mineral within the meaning of any Act relating to mining. Material includes for example stone, gravel, sand, rock, clay, mud, silt and soil, unless it is removed from a culvert, stormwater drain or other drainage infrastructure as waste material.

"site" means land or tidal waters on or in which it is proposed to carry out the development approved under this development approval.

"tidal water" means the sea and any part of a harbour or watercourse ordinarily within the ebb and flow of the tide at spring tides.

"watercourse" means a river, creek or stream in which water flows permanently or intermittently-
- in a natural channel, whether artificially improved or not; or
- in an artificial channel that has changed the course of the watercourse.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater and any part-thereof.

"waterway" includes a river, creek, stream, watercourse or inlet of the sea

"works" or **"operation"** means the development approved under this development approval.

"you" means the holder of this development approval or owner / occupier of the land which is the subject of this development approval.

END OF CONDITIONS

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I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed: MFlanagan
Name: Sandra Joy Flanagan
Date: 12/01/12

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DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

Department of Environment and Resource Management

Information sheet

Appeals – *Sustainable Planning Act 2009*
(extract from the *Sustainable Planning Act 2009* Reprint 1A effective 1 January 2010)

Chapter 7, Part 1, Division 8 Appeals to court relating to development applications and approvals

461 Appeals by applicants

(1) An applicant for a development application may appeal to the court against any of the following—

(a) the refusal, or the refusal in part, of the development application;

(b) any condition of a development approval, another matter stated in a development approval and the identification or inclusion of a code under section 242;

(c) the decision to give a preliminary approval when a development permit was applied for;

(d) the length of a period mentioned in section 341;

(e) a deemed refusal of the development application.

(2) An appeal under subsection (1)(a), (b), (c) or (d) must be started within 20 business days (the ***applicant's appeal period***) after—

(a) if a decision notice or negotiated decision notice is given—the day the decision notice or negotiated decision notice is given to the applicant; or

(b) otherwise—the day a decision notice was required to be given to the applicant.

(3) An appeal under subsection (1)(e) may be started at any time after the last day a decision on the matter should have been made.

462 Appeals by submitters—general

(1) A submitter for a development application may appeal to the court only against—

(a) the part of the approval relating to the assessment manager's decision about any part of the application requiring impact assessment under section 314; or

(b) the part of the approval relating to the assessment manager's decision under section 327.

(2) To the extent an appeal may be made under subsection (1), the appeal may be against 1 or more of the following—

(a) the giving of a development approval;

(b) any provision of the approval including—

(i) a condition of, or lack of condition for, the approval; or

(ii) the length of a period mentioned in section 341 for the approval.

(3) However, a submitter may not appeal if the submitter—

(a) withdraws the submission before the application is decided; or

(b) has given the assessment manager a notice under section 339(1)(b)(ii).

(4) The appeal must be started within 20 business days (the ***submitter's appeal period***) after the decision notice or negotiated decision notice is given to the submitter.

463 Additional and extended appeal rights for submitters for particular development applications

(1) This section applies to a development application to which chapter 9, part 7 applies.

(2) A submitter of a properly made submission for the application may appeal to the court about a referral agency's response made by a prescribed concurrence agency for the application.

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Signed:
Name: Sandra Joy Flanagan
Date: 20/01/12

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Reg. No. 8880
DEPARTMENT OF JUSTICE AND ATTORNEY-GENERAL

(3) However, the submitter may only appeal against a referral agency's response to the extent it relates to—
(a) if the prescribed concurrence agency is the chief executive (environment)—development for an aquacultural ERA; or
(b) if the prescribed concurrence agency is the chief executive (fisheries)—development that is—
(i) a material change of use of premises for aquaculture; or
(ii) operational work that is the removal, damage or destruction of a marine plant.
(4) Despite section 462(1), the submitter may appeal against the following matters for the application even if the matters relate to code assessment—
(a) a decision about a matter mentioned in section 462(2) if it is a decision of the chief executive (fisheries);
(b) a referral agency's response mentioned in subsection (2).

464 Appeals by advice agency submitters
(1) Subsection (2) applies if an advice agency, in its response for an application, told the assessment manager to treat the response as a properly made submission.
(2) The advice agency may, within the limits of its jurisdiction, appeal to the court about—
(a) any part of the approval relating to the assessment manager's decision about any part of the application requiring impact assessment under section 314; or
(b) any part of the approval relating to the assessment manager's decision under section 327.
(3) The appeal must be started within 20 business days after the day the decision notice or negotiated decision notice is given to the advice agency as a submitter.
(4) However, if the advice agency has given the assessment manager a notice under section 339(1)(b)(ii), the advice agency may not appeal the decision.

465 Appeals about decisions relating to extensions for approvals
(1) For a development approval given for a development application, a person to whom a notice is given under section 389, other than a notice for a decision under section 386(2), may appeal to the court against the decision in the notice.
(2) The appeal must be started within 20 business days after the day the notice of the decision is given to the person.
(3) Also, a person who has made a request under section 383 may appeal to the court against a deemed refusal of the request.
(4) An appeal under subsection (3) may be started at any time after the last day the decision on the matter should have been made.

466 Appeals about decisions relating to permissible changes
(1) For a development approval given for a development application, the following persons may appeal to the court against a decision on a request to make a permissible change to the approval—
(a) if the responsible entity for making the change is the assessment manager for the application—
(i) the person who made the request; or
(ii) an entity that gave a notice under section 373 or a pre-request response notice about the request;
(b) if the responsible entity for making the change is a concurrence agency for the application—the person who made the request.
(2) The appeal must be started within 20 business days after the day the person is given notice of the decision on the request under section 376.
(3) Also, a person who has made a request under section 369 may appeal to the court against a deemed refusal of the request.
(4) An appeal under subsection (3) may be started at any time after the last day the decision on the matter should have been made.

467 Appeals about changing or cancelling conditions imposed by assessment manager or concurrence agency
(1) A person to whom a notice under section 378(9)(b) giving a decision to change or cancel a condition of a development approval has been given may appeal to the court against the decision in the notice.
(2) The appeal must be started within 20 business days after the day the notice of the decision is given to the person.

Chapter 7, Part 1, Division 9 Appeals to court about compliance assessment

468 Appeals against decision on request for compliance assessment
(1) A person to whom an action notice has been given under section 405(5) about a request for compliance assessment of development, a document or work may appeal to the court against the decision in the notice.
(2) The appeal must be started within 20 business days after the notice is given to the person.

469 Appeals against condition imposed on compliance permit or certificate
(1) A person who is given a compliance permit or compliance certificate subject to any conditions may appeal to the court against the decision to impose the condition.
(2) The appeal must be started within 20 business days after the day the compliance permit or compliance certificate is given to the person.

470 Appeals against particular decisions about compliance assessment
(1) A person to whom any of the following notices have been given may appeal to the court against the decision in the notice—
- (a) a notice of a decision on a request to change or withdraw an action notice;
- (b) a notice under section 413(2)(c) about a decision to refuse a request to change a compliance permit or compliance certificate.

(2) The appeal must be started within 20 business days after the day the notice is given to the person.

Chapter 7, Part 1, Division 11 Making an appeal to court

481 How appeals to the court are started
(1) An appeal is started by lodging written notice of appeal with the registrar of the court.
(2) The notice of appeal must state the grounds of the appeal.
(3) The person starting the appeal must also comply with the rules of the court applying to the appeal.
(4) However, the court may hear and decide an appeal even if the person has not complied with subsection (3).

482 Notice of appeal to other parties—development applications and approvals
(1) An appellant under division 8 must give written notice of the appeal to—
- (a) if the appellant is an applicant—
  - (i) the chief executive; and
  - (ii) the assessment manager; and
  - (iii) any concurrence agency; and
  - (iv) any principal submitter whose submission has not been withdrawn; and
  - (v) any advice agency treated as a submitter whose submission has not been withdrawn; or
- (b) if the appellant is a submitter or an advice agency whose response to the development application is treated as a submission for an appeal—
  - (i) the chief executive; and
  - (ii) the assessment manager; and
  - (iii) any referral agency; and
  - (iv) the applicant; or
- (c) if the appellant is a person to whom a notice mentioned in section 465(1) has been given—
  - (i) the chief executive; and

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Signed: [signature]
Name: Sandra Joy Flanagan
Date: 2/01/12

Reg. No. 8880

(ii) the assessment manager for the development application to which the notice relates; and
(iii) any entity that was a concurrence agency for the development application to which the notice relates; and
(iv) the person who made the request under section 383 to which the notice relates, if the person is not the appellant; or
(d) if the appellant is a person mentioned in section 466(1)—
(i) the chief executive; and
(ii) the responsible entity for making the change to which the appeal relates; and
(iii) the person who made the request to which the appeal relates under section 369, if the person is not the appellant; and
(iv) if the responsible entity is the assessment manager—any entity that was a concurrence agency for the development application to which the notice of the decision on the request relates; or
(e) if the appellant is a person to whom a notice mentioned in section 467 has been given—the entity that gave the notice.
(2) The notice must be given within—
(a) if the appellant is a submitter or advice agency whose response to the development application is treated as a submission for an appeal—2 business days after the appeal is started; or
(b) otherwise—10 business days after the appeal is started.
(3) The notice must state—
(a) the grounds of the appeal; and
(b) if the person given the notice is not the respondent or a co-respondent under section 485—that the person may, within 10 business days after the notice is given, elect to become a co-respondent to the appeal by filing in the court a notice of election in the approved form.

483 Notice of appeals to other parties—compliance assessment
(1) An appellant under division 9 must, within 10 business days after the day the appeal is started, give written notice of the appeal to—
(a) if the appellant is a person to whom an action notice, compliance permit or compliance certificate has been given—
(i) the compliance assessor who gave the notice, permit or certificate; and
(ii) if the compliance assessor was a nominated entity of a local government and a copy of the request for compliance assessment was given to the local government under section 402—the local government; or
(b) if the appellant is a person to whom a notice mentioned in section 470(1) has been given—
(i) the entity that gave the notice; and
(ii) if the entity that gave the notice was a nominated entity of a local government and the written agreement of the local government was required to give the notice—the local government.
(2) The notice must state the grounds of the appeal.

485 Respondent and co-respondents for appeals under div 8
(1) Subsections (2) to (8) apply for appeals under sections 461 to 464.
(2) The assessment manager is the respondent for the appeal.
(3) If the appeal is started by a submitter, the applicant is a co-respondent for the appeal.
(4) Any submitter may elect to become a co-respondent for the appeal.
(5) If the appeal is about a concurrence agency's response, the concurrence agency is a co-respondent for the appeal.
(6) If the appeal is only about a concurrence agency's response, the assessment manager may apply to the court to withdraw from the appeal.
(7) The respondent and any co-respondents for an appeal are entitled to be heard in the appeal as a party to the appeal.
(8) A person to whom a notice of appeal is required to be given under section 482 and who is not the respondent or a co-respondent for the appeal may elect to be a co-respondent.

CERTIFIED COPY
I hereby certify that this is a true and correct copy of the original document which I have sighted.
Signed:
Name: Sandra Joy Flanagan
Date: 12/01/12

Reg. No. 8880

(9) For an appeal under section 465—
(a) the assessment manager is the respondent; and
(b) if the appeal is started by a concurrence agency that gave the assessment manager a notice under section 385—the person asking for the extension the subject of the appeal is a co-respondent; and
(c) any other person given notice of the appeal may elect to become a co-respondent.
(10) For an appeal under section 466—
(a) the responsible entity for making the change to which the appeal relates is the respondent; and
(b) if the responsible entity is the assessment manager—
(i) if the appeal is started by a person who gave a notice under section 373 or a pre-request response notice—the person who made the request for the change is a co-respondent; and
(ii) any other person given notice of the appeal may elect to become a co-respondent.
(11) For an appeal under section 467, the respondent is the entity given notice of the appeal.

486 Respondent and co-respondents for appeals under div 9
(1) For an appeal under section 468 or 469—
(a) the compliance assessor is the respondent; and
(b) if the compliance assessor is a nominated entity of a local government and the appeal relates to a matter required by a local government—the local government is a co-respondent.
(2) However, if the appeal is only about a matter required by the local government, the compliance assessor may apply to the court to withdraw from the appeal.
(3) For an appeal under section 470—
(a) the entity that gave the notice to which the appeal relates is the respondent; and
(b) if the entity mentioned in paragraph (a) is a nominated entity of a local government and the local government did not agree to the request mentioned in section 470(1)—the local government is a co-respondent.
(4) However, if the appeal is only about the local government's refusal of the request, the entity that gave the notice to which the appeal relates may apply to the court to withdraw from the appeal.

488 How an entity may elect to be a co-respondent
An entity that is entitled to elect to be a co-respondent to an appeal may do so, within 10 business days after notice of the appeal is given to the entity, by following the rules of court for the election.

489 Minister entitled to be party to an appeal involving a State interest
If the Minister is satisfied an appeal involves a State interest, the Minister may, at any time before the appeal is decided, elect to be a party to the appeal by filing in the court a notice of election in the approved form.

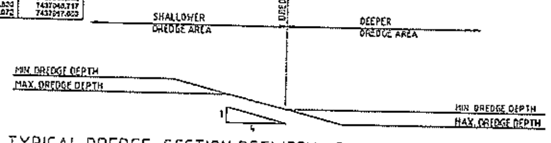
490 Lodging appeal stops particular actions
(1) If an appeal, other than an appeal under section 465, 466 or 467, is started under division 8, the development must not be started until the appeal is decided or withdrawn.
(2) If an appeal is about a condition imposed on a compliance permit, the development must not be started until the appeal is decided or withdrawn.
(3) Despite subsections (1) and (2), if the court is satisfied the outcome of the appeal would not be affected if the development or part of the development is started before the appeal is decided, the court may allow the development or part of the development to start before the appeal is decided.

NUMBER	EASTING	NORTHING
1	273427.591	7437292.332
2	273501.737	7437121.583
3	273652.298	7437070.334
4	273733.764	7437009.844
5	273754.504	7436992.284
6	273742.914	7436907.295
7	273741.454	7436930.425
8	273738.624	7436918.473
9	273694.704	7436831.463
10	273682.874	7436759.335
11	273637.804	7436692.725
12	273577.233	7436702.263
13	273615.435	7436734.755
14	273649.476	7436922.715
15	273574.074	7436887.855
16	273725.434	7436923.624
17	273700.764	7436925.204
18	273718.265	7436960.174
19	273622.827	7437070.874
20	273590.137	7437098.504
21	273397.642	7437263.952
22	273678.705	7437067.364
23	273748.524	7437029.364
24	273751.674	7437029.924
25	273761.374	7437024.234
26	273772.344	7437001.684
27	273782.083	7436973.025
28	273772.954	7436930.995
29	273763.554	7436934.016
30	273763.654	7436927.833
31	273812.285	7436863.714
32	273807.236	7436834.374
33	273810.695	7436848.934
34	273809.929	7436849.804
35	273992.624	7436702.405
36	273932.224	7436742.615
37	273963.453	7436752.115
38	273965.173	7436733.475
39	273995.723	7436752.125
40	273991.063	7436753.833
41	273977.064	7436754.603
42	273936.255	7436583.125
43	273936.253	7436553.195
44	273907.254	7436475.185
45	273906.234	7436634.965
46	273931.304	7436643.815
47	273979.908	7436716.093
48	273985.690	7436696.425
49	273843.490	7436639.000
50	273826.470	7436653.000
51	273678.842	7436709.578
52	273637.814	7436746.097
53	273676.929	7436985.045
54	273503.633	7437082.602
55	273487.835	7437048.717
56	273501.072	7437047.603

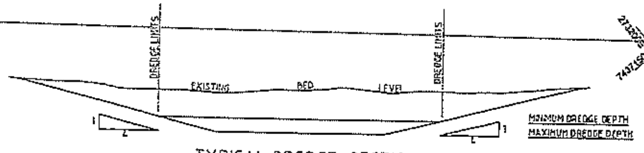
DREDGE DEPTHS (METRES BELOW L.A.T.)		
DREDGE AREA	MINIMUM DREDGE DEPTH	MAXIMUM DREDGE DEPTH
A1	2.49 m	2.90 m
A	2.49 m	2.90 m
B	1.70 m	2.00 m
C	1.90 m	2.20 m
D	1.49 m	1.79 m
M1	1.49 m	1.79 m
M2	1.49 m	1.79 m
E1	2.00 m	2.30 m
E2	1.00 m	1.30 m
F	1.40 m	1.70 m
CCYC	1.60 m	2.00 m
H	2.40 m	2.90 m

NOTES:

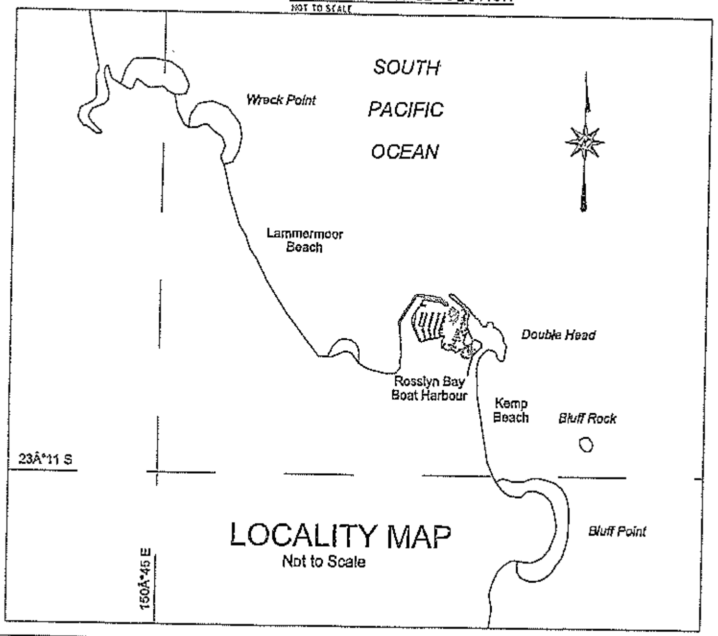
1. The proposed dredging area is structurally suited for anticipated usage
2. Works comply with all relevant codes including DERM's Operational Policy - Building and Engineering Standdards for tidal works
3. Please note details of dredge areas currently with tidal works approval have been indicated on this plan for information only.
4. The cross-hatched Area H indicates the area proposed for tidal works approval



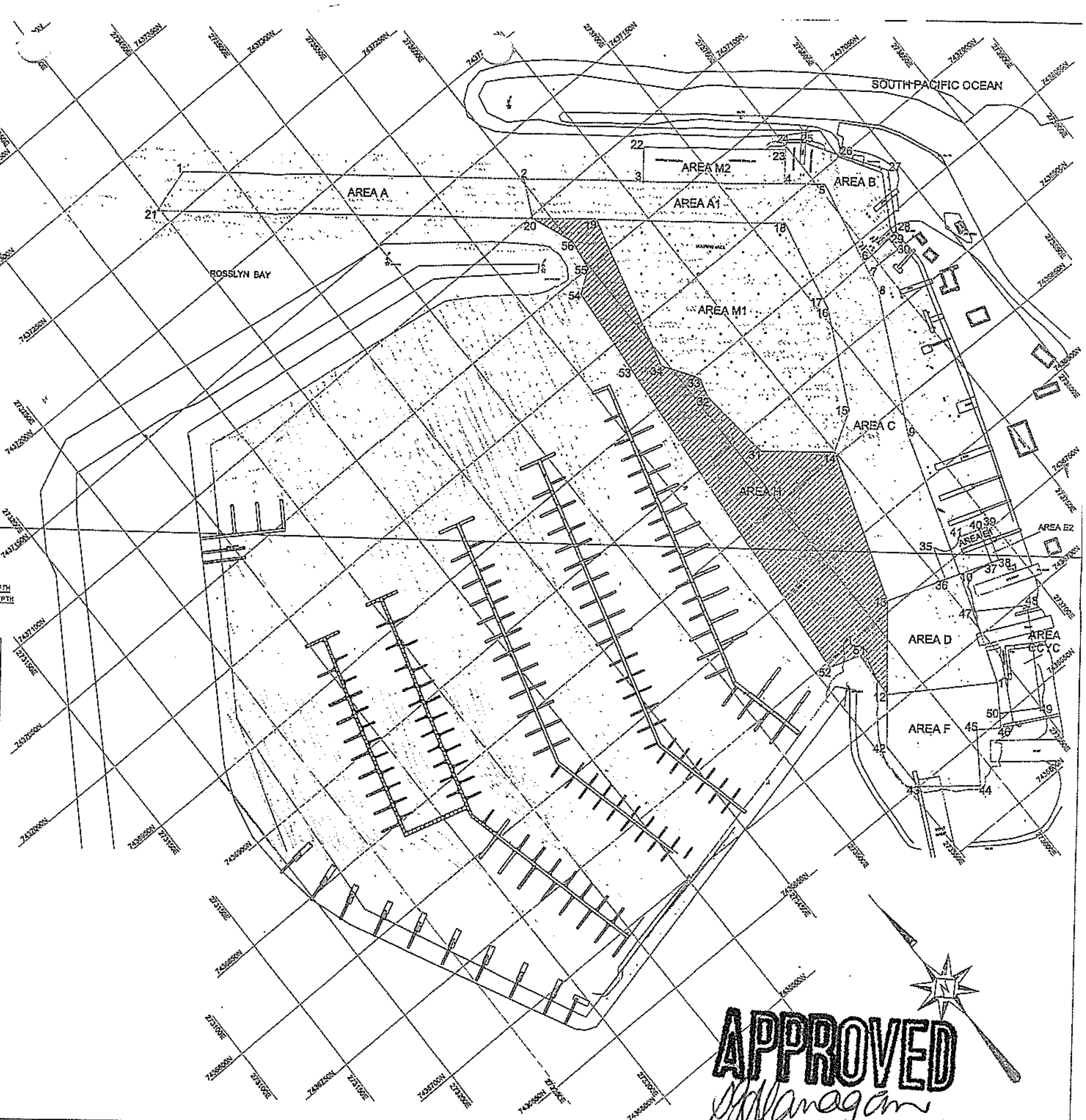
TYPICAL DREDGE SECTION BETWEEN ADJACENT DREDGE AREAS
NOT TO SCALE



TYPICAL DREDGE SECTION
NOT TO SCALE



LOCALITY MAP
Not to Scale



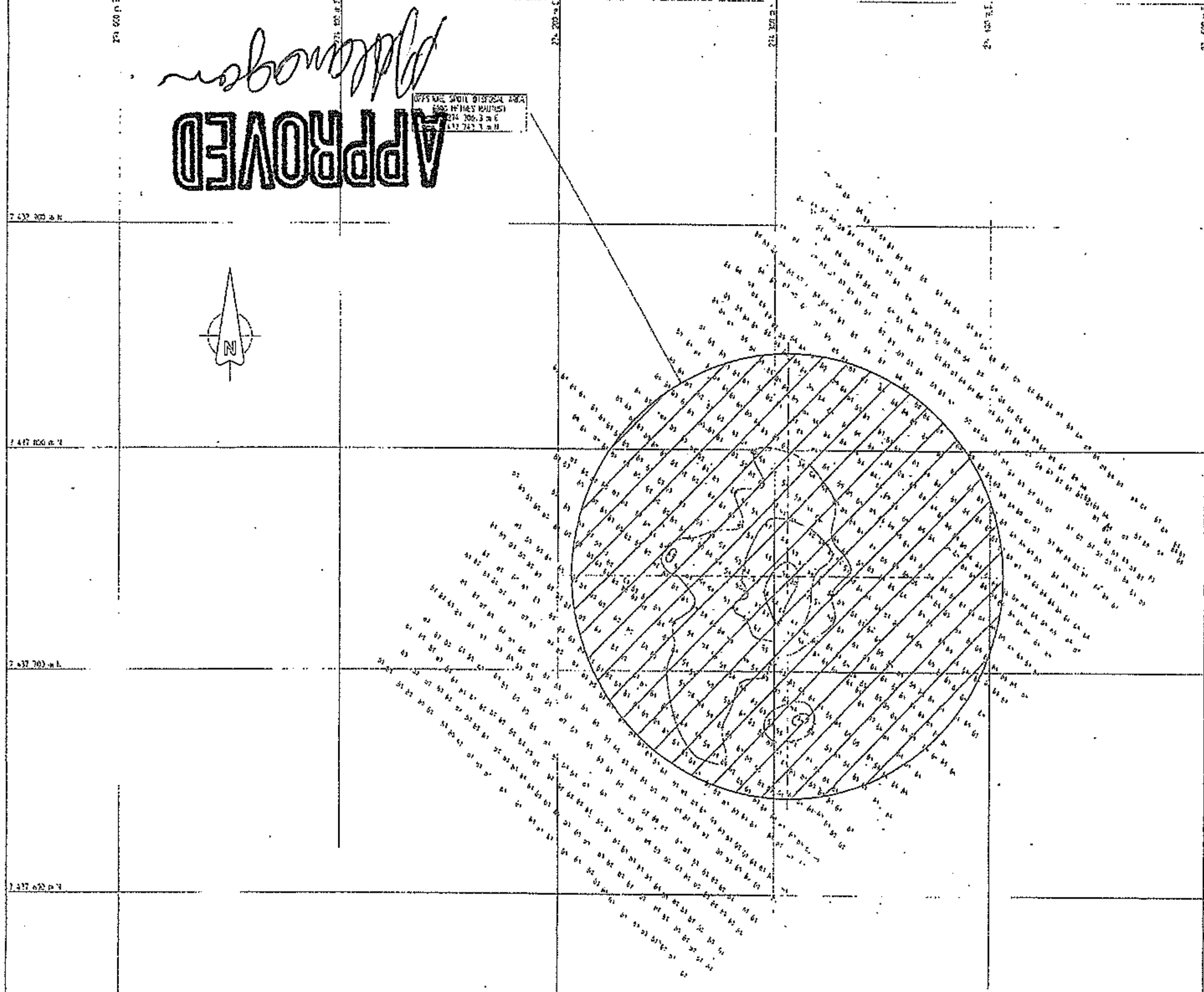
NOTES:
1) This tidal works plan has been created using the MSQ Hydrographic Services Plan G005-079 as a base

Certified	C. Vo	
RPEQ No.	8140	
Date	15/8/11	
Drawn	CJV	
Checked	TBC	

Queensland Government
Maritime Safety Queensland

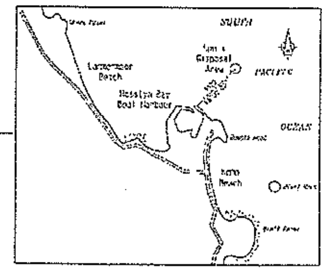
ROSSLYN BAY
BOAT HARBOUR

APPROVED



SPOIL DISPOSAL SITE PLAN

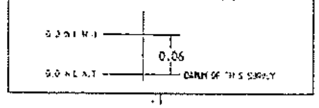
SCALE 1:5000



LOCALITY PLAN

SCALE 1:20 000

TIDAL DATUM NOTE



NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. ALL LEVELS AND SOUNDINGS ARE IN METRES AND HAVE REFERENCE TO LOWEST ASTRONOMICAL TIDE (L.A.T.)
3. VERTICAL DATUM FOR LEVELS ESTABLISHED FROM [illegible] 6.64 L.A.T.
4. SOUNDINGS SHOWN THUS eg. 57 INDICATE METRES BELOW L.A.T.
5. SOUNDING INFORMATION ON THIS DRAWING WAS DERIVED FROM QUEENSLAND TRANSPORT DRAWING NUMBER [illegible] (DATED FEBRUARY 1996).
6. ALL COORDINATES ARE IN METRES AND ARE TO THE AUSTRALIAN MAP GRID. HORIZONTAL DATUM IS AGD 84 ZONE 56.
   BASE STATION: BOAT SHED
   EASTING: 273 671.6
   NORTHING: 7 436 737 S

THIS IS A COPY OF THE PLAN WHICH WAS ENDORSED PURSUANT TO SECTION [illegible] OF THE [illegible] ACT [illegible] ON THE 1 DAY OF AUGUST 1996 SUBJECT TO THE CONDITIONS SPECIFIED IN THE DEPARTMENT'S LETTER DATED 5.8.96

REGIONAL DIRECTOR CENTRAL COAST
DEPARTMENT OF ENVIRONMENT

RS-1-19-5	LAYOUT, SECTIONS, SITE PLAN AND NOTES			
Drawing No.	Associated Drawings	Amd No.	Description	Date / Approved

119-21-327
File No.

K.S. SUNDOUN
Drawing
R.S.A.
Design
Checked
RPEQ No 2323
Manager Marine
Date 2-5-96

QUEENSLAND TRANSPORT
Queensland Department of Transport
Technology Division
Business Centre

ROSSLYN BAY BOAT HARBOUR
DREDGING 1996
OFFSHORE SPOIL DISPOSAL AREA

© The State of Queensland, Department of Transport

RS-1-19-9
Drawing Number

RECEIVED
17 OCT 2011
BY: MSQ Bitumen

Queensland Government

Department of
Transport and Main Roads

13.10.2011

Trevor Carter
Principal Engineer (Dredging)
Department of Transport and Main Roads
Floor 20 Mineral House
41 George Street Brisbane Qld 4000

Dear Trevor

Tidal Early Concurrence response application for dredging Rosslyn Bay State Boat Harbour, Rosslyn Bay (Lot 105 on SP161849 and Lot 106 on SP161849)

As a concurrence agency, Maritime Safety Queensland has no objection to the proposal provided the following navigation and marine safety conditions are addressed.

1. The contractor must complete the dredging according to Jones Flint & Pike Drawing No RS-1-19-5B, RS-1-19-3, attached to letter dated 19 September 2011.

2. The constructing authority must inform, in writing Maritime Safety Queensland, Regional Harbour Master, Gladstone at least 14 days prior to commencement of the works including the following:

a. The proposed date of commencement of construction or the establishment of plant on the site.
b. The proposed timetable associated with the works.
c. The name and address of the on-site contractor undertaking the works.
d. The name and telephone number (work and after hours) of a contact for the on-site contractor.

3. The constructing authority must issue any notices or advertisements as required by the Regional Harbour Master.

4. The applicant or his agent are responsible for the removal of any existing structure, must ensure all works, including debris containment, removal and disposal, do not compromise or impede safe navigation.

5. All floating plant and mooring for such plants shall be kept clear of navigation channels when working or moored, and the moorings shall be marked and lit in accordance with the requirements of the Regional Harbour Master or his representative.

Maritime Safety Queensland
Level 2, 136 Goondoon Street
PO Box 123
GLADSTONE Q 4680
ABN 13 200 330 520

Our ref P15927
Your ref
Enquiries Mike Lutze
Telephone +61 7 4973 1200
Facsimile +61 7 4972 5520
Website www.msq.qld.gov.au

6. The constructing authority must supply, install and maintain, at its own cost, any navigation lights, buoys, marks and any warning signs which the Regional Harbour Master, Gladstone considers necessary. All navigation aids must be constructed and operated in accordance with the requirements of Queensland Transport (Marine Operations).

7. All Flood lighting or other lighting, except navigation lighting, installed on the structures or surrounds must be shielded to seaward so as not to cause a navigation hazard to the satisfaction of the Regional Harbour Master, Gladstone.

8. The dredging must be carried out totally within the approved real property boundary line.

9. The proponent must ensure that all works are undertaken in accordance with the provision and conditions of any relevant International Conventions.

10. All marine plant and equipment used by the constructing authority must:

   a. Carry the lights and shapes prescribed by The International Regulations for the Prevention of Collision at Sea 1972 and to the satisfaction of the Regional Harbour Master, Gladstone.
   b. Be in Queensland Registration as required by the transport Operations (Marine safety) Act 1994 and the Transport Operations (Marine Safety) Regulations 2004.
   c. Be fitted with effective silencing devices by the constructing authority to keep noise at a minimum.
   d. Be maintained by the constructing authority to minimise discharge of noxious fumes and pollutants.
   e. All operators of marine plant must hold the appropriate marine certificates of competency as prescribed by the above Act and Regulations.

11. Any ships using this structure must comply with the *Transport Operations (Marine Safety) Act 1994* and the *Transport Operations (Marine Safety) Regulation 2004*.

12. The constructing authority must inform the Regional Harbour Master of completion of the works within 14 days of practical completion.

13. The constructing authority must comply with all instructions issued by the Regional Harbour Master, Gladstone or his representatives and the works must be curtailed or cancelled if the Regional Harbour Master, Gladstone recommends such action.

14. Please ensure the property owner receives a copy of this letter.

15. The dredging must be carried out within one year from the date of this letter. If dredging is not completed, you will need additional or amended comments from the Regional Harbour Master.

Maritime Safety Queensland does not need to be further consulted if all of the above conditions are met.

Yours sincerely

Capt. Mike Lutze
Regional Harbour Master (Gladstone)

RECEIVED
17 OCT 2011
BY: MSQ Bitumen

Queensland Government

Department of Transport and Main Roads

13.10.2011

Trevor Carter
Principal Engineer (Dredging)
Department of Transport and Main Roads
Floor 20 Mineral House
41 George Street Brisbane Qld 4000

Dear Trevor

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As a concurrence agency, Maritime Safety Queensland has no objection to the proposal provided the following navigation and marine safety conditions are addressed.

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2. The constructing authority must inform, in writing Maritime Safety Queensland, Regional Harbour Master, Gladstone at least 14 days prior to commencement of the works including the following:

a. The proposed date of commencement of construction or the establishment of plant on the site.
b. The proposed timetable associated with the works.
c. The name and address of the on-site contractor undertaking the works.
d. The name and telephone number (work and after hours) of a contact for the on-site contractor.

3. The constructing authority must issue any notices or advertisements as required by the Regional Harbour Master.

4. The applicant or his agent are responsible for the removal of any existing structure, must ensure all works, including debris containment, removal and disposal, do not compromise or impede safe navigation.

5. All floating plant and mooring for such plants shall be kept clear of navigation channels when working or moored, and the moorings shall be marked and lit in accordance with the requirements of the Regional Harbour Master or his representative.

Maritime Safety Queensland
Level 2, 136 Goondoon Street
PO Box 123
GLADSTONE Q 4680
ABN 13 200 330 520

Our ref P15927
Your ref
Enquiries Mike Lutze
Telephone +61 7 4973 1200
Facsimile +61 7 4972 5520
Website www.msq.qld.gov.au

6. The constructing authority must supply, install and maintain, at its own cost, any navigation lights, buoys, marks and any warning signs which the Regional Harbour Master, Gladstone considers necessary. All navigation aids must be constructed and operated in accordance with the requirements of Queensland Transport (Marine Operations).

7. All Flood lighting or other lighting, except navigation lighting, installed on the structures or surrounds must be shielded to seaward so as not to cause a navigation hazard to the satisfaction of the Regional Harbour Master, Gladstone.

8. The dredging must be carried out totally within the approved real property boundary line.

9. The proponent must ensure that all works are undertaken in accordance with the provision and conditions of any relevant International Conventions.

10. All marine plant and equipment used by the constructing authority must:

    a. Carry the lights and shapes prescribed by The International Regulations for the Prevention of Collision at Sea 1972 and to the satisfaction of the Regional Harbour Master, Gladstone.
    b. Be in Queensland Registration as required by the transport Operations (Marine safety) Act 1994 and the Transport Operations (Marine Safety) Regulations 2004.
    c. Be fitted with effective silencing devices by the constructing authority to keep noise at a minimum.
    d. Be maintained by the constructing authority to minimise discharge of noxious fumes and pollutants.
    e. All operators of marine plant must hold the appropriate marine certificates of competency as prescribed by the above Act and Regulations.

11. Any ships using this structure must comply with the *Transport Operations (Marine Safety) Act 1994* and the *Transport Operations (Marine Safety) Regulation 2004*.

12. The constructing authority must inform the Regional Harbour Master of completion of the works within 14 days of practical completion.

13. The constructing authority must comply with all instructions issued by the Regional Harbour Master, Gladstone or his representatives and the works must be curtailed or cancelled if the Regional Harbour Master, Gladstone recommends such action.

14. Please ensure the property owner receives a copy of this letter.

15. The dredging must be carried out within one year from the date of this letter. If dredging is not completed, you will need additional or amended comments from the Regional Harbour Master.

Maritime Safety Queensland does not need to be further consulted if all of the above conditions are met.

Yours sincerely

Capt. Mike Lutze
Regional Harbour Master (Gladstone)

File No.: P007364
Ref.: G16/38147.1

STATE OF QUEENSLAND
Acting Through the Department of Transport and Main Roads
GPO Box 2595
BRISBANE QLD 4000
ATTN: Mr Chris Voisey

Dear Mr Voisey

RE: Marine Parks permit G16/38147.1 Environmental Management Pan (Dredging) – Rosslyn Bay Boat Harbour 2016

I refer to your email correspondence dated, 26 April 2016 where you provided an Environmental Management Plan entitled Environmental Management Plan (Dredging) Rosslyn Bay Boat Harbour 2016 (version 5)- dated 22/04/2016.

Please be advised that in accordance with conditions 18 and 19 of Marine Parks permit G16/38147.1 1 the Managing Agencies have given approval for you to implement the Environmental Management Plan for dredging at the Rosslyn Bay Boat Harbour.

If you propose to change the approved Environmental Management Plan you must apply in writing to this office.

In accordance with condition 23, the Managing Agencies are still to advise whether Environmental Site Supervision will be required. Please provide us with the updated start dates and the proposed timing of the dredging in order for the Managing Agencies to determine if Environmental Site Supervision will be required.

Please ensure you read and understand all the conditions of your permit, including permitted areas of operation before undertaking field work. The approved Environmental Management Plan and a copy of this letter must be available with the permit for inspection at all times.

If you have any queries regarding this approval or your current permissions, please do not hesitate to contact the Great Barrier Reef Marine Park Authority at assessments@gbrmpa.gov.au or by phone on (07) 4750 0700.

Yours sincerely

……………………………………
Rean Gilbert
For the Managing Agencies
26 April 2016

THIS LETTER MUST BE AVAILABLE WITH THE PERMIT FOR INSPECTION AT ALL TIMES

PERMIT

Great Barrier Reef Marine Park Regulations 1983 (Commonwealth)
Marine Parks Regulation 2006 (Queensland)

G16/38147.1

These permissions remain in force, unless sooner surrendered or revoked, for the following period:

22 MAR 2016 TO **1-APR-2026**

Permission is granted to:

PERMITTEE: **STATE OF QUEENSLAND**
Acting Through the Department of Transport and Main Roads

ADDRESS: **GPO Box 2595**
BRISBANE QLD 4000

for use of and entry to zones in the **Amalgamated Great Barrier Reef Marine Park Section** (as established by the *Great Barrier Reef Marine Park Act 1975* (Cth)) and the **Great Barrier Reef Coast Marine Park** (as established by the *Marine Parks Act 2004* (Qld)) in accordance with the details set out herein.

Date 21/03/2016
Delegate of the
Great Barrier Reef Marine Park Authority

Date 22/03/16
Delegate of the Chief Executive of the
Department of National Parks, Sport and Racing

The purpose/s of use and entry may only be undertaken in the zone/s and location/s described below.

Zone/s and location/s to which the permission applies:

GENERAL USE ZONE, HABITAT PROTECTION ZONE and CONSERVATION PARK ZONE – the coastal strip between Wreck Point and Zilzie Point.

Purpose/s of use and entry authorised by the permission:

CARRYING OUT WORKS – being:

- the dumping of up to a maximum of 210,000 cubic metres of maintenance dredge spoil material within the Approved Dredge Spoil Disposal Area; and
- the dumping of up to a maximum of 70,000 cubic metres of contingency maintenance dredge spoil material within the Approved Dredge Spoil Disposal Area,

associated with maintenance dredging of the Rosslyn Bay Boat Harbour.

CONDUCT OF A RESEARCH PROGRAM – being surveying, sampling and monitoring of environmental variables associated with dredging and disposal.

STANDARD CONDITIONS

1 All activities conducted under this Permission must be undertaken in accordance with the provisions of the laws in force from time to time in the State of Queensland and the Commonwealth of Australia.

2 The Permittee must ensure that when operations are conducted in the Marine Parks under this permit, this permit (or a copy), and any related documents such as the approved Environmental Management Plan are held at the site or sites of operation.

3 The Permittee must inform all participants in the activities permitted herein (including, but not limited to, the employees, officers, sub-contractors, and agents of the Permittee) of any relevant restrictions or requirements applying under any zoning plans, plans of management, Marine Parks regulations, this permit, the Deed and the Environmental Management Plan.

DEED CONDITIONS

4 Within 30 business days of the date of commencement of this permit, the Permittee must execute, seal and deliver as a Deed to the Great Barrier Reef Marine Park Authority, a Deed in the form annexed to this permit, identified with the permit number, and marked 'Deed of Agreement.'

5 The Permittee must, upon execution of the Deed, observe and perform its obligations under and pursuant to the Deed. Any breach of the Deed shall be a breach of this condition.

DREDGE SPOIL DISPOSAL CONDITIONS

6 The Permittee must not dispose of more of than 210,000 cubic metres of maintenance dredge spoil material in total to the Approved Dredge Spoil Disposal Area.

7 The Permittee must not dispose of more than 60,000 cubic metres of maintenance dredge spoil material to the Approved Dredge Spoil Disposal Area per year.

8 The Permittee must not dispose of more than 70,000 cubic metres of contingency maintenance dredge spoil material in total to the Approved Dredge Spoil Disposal Area.

9 The Permittee must not undertake the disposal of contingency maintenance dredge spoil material to the Marine Parks unless:
(i) the Managing Agency has received prior written notification; and
(ii) the Permittee complies with any directions of the Managing Agency in relation to such works or activities.

10 The Permittee when undertaking works in the Marine Parks, must use a Cutter Suction Dredge and associated pipeline, unless otherwise advised in writing by the Managing Agency.

11 The Permittee must not carry out any works within the Marine Parks associated with the Dredge Area unless the Managing Agency has advised the Permittee in writing that the relevant components of the Sampling and Analysis Plan and Sampling and Analysis Plan Report have been approved and the sediments are demonstrated to be suitable for unconfined ocean disposal.

12 The Permittee must not undertake the disposal of maintenance dredge spoil material to the Marine Parks without a permit for the works issued under the *Environment Protection (Sea Dumping) Act 1981*.

13 The Permittee must provide bathymetric surveys of the Approved Dredge Spoil Disposal Area to the Managing Agency within two (2) months of the completion of each disposal campaign authorised under this permit.

14 The Permittee must provide to the Managing Agency *in-situ* calculations of spoil material disposed to the Approved Dredge Spoil Disposal Area within two (2) months of the completion of each disposal campaign authorised under this permit. The volume calculations must be based on bathymetric surveys undertaken prior to work commencing and following the completion of dredging and disposal activities.

ENVIRONMENTAL HARM CONDITIONS

15 The Permittee must take all reasonable steps to ensure that activities carried out under this permit do not cause harm to the environment.

16 The Permittee must notify the Managing Agency, within 24 hours, of all incidents. The notification must include:
- (i) details of the incident including date, time, location, cause and nature of the incident;
- (ii) the name and contact details of the person(s) witnessing, reporting and/or responsible for the incident;
- (iii) the type, estimated volume and concentration of any pollutants involved;
- (iv) measures taken or proposed to be taken to manage the impact and the success of those measures in addressing the incident; and
- (v) any monitoring and reporting that will be undertaken.

17 The Permittee must keep a record of all incidents and produce the record for inspection upon request by the Managing Agency. Such records must be kept and made available for the term of the permit.

ENVIRONMENTAL MANAGEMENT PLAN CONDITIONS

18 The Permittee must submit to the Managing Agency for approval, an Environmental Management Plan, no later than 40 business days prior to the commencement of works or operations.

19 The Permittee must not commence any works or operations unless the Managing Agency has advised the Permittee in writing that the Environmental Management Plan has been approved.

20 The Permittee must comply with the current Environmental Management Plan as approved in writing by the Managing Agency.

21 The Managing Agency may request the Permittee to make revisions to the Environmental Management Plan, if required to meet the objects of the *Great Barrier Reef Marine Park Act 1975*.

22 The Permittee must ensure that any revisions to the Environmental Management Plan are approved in writing by the Managing Agency prior to implementation.

ENVIRONMENTAL SITE SUPERVISOR CONDITIONS

23 Where the Permittee is advised in writing by the Managing Agency that environmental site supervision of works is required, the Permittee must:
- (i) provide the 24-hour contact details of an on-site liaison officer whom the Environmental Site Supervisor can contact; and
- (ii) provide the Environmental Site supervisor with access to the works as and when they require.

24 The Environmental Site Supervisor is authorised to stop or suspend or modify works, which in their opinion have caused or are likely to cause environmental harm.

25 Where the Environmental Site Supervisor has directed the Permittee to cease works under condition 24, the Permittee must not recommence works unless authorised in writing by the Environmental Site Supervisor.

26 Where the Environmental Site Supervisor directs the Permittee to cease or modify works under condition 24, the conduct of the Permittee when complying with the order must be in accordance with:
- (i) any directions given by the Environmental Site Supervisor; or
- (ii) best environmental practice (where (i) does not apply).

27 The Permittee and its employees, contractors and subcontractors and agents must comply with any reasonable direction given by the Environmental Site Supervisor for the purpose of ensuring compliance with the Permit, Deed of Agreement, Environmental Management Plan or any direction considered necessary by the Environmental Site Supervisor for the conservation, protection and preservation of the Marine Parks and property in the Marine Park

INTERPRETATION

This permit extends to all employees of the Permittee, or other persons, who are acting on behalf of, or at the direction of, the Permittee for the purposes specified in this permit.

This permit is not intended to extinguish any native title.

A law shall be taken to be a law in force in the State of Queensland notwithstanding that it applies to only part of the State.

A word or phrase in this permit has the same meaning as the word or phrase has in the *Great Barrier Reef Marine Park Act 1975*, the *Great Barrier Reef Marine Park Regulations 1983* (Cth), the *Marine Parks Act 2004 (Qld)*, the *Marine Parks Regulation 2006* (Qld), Zoning Plans or Plans of Management, unless the contrary intention appears.

A note or heading may be used to give assistance in interpreting conditions in case of ambiguity.

A reference to a date includes that date.

DEFINITIONS

'**Dredge Area**' is defined as the Rosslyn Bay Boat Harbour outer and inner entrance channel, internal public navigation channels, berthing areas, the secondary public channel and pile mooring area.

'Approved Dredge Spoil Disposal Area' is defined by the following coordinates (GDA94 datum): an area of 100 metre radius centred on Latitude 23° 9.13' south and Longitude 150° 47.8' east.

'coastal strip' means that area between the landward boundary of the Great Barrier Reef Coast Marine Park and a line every point of which is three (3) nautical miles from that boundary.

'contingency maintenance dredge spoil' means additional dredge spoil disposal other than regular maintenance disposal required to maintain existing facilities and navigable depths as a result of unexpected severe weather conditions.

'environment' includes:
(a) ecosystems and their constituent parts;
(b) natural and physical resources; and
(c) the qualities and characteristics of locations, places and areas, that contribute to their:
  (i) biodiversity and ecological integrity; or
  (ii) intrinsic or attributed aesthetic, cultural, heritage, ecological, economic, recreational, social, scientific value or interest or amenity.

'Environmental Management Plan' means the environmental management plan prepared by the Permittee (or at its direction), and approved by the Managing Agency in writing.

'Environmental Site Supervisor' means the person from time to time nominated in writing by the Managing Agency to the Permittee.

'harm' includes:
(a) any adverse effect;
(b) direct or indirect harm; and
(c) harm to which the person's use or entry has contributed, to any extent (whether or not other matters have contributed to the harm).

'harm' to the environment is material if:
(a) it involves actual or potential harm to the health or safety the environment that is not trivial and any act or omission that results in the pollution of the Marine Park; or
(b) it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (or such other amount as is prescribed by the regulations). Loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment, that is not trivial or otherwise not authorised by this Permit.

'incident' means an event involving actual or potential harm to the ecosystem, including but not limited to:
(a) coral damage; or
(b) a cyclone; or
(c) any shipping event that requires notification to a relevant authority under the *Queensland Marine Act 1958* or the *Navigation Act 2012*; or
(d) any aircraft event that requires notification to the relevant Authority under the *Civil Aviation Act 1988*; or
(e) any discharge of more than five (5) litres of untreated sewage effluent; or
(f) any discharge of more than five (5) litres of hazardous chemicals, fuel or biotoxic products.

'maintenance' means all works to ensure that channels, berths or other port areas are maintained at their designed dimensions.

'Managing Agency' means:
(a) in relation to the Great Barrier Reef Marine Park, the Great Barrier Reef Marine Park Authority, a member of the staff of that Authority or a person referred to in Section 48A of the *Great Barrier Reef Marine Park Act 1975* (Cth) performing functions or exercising powers under that Act in accordance with an agreement referred to in that section; and
(b) in relation to a Great Barrier Reef Coast Marine Park, means the Chief Executive of the Department of National Parks, Sport and Racing, his/her Delegate, an officer of the Queensland Parks and Wildlife, or a person referred to in Section 52 of the *Marine Parks Act 2004* (Qld) appointed as an inspector.

'Marine Parks' means:
(a) the Great Barrier Reef Marine Park established by the *Great Barrier Reef Marine Park Act 1975* (Cth); and
(b) the Great Barrier Reef Coast Marine Park established pursuant to the *Marine Parks Act 2004* (Qld).

'Marine Parks regulations' means:
(a) in relation to the Great Barrier Reef Marine Park, the *Great Barrier Reef Marine Park Regulations 1983* (Cth); and
(b) in relation to the Great Barrier Reef Coast Marine Park, the *Marine Parks Regulation 2006* (Qld).

'per year' means each 12 month period starting from the commencement date of the permit.

'permit' means the permissions the subject of Permit Number G16/38147.1 granted to the Permittee pursuant to the *Great Barrier Reef Marine Park Regulations 1983* (Cth) and the *Marine Parks Regulation 2006* (Qld).

'Permittee' means STATE OF QUEENSLAND Acting Through the Department of Transport and Main Roads.

'Sampling and Analysis Plan' means a plan prepared in accordance with the *National Assessment Guidelines for Dredging 2009*.

Sampling and Analysis Plan Report means a report prepared in accordance with the *National Assessment Guidelines for Dredging 2009*.

'works' means all activities associated with installation, construction, maintenance and/or removal of all plant and materials comprising or used in connection with the permitted activities (including dredging, installations, structures, facilities, moorings, vessels or aircraft of any kind associated directly or indirectly with the permission) and the use (authorised or unauthorised) of the Marine Parks in connection with the permit.

'Zoning Plan' means:

(a) in relation to the Great Barrier Reef Marine Park, the Great Barrier Reef Marine Park Zoning Plan 2003 (Cth); and

(b) in relation to the Great Barrier Reef Coast Marine Park, the Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004 (Qld).

ENVIRONMENT PROTECTION (SEA DUMPING) ACT 1981

SEA DUMPING PERMIT 16/001

for

State of Queensland acting through the Department of Transport and Main Roads

I, BRUCE ELLIOT, a delegate of the Minister for the Environment acting under Sections 19 and 21 of the *Environment Protection (Sea Dumping) Act 1981*, hereby grant a sea dumping permit to the State of Queensland acting through the Department of Transport and Main Roads, Brisbane, Queensland, to:

- load for the purposes of dumping, and to dump up to 210,000 cubic metres of seabed material, derived from maintenance dredging of the Rosslyn Bay Boat Harbour, and
- load for the purposes of dumping, and dump up to 70,000 cubic metres of seabed material, derived from contingency maintenance dredging of the Rosslyn Bay Boat Harbour,

commencing on the date of signature of this permit and extending until 1 April 2026, subject to conditions which are specified in Appendices 1 and 2.

DATE 21st day of March 2016

Bruce Elliot
Delegate of the Minister

This permit comprises nine (9) pages, including Appendices 1 and 2.

Appendix 1

CONDITIONS FOR DUMPING AT SEA OF SEABED MATERIAL DERIVED FROM MAINTENANCE DREDGING OF THE ROSSLYN BAY BOAT HARBOUR, QUEENSLAND

Definitions

In this permit:

the Act	means the *Environment Protection (Sea Dumping) Act 1981*;
Application	means the Application for a permit under the *Environment Protection (Sea Dumping) Act 1981* submitted by State of Queensland acting through Department of Transport and Main Roads on 16 February 2016;
Cetacean	means the migratory whales identified as of significance under the *Environment Protection and Biodiversity Conservation Act 1999*;
Contingency maintenance	means additional dredging other than regular maintenance dredging required to maintain existing facilities and navigable depths as a result of unexpected severe weather conditions;
Department	means the Department of the Environment or successor entities;
Disposal site	Means area bound by the following coordinates (GDA 94 Datum): an area of 100 metre radius centred on Latitude 23° 9.13' south and Longitude 150° 47.8' east.
Dumping activities	means all activities associated with the dumping permitted under this permit, including: (i) the loading for the purpose of dumping of dredged material; (ii) the dumping of the material at the prescribed disposal site;
Environmental incident	means any event which has the potential to, or does impact, on the environment;
Environmental risk	means any risk, which has the potential to, or does impact, on the environment
GPS	Global Positioning System;
Managing Agency	means: a) the Great Barrier Reef Marine Park Authority; and b) a member of the staff of that Authority or a person referred to in s.43 of the *Great Barrier Reef Marine Park Act 1975* performing functions or exercising powers under that Act In accordance with an agreement referred to in that section;

Marine Park	means the Great Barrier Reef Marine Park established by the *Great Barrier Reef Marine Park Act 1975*;
the Minister	means the Australian Government Minister who administers the *Environment Protection (Sea Dumping) Act 1981* and includes a delegate of the Minister;
monitoring zone	means the area within 300 metres of any point on the dredging/dumping run about to be commenced;
per year	means each 12 month period starting from the commencement date of the permit.
Vessel	means any vessel or vessels used for or in connection with the loading and/or dumping activities.

1. Except so far as the contrary intention appears, terms used in these conditions to this permit have the same meaning as such terms in the Act.

Material to be dumped

2. The State of Queensland acting through the Department of Transport and Main Roads must not dump more than 210,000 cubic metres of maintenance dredge spoil material in total to the **disposal site**.

3. The State of Queensland acting through the Department of Transport and Main Roads must not dump more than 60,000 cubic metres of maintenance dredge spoil material to the **disposal site**, **per year**.

4. The State of Queensland acting through the Department of Transport and Main Roads must not dump more than 70,000 cubic metres of **contingency maintenance** dredge spoil material in total to the **disposal site**.

5. The State of Queensland acting through the Department of Transport and Main Roads must not undertake **dumping activities** associated with **contingency maintenance** dredge spoil material unless:

    a. the **Managing Agency** has received prior written notification; and

    b. the State of Queensland acting through the Department of Transport and Main Roads complies with any directions of the **Managing Agency** in relation to such works or activities.

6. The State of Queensland acting through the Department of Transport and Main Roads must not carry out **dumping activities** unless the Managing Agency has advised the State of Queensland acting through the Department of Transport and Main Roads in writing that the relevant components of the Sampling and Analysis Plan and Sampling and Analysis Plan Reports have been approved and the sediments are demonstrated to be suitable for unconfined ocean disposal in accordance with the *National Assessment Guidelines for Dredging 2009*.

Disposal Site

7. The State of Queensland acting through the Department of Transport and Main Roads must only dump within the **disposal site**.

8. The State of Queensland acting through the Department of Transport and Main Roads when undertaking **disposal activities** must use a Cutter Suction Dredge and associated pipeline, unless otherwise advised in writing by the Managing Agency.

9. The State of Queensland acting through the Department of Transport and Main Roads must establish by **GPS** that, prior to dumping; the **vessel** is within the **disposal site**.

Environmental Management Plan

10. The State of Queensland acting through the Department of Transport and Main Roads must develop and submit for the **Managing Agency** approval an Environmental Management Plan for managing the impacts on the environment from **dumping activities**. **Dumping activities** must not commence until an Environmental Management Plan is approved.

11. The State of Queensland acting through the Department of Transport and Main Roads must implement the approved Environmental Management Plan.

12. The State of Queensland acting through the Department of Transport and Main Roads may submit for the **Managing Agency** approval a revised version of the an Environmental Management Plan specified under Condition 10. If the **Managing Agency** approves such a revised Environmental Management Plan, the revised an Environmental Management Plan must be implemented.

13. If the **Managing Agency** believes that it is necessary or desirable for the better protection of the environment to do so, the **Managing Agency** may request the State of Queensland acting through the Department of Transport and Main Roads to make specified revisions to the Environmental Management Plan approved under Condition 10 and submit the revised Environmental Management Plan for the Minister's approval. If the **Managing Agency** approves a revised Environmental Management Plan pursuant to this condition, the State of Queensland acting through the Department of Transport and Main Roads must implement that Environmental Management Plan.

14. The Environmental Management Plan must be made available for the permit duration (electronically) on the State of Queensland acting through the Department of Transport and Main Roads website within 30 days of the Environmental Management Plan being approved by the **Managing Agency.**

Mitigation Measures for Protection of Marine Species

15. Before beginning **dumping activities**, the State of Queensland acting through the Department of Transport and Main Roads must check, using binoculars from the vessel, for **cetaceans** and/or dugongs within the **monitoring zone**.

16. If any **cetaceans** and/or dugongs are sighted in the **monitoring zone**, **dumping activities** must not commence in the **monitoring zone** until 20 minutes after the last **cetacean** and/or dugong is observed to leave the **monitoring zone** or the **vessel** is to move to another area of the **disposal site** to maintain a minimum distance of 300 metres between the vessel and any **cetacean** and/or dugong.

Environmental Risk and Incidents

17. If, at any time during the course of the dumping activities, an **environmental incident** occurs or **environmental risk** is identified, all measures must be taken immediately by the State of Queensland acting through the Department of Transport and Main Roads to minimise or mitigate the risk or the impact. The State of Queensland acting through the Department of Transport and Main Roads must provide a report on the environmental incident or environmental risk to the **Managing Agency** within 24 hours, with details of the incident or risk, the measures taken, the success of those measures in addressing the incident or risk and any additional measures proposed to be taken.

18. The State of Queensland acting through the Department of Transport and Main Roads must document any incidents involving the **dumping activities** that result in injury or death to any **cetacean** or dugong. The time and nature of each incident and the species involved, if known, must be recorded and the incident is to be reported to the **Managing Agency** within 24 hours.

Compliance of all Parties engaged in dumping activities

19. The State of Queensland acting through the Department of Transport and Main Roads must ensure that all persons engaged in the **dumping activities** under this permit, including the owner(s) and/or person(s) in charge of the **vessel**, comply with this permit and the requirements of the Act. The fulfilment of these conditions remains the responsibility of the State of Queensland acting through Department of Transport and Main Roads.

Access for Observers

20. If requested by the **Managing Agency** the State of Queensland acting through the Department of Transport and Main Roads must provide access for at least two nominees of the **Managing Agency** to witness, inspect, examine and/or audit any part of the operations, including any **dumping activities** or monitoring activities, the **vessel** or any other equipment, or any documented records. The State of Queensland acting through the Department of Transport and Main Roads must provide all reasonable assistance to the nominees of the **Managing Agency** for carrying out their duties.

Reporting

21. State of Queensland acting through the Department of Transport and Main Roads must make and retain records comprising either weekly plotting sheets or a certified extract of the ship's log which detail:

    a. the dates and times of when each dumping run commenced and finished;

    b. the position (as determined by **GPS**) of the dumping **vessel** at the beginning and end of each dumping run, including the path of each dumping run;

c. the volume of dredged material (in-situ cubic metres) dumped and quantity in dry tonnes for the specified operational period and compared to the total amount permitted under the permit;

d. the person(s) undertaking the marine species observation required in Condition 15 and any **cetaceans** and/or dugongs observed within the **monitoring zone** for each run, including the date, time and approximate distance from the **vessel**, and the action taken to comply with Condition 16; and

e. the persons(s) responsible for the operation of the **vessel** at any time during **dumping activities**.

22. The State of Queensland acting through the Department of Transport and Main Roads must retain the records required by Conditions 17, 18 and 21 for verification and audit purposes.

23. The State of Queensland acting through the Department of Transport and Main Roads must ensure that a bathymetric survey of the disposal site is undertaken by a suitably qualified person:

    a. prior to the commencement of **dumping activities** under this permit; and

    b. within one month of the completion of **dumping activities** authorised under this permit.

24. Within two (2) months of the final bathymetric survey being undertaken, the State of Queensland acting through the Department of Transport and Main Roads must provide a digital copy of each of the bathymetric surveys to the Australian Hydrographic Office, Locked Bag 8801, Wollongong, NSW 2500.

25. The State of Queensland acting through the Department of Transport and Main Roads must provide a report on the bathymetry to the **Managing Agency** within two (2) months of the final bathymetric survey being undertaken. The report must include a chart showing the change in sea floor bathymetry as a result of dumping and include written commentary on the volumes of dumped material that appear to have been retained within the **disposal site**.

26. To facilitate annual reporting to the International Maritime Organization, State of Queensland acting through the Department of Transport and Main Roads must report to the **Department** and the **Managing Agency** by 31 January each year, including on the day of the expiry of the permit or completion of all **dumping activities** under this permit, information at Appendix 2 to this permit, or in a format as approved by the **Department** from time to time.

Appendix 2: Sea Dumping Permit International Reporting Requirements

Please fill in this form and return it by **email** to the Department of the Environment and the Great Barrier Reef Marine Park Authority, **by 31 January each year**. This information is required for Australia's international reporting obligations under the London Protocol.
Email: seadumping@environment.gov.au, and assessments@gbrmpa.gov.au quoting the permit reference number

Permit Holder: The State of Queensland acting through the Department of Transport and Main Roads
Address:
Submitted by:
Phone:
Email: Date: *(/ /)*

Permit Details:
1) Sea Dumping Permit number: SD16-001

2) Permit start date: *(/ /)* Permit end date: *(01/04/2026)*

3) Description of material *Please tick relevant box or boxes*

Capital Dredged Material☐, Maintenance Dredged Material☐, Fish Waste☐, Vessels☐, Platforms or other man-made structures☐, Sewage Sludge☐, CO_2☐, Organic Material of Natural Origin☐, Bulky Waste☐, Inert-Inorganic Geological Material☐

4) Total permit quantity (cubic metres/number):

5) Approved disposal site/s:
Geodetic Datum:

Latitude (North/South degrees, minutes, seconds)	**Longitude** (East/West degrees, minutes, seconds)

Annual Report:

6) Specify the calendar year this report applies to: ____________________

7) Quantity dumped in the specified calendar year. Please complete either section A or B.

A. For dredged material disposed please report against all of the following:

Quantity in in-situ cubic metres ____________________________
Quantity in dry weight tonnes ____________________________
Remaining permit quantity ____________________________

Briefly describe any conversion rates used:

____
____
____

B. Other wastes (number/volume/type):

____
____
____
____

8) Additional comments:

____
____
____
____
____

9) Was monitoring of the disposal site conducted during the reporting period?
Yes ☐ No☐

If yes, please complete questions 10-13 of this form.

Monitoring of the disposal site

10) What type(s) of field monitoring was undertaken?

Biological☐, Geological☐, Chemical☐, Physical☐, Other ☐ (explain)_____

____
____
____
____
____
____

11) When was field monitoring conducted?

Before dumping☐, During dumping☐, After Dumping☐, Other ☐ (explain, provide dates)____

12) Where any adverse impact(s) found beyond those that were predicted?
Yes☐, No☐
If yes, briefly describe the impacts (e.g. physical, chemical or biological) and their spatial or temporal variation.

13) Provide a website/URL link to Field Monitoring Reports, or any additional information.

Appendix F – final report content

Appendix F – final report content

Within 1 month of completion of dredging works a final report shall be provided to DEHP, Harbour Master and GBRMPA representatives including the following;

1. detail of dredging and disposal locations
2. A copy of the pre and post dredge hydrographic surveys
3. Provide insitu volume calculations outlining the volume of material dredged and placed. A short commentary will also be provided with this data.
4. a short report of any observations during the works and suggestions for improvement
5. a summary sheet of spoil disposal data for International Maritime Organisation (IMO) as detailed in the Sea dumping Permit template

Within 3 months of the completion of the dredging works an interim monitoring report will be provided to DEHP and GBRMPA providing all the outcomes of the Water Quality and Coral/Benthic monitoring. Then following completion of the monitoring program in full a final report will be provided to DEHP and GBRMPA.