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Hans Jacob
Manager, Infrastructure Assessment
Office of the Environmental Protection Authority
The Atrium, Level 4, 168 St Georges Tce
Perth WA

8/08/2013
Project No.: 365_01_004

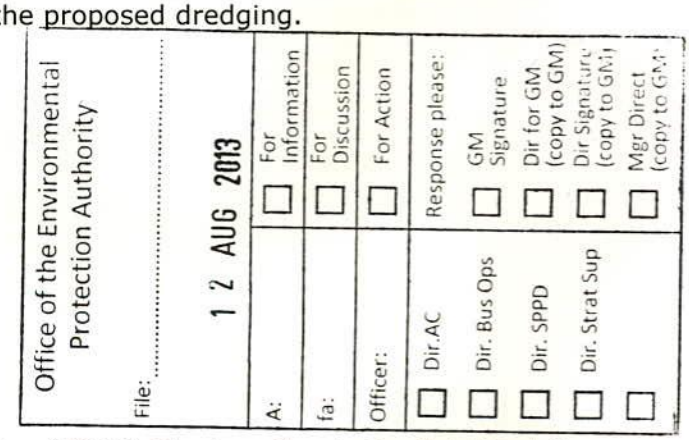
Dear Mr Jacob,

BEADON CREEK CAPITAL DREDGING REFERRAL IN ACCORDANCE WITH SECTION 38 OF THE ENVIRONMENTAL PROTECTION ACT

The Department of Transport (DoT) proposes to upgrade the facilities in Beadon Creek to support the growing demand for land at the Maritime Facility. The upgrade works include capital dredging a berth pocket and turning basin immediately west of the existing channel. The dredged material will be used to create additional land-backed wharf area immediately north of the existing lots.

On behalf of DoT, this environmental impact assessment document for the proposed Beadon Creek capital dredging program is submitted to the Office of the Environmental Protection Authority for review in accordance with the Section 38 assessment process. The Section 38 referral form is Appendix C of the environmental impact assessment document.

Please don't hesitate to contact either myself or Bruce Hegge at Oceanica Consulting, should you require any further information regarding the proposed dredging.



Regards,

Dr Katharine Cox
Consultant
Email: katharine.cox@oceanica.com.au
Telephone: 6272 0000

Enc

- Hard copy and electronic copy of Oceanica (2013) Beadon Creek Capital Dredging – Dredging Environmental Impact Assessment. Prepared for the Department of Transport by Oceanica Consulting Pty Ltd, Report No 365_01_004/1_Rev0, Perth, Western Australia, August 2013
- Electronic copy of required spatial data

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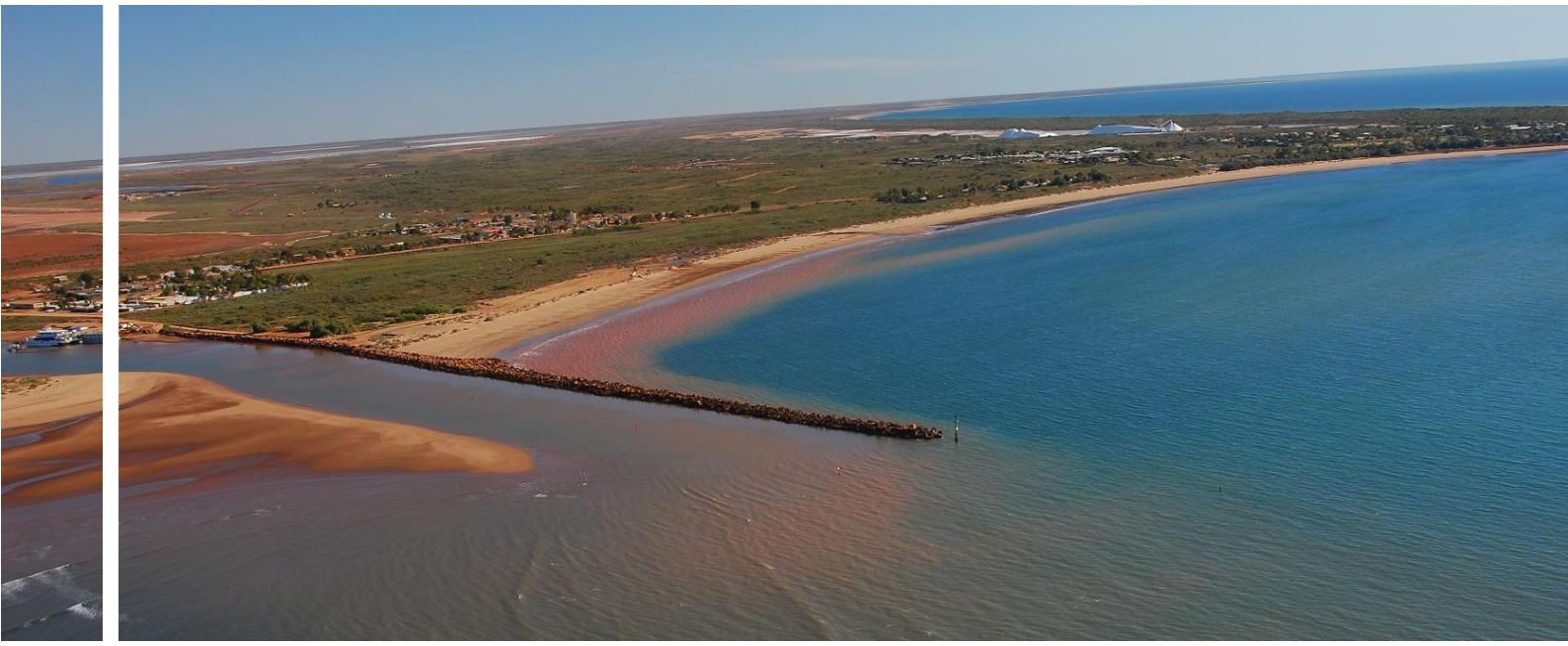

Beadon Creek Capital Dredging

Dredging Environmental Impact Assessment

August 2013

Beadon Creek Capital Dredging

Dredging Environmental Impact Assessment

Prepared for

Department of Transport

Prepared by

Oceanica Consulting Pty Ltd

in conjunction with

BMT JFA Consutlants Pty Ltd

August 2013

Report No. 365_01_004/1_Rev0

Client: Department of Transport

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Review

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Cover

Main image: Beadon Creek (Oceanica Consulting);

Minor images: Sediment core, Beadon Creek (Oceanica Consulting);
Sediment coring, Beadon Creek (Oceanica Consulting).

Disclaimer

Contents

List of Figures

List of Tables

List of Appendices

Acronyms

ASS	acid sulfate soils
BoM	Bureau of Meteorology
BTEX	benzene, toluene, ethylbenzene and xylene
CD	chart datum
DEC	Department of Environment and Conservation WA
DEIA	dredging environmental impact assessment
DoT	WA Department of Transport
EILs	Environmental Investigation Levels
EMF	Environmental Management Framework
FRP	filterable reactive phosphorus
HILs	Health Investigations Levels
ISQG	interim sediment quality guidelines
LoR	limit of reporting
NAGD	National Assessment Guidelines for Dredging
NATA	National Association of Testing Authorities
NO_2+NO_3	nitrate+nitrite
PAH	polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soils
PSD	particle size distribution
RPD	relative percent difference
RSD	relative standard deviation
TBT	tributyltin
TCO_3	total carbonate
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TPH	total petroleum hydrocarbons
QA/QC	quality assurance/quality control
UCL	upper confidence limit

1. Introduction

Beadon Creek is a tidal inlet on the eastern side of the town of Onslow, on the northwest coast of Western Australia (Figure 1.1). The Beadon Creek Maritime Facility provides boating facilities for commercial fishing vessels, charter vessels, tugs, barges and recreational vessels. The Beadon Creek Maritime Facility is also regionally important for providing cyclone refuge for vessels along the Pilbara coast. This marine facility has become increasingly important for supporting the expanding oil and gas industry in the Pilbara region.

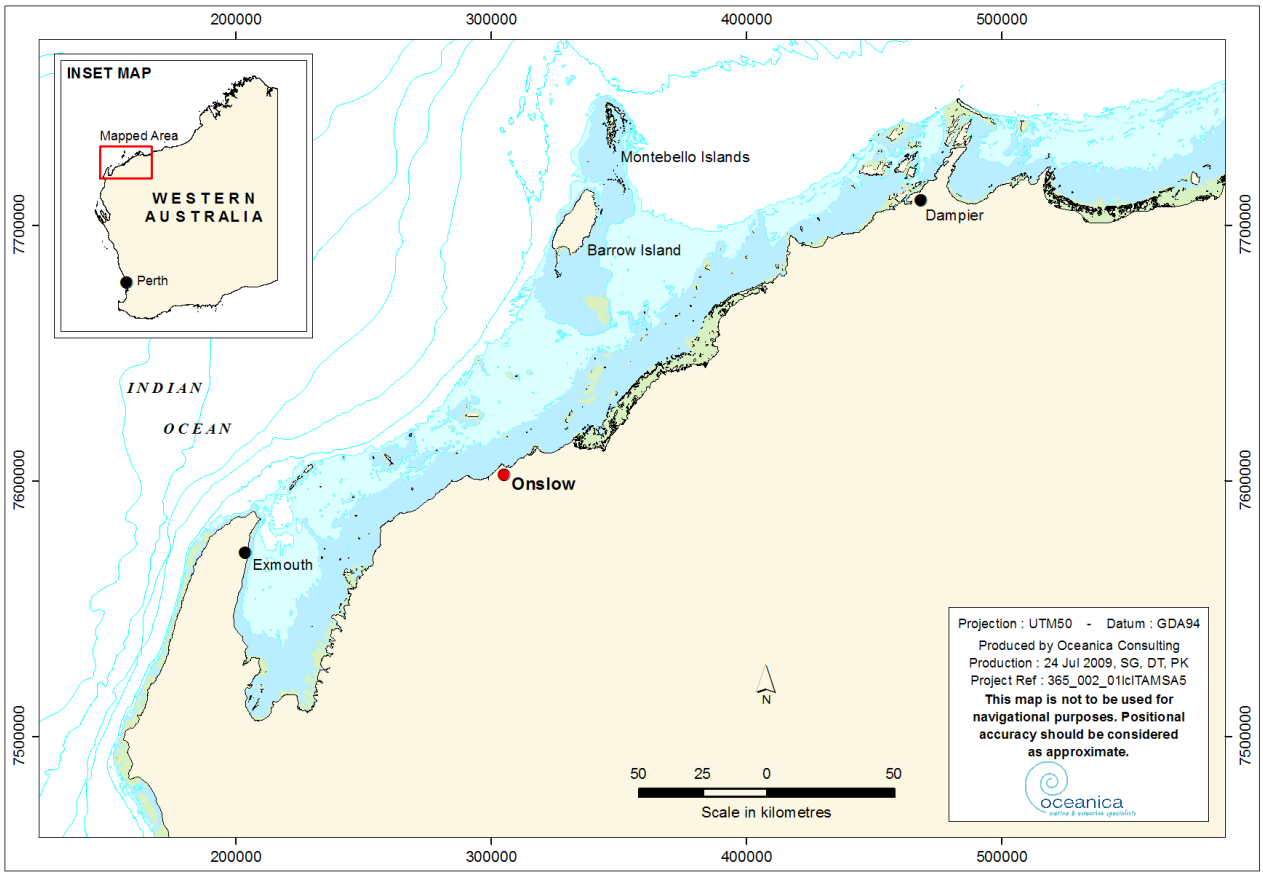


Figure 1.1 Site location

The Department of Transport (DoT) is presently responsible for the management and maintenance of the Beadon Creek Maritime Facility, to ensure it provides safe boating access and mooring facilities. Maintenance dredging works in Beadon Creek were undertaken in 2012 and 2013. During these works, a total[1] of ~53 000 m^3 of material was excavated from the entrance channel bell mouth, entrance channel, berth pockets and cyclone moorings to ensure safe boating facilities and conditions are maintained within the Maritime Facility (Appendix A).

The DoT is proposing to upgrade the facilities in Beadon Creek to support the growing demand for land at the Maritime Facility. The upgrade works include capital dredging a berth pocket and turning basin immediately west of the existing channel. The dredged material will be used to create additional land-backed wharf area immediately north of the existing lots (Figure 1.2, Appendix B). This capital dredging has a design footprint of ~31 000 m^2 and a volume of ~65 000 m^3.

[1] *Note that this is an estimate as the post-dredge hydrographic survey has not been completed.*

1.1 Purpose of this document

This report presents a Dredging Environmental Impact Assessment (DEIA) of the proposed capital dredging and land reclamation in Beadon Creek. This DEIA supports a referral to the Office of the Environmental Protection Authority (OEPA) in accordance with Section 38(1) of the *Environmental Protection Act 1986*, for a decision on whether formal assessment is required (Appendix C).

To support the impact assessment, sediment samples were obtained from the proposed dredging area in Beadon Creek in accordance with the Sediment Sampling and Analysis Plan (SAP) (Oceanica 2012a). This DEIA:

1. considers the specific nature of the dredging program and proposed disposal methods
2. identifies the environmental issues and impacts that could arise from the works
3. provides recommendations for environmental monitoring and management to control the impact of the dredging.

1.2 Environmental Management Framework

The DoT has an Environmental Management Framework (EMF; Oceanica 2012b) that provides guidance for the environmental management of their state-wide maintenance dredging operations. The EMF includes guidelines on sediment sampling and analysis with reference to the National Assessment Guidelines for Dredging (NAGD; CA 2009), the *Contaminated Site Management Series: Assessment Levels for Soils* (DEC 2010), and the ANZECC/ARMCANZ (2000) *Guidelines for Fresh and Marine Water Quality*. The EMF is intended to ensure that DoT's maintenance dredging activities are undertaken with the objectives of:

- protection of the environment
- clear, relevant and practical identification of environmental issues
- efficient management and completion of environmental assessments as required.

The EMF is updated annually, ensuring that best practice environmental management is applied to maintenance dredging.

While the primary focus of the EMF is on small-scale maintenance dredging projects, it is considered appropriate that the same management guidelines be applied to this capital dredging project due to its small scale.

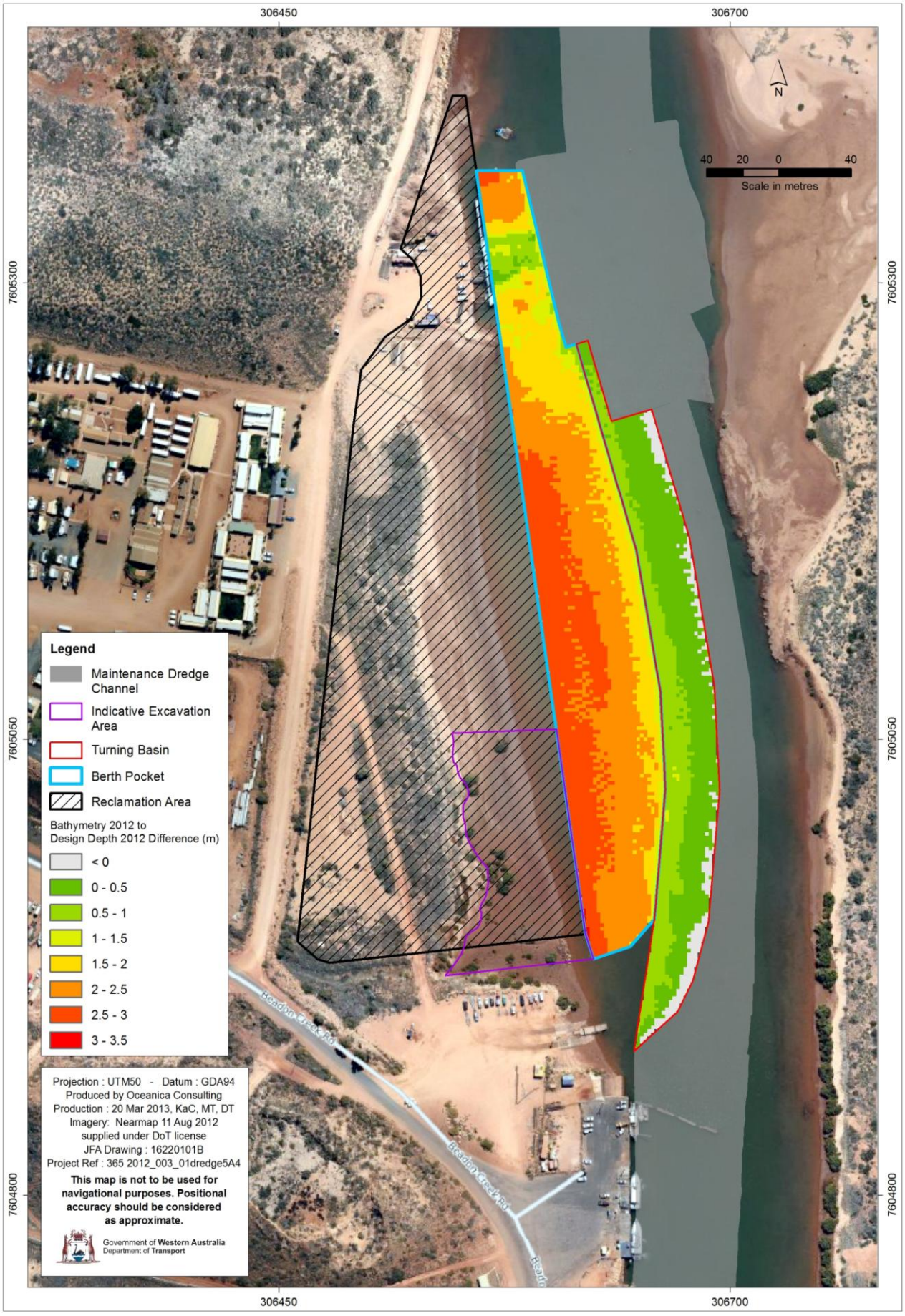


Figure 1.2 Beadon Creek capital dredge and reclamation areas

2. Background

2.1 Existing environment

Beadon Creek is a tidal inlet approximately 2.5 km east of the town of Onslow on the northwest coast of Western Australia. Beadon Creek is used as a harbour for both recreational and commercial activities. Commercial operators include fishing vessels, charter vessels, tugs, barges and oil and gas industry supply vessels operating within the area (HGM 1999, WA 1999, Chevron 2012a). Presently, the Beadon Creek Maritime Facility consists of a 50 m long public wharf, fuelling facilities, 12 mooring piles and commercial and recreational boat ramps.

2.1.1 Climate

Onslow has a tropical climate, which is wet in summer and dry in winter. The mean daily temperature range is 24–36°C in summer (December–February) and 12–27°C in winter (June–August). Winds are predominantly westerly and south-westerly during summer, and easterly to south-easterly during winter (Chevron 2012a). Mean rainfall is ~60 mm/month in summer and ~28 mm/month in winter. The heaviest rainfalls are often associated with the passage of tropical cyclones, which typically occur between November and April and can cause extensive flooding. Cyclones cross the coast at Onslow with a frequency of about 1-in-10 years. Furthermore, approximately 1-in-3 years, cyclones approach the coast sufficiently close to cause structural damage in Onslow (HGM 1999).

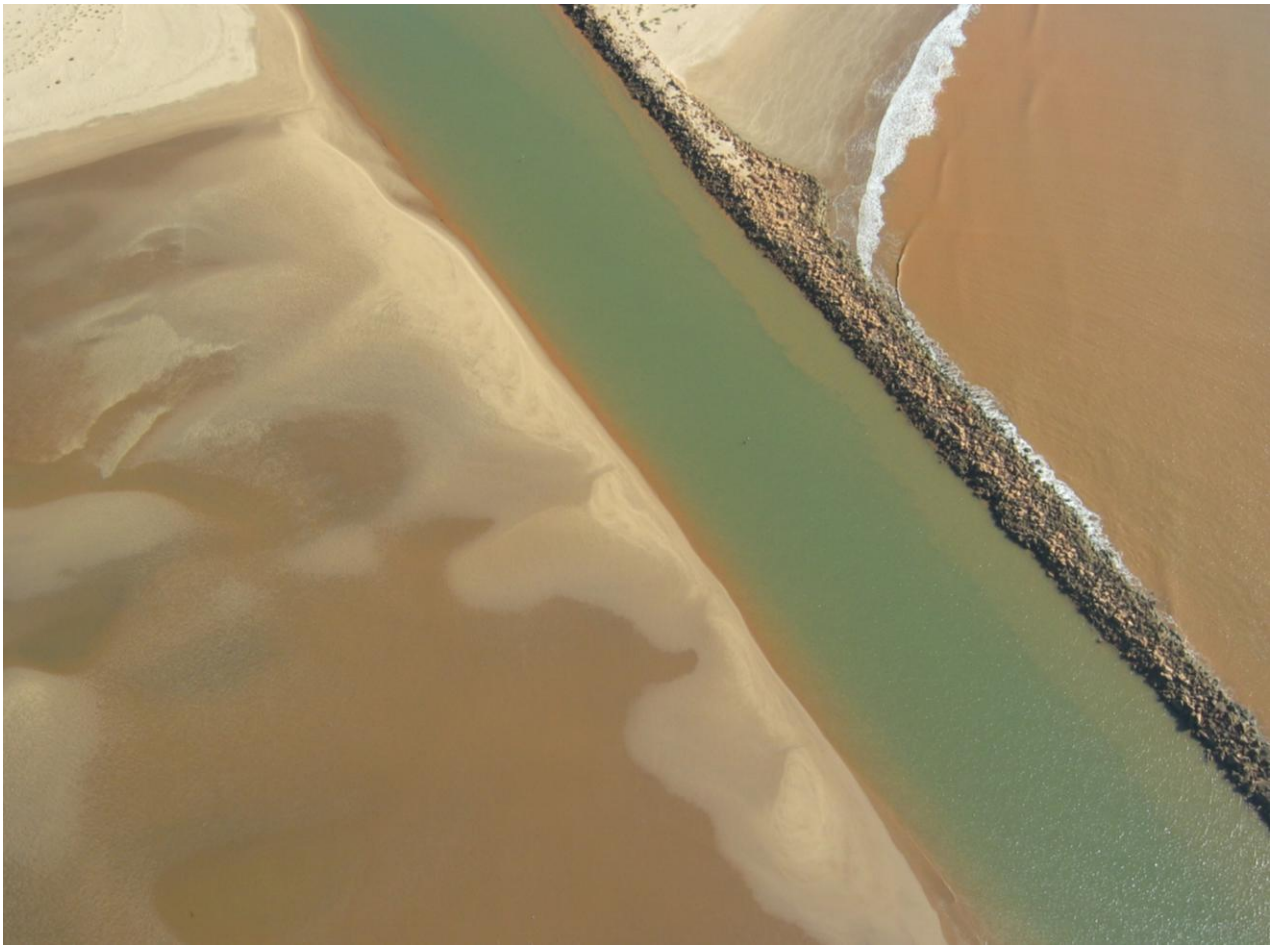
2.1.2 Hydrodynamics

There is generally low wave-energy offshore from Onslow because the coastline is sheltered from the prevailing south-west swells by the North West Cape and nearby islands, and from the north-east swells by a series of islands and attenuation resulting from the long, shallow continental shelf (Chevron 2012a). A west-north-west sea breeze occurs during most of the year, causing a short-period sea to develop most afternoons.

The tide at Onslow is predominantly semi-diurnal with a mean spring range of approximately 1.8–1.9 m (HGM 1999, Chevron 2012a). Tidal currents flow along the coastline in the nearshore area; these are generally easterly during flood tides and westerly during ebb tides. Local wind-driven currents interrupt this flow causing net currents that propagate along the coastline; in shallow water these flows can be significant. These wind-driven currents often dominate over the tidal currents (Chevron 2012a). The geomorphology of the coastline has been influenced by the tidal- and wind-induced currents and is characterised by bays and headlands reflecting the net movement of sand towards the northeast (HGM 1999).

2.1.3 Turbidity

An aerial flight conducted during a period of no dredging (August 2003) indicates the high natural turbidity levels in both nearshore and offshore waters throughout the region (Figure 2.1). A review of studies for the Wheatstone project indicated during non-cyclonic periods, median turbidity ranged between <1 and 6 Nephelometric Turbidity Units (NTU) (Chevron 2012a). The periodic high turbidity observed in nearshore waters around Onslow and Beadon Creek is a result of outflow from the Ashburton River following high rainfall periods. During cyclone events the turbidity observed in the nearshore waters may increase by more than ten times that observed during non-cyclonic periods (Chevron 2012a). These high turbidity events in nearshore waters are natural and species within the local marine environment are able to tolerate these conditions for short periods.



Source: Oceanica (12 August 2003)

Figure 2.1 Comparison of turbidity levels between Beadon Creek and the adjacent nearshore waters west of the breakwater

2.1.4 Flora and fauna

A dive survey of benthic habitat was conducted in Beadon Creek and surrounding areas in August 2003 (DALSE & JFA 2003). The benthic area within and surrounding Beadon Creek was entirely sand habitat—no seagrass or macroalgae was observed. This is supported by nearshore benthic grab samples taken in March 2009, which indicated that no vegetation was present at any of the three sites sampled. Further, during a diver survey in the channel in December 2012 only bare sand was observed (Oceanica 2013).

Terrestrial vegetation within the reclamation area partly consists of mangroves (0.08 ha) and has been classified as Beard Vegetation Association 676: succulent steppe, samphire (Shepherd et al. 2002, Appendix D). The vegetation condition has been described as degraded, according to Keighery's Vegetation Condition Scale (Keighery 1994, Appendix D).

A search of the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999* database of protected species and Department of Environment and Conservation (DEC) Threatened and Priority Fauna database returned seven listed threatened species and 16 listed migratory species that may occur within the Beadon Creek area (Table 2.1). Migratory birds listed in the international treaties, the Japan-Australia Migratory Bird Agreement—JAMBA, the China-Australia Migratory Bird Agreement—CAMBA and the Republic of Korea-Australia Migratory Bird Agreement—ROKAMBA, may also be present (Table 2.1).

The reclamation area is not a known turtle nesting area and therefore the occurrence of turtles in this area is unlikely. It is considered likely that sawfish are present in Beadon Creek as they have been observed in similar habitats in the Ashburton River and other nearby creeks (Chevron 2012b, Dr Glen Young, 2013, pers. comm., 25 June). However sawfish studies have not been undertaken specifically within Beadon Creek and therefore size of the Beadon Creek population is unknown.

The habitat within the reclamation area is considered degraded therefore regular occurrence of the quolls and migratory birds listed in Table 2.1 is unlikely.

Table 2.1 Threatened and migratory species that may be present in the Beadon Creek area

Species	Category and status	Type of presence
Mammals		
Northern quoll (*Dasyurus hallucatus*)	Threatened species Endangered	Species or species habitat likely to occur within area
Migratory Marine Species		
Loggerhead turtle (*Caretta caretta*)	Threatened species Migratory species Endangered	Species or species habitat likely to occur within area
Green turtle (*Chelonia mydas*)	Threatened species Migratory species Vulnerable	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle, leathery turtle (*Dermochelys coriacea*)	Threatened species Migratory species Endangered	Foraging, feeding or related behaviour known to occur within area
Hawksbill turtle (*Eretmochelys imbricata*)	Threatened species Migratory species Vulnerable	Foraging, feeding or related behaviour known to occur within area
Flatback turtle(*Natator depressus*)	Threatened species Migratory species Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Dwarf sawfish, Queensland sawfish (*Pristis clavata*)	Threatened species Vulnerable	Species or species habitat likely to occur within area
Migratory Birds		
Fork-tailed swift (*Apus pacificus*)	Migratory species JAMBA[1]/CAMBA[2]	Species or species habitat likely to occur within area
Great egret, white egret (*Ardea alba*)	Migratory species JAMBA[1]/CAMBA[2]	Species or species habitat likely to occur within area
Cattle egret (*Ardea ibis*)	Migratory species JAMBA[1]/CAMBA[2]	Species or species habitat likely to occur within area
Lesser crested tern (*Sterna bengalensis*)	Migratory species CAMBA[2]	Breeding known to occur within area
White-bellied sea-eagle (*Haliaeetus leucogaster*)	Migratory species CAMBA[2]	Species or species habitat likely to occur within area
Barn swallow (*Hirundo rustica*)	Migratory species JAMBA[1]/CAMBA[2]	Species or species habitat likely to occur within area
Rainbow bee-eater (*Merops ornatus*)	Migratory species Protected under international agreement	Species or species habitat likely to occur within area
Oriental plover, oriental dotterel (*Charadrius veredus*)	Migratory species JAMBA[1]	Species or species habitat likely to occur within area
Oriental pratincole (*Glareola maldivarum*)	Migratory species JAMBA[1]/CAMBA[2]/ ROKAMBA[3]	Species or species habitat likely to occur within area

Notes:
1. JAMBA = Japan-Australia Migratory Bird Agreement
2. CAMBA = China-Australia Migratory Bird Agreement
3. ROKAMBA = Republic of Korea-Australia Migratory Bird Agreement

2.2 Previous dredging in Beadon Creek

The Beadon Creek Marine Facility was constructed in 1964 and included capital dredging at the entrance to the creek (Table 2.2). Further dredging was carried out in 1968 in conjunction with the construction of a rock training wall on the western side of the creek. During this campaign, the creek was dredged to approximately -0.7 m chart datum (CD) (HGM 1998).

In 1999, the DoT carried out further capital and maintenance dredging works in Beadon Creek with the primary objective of improving safe passage and mooring of vessels during cyclone events (HGM 1999). This included dredging of the sand bar at the mouth of Beadon Creek, the entrance channel (to a minimum depth of -1.6 m CD) and the mooring basin (to a minimum depth of -2.6 m CD). A total of 40 900 m^3 of dredged material was removed

during these works and deposited on the beach to the west of the rock training wall, and in the old quarry, south of Beadon Creek Road. Other works carried out at the same time included installation of new cyclone moorings and an upgrade of the existing timber wharf.

Maintenance dredging in Beadon Creek was again carried out in November 2003, where the bell mouth and the mid-entrance channel were dredged to a minimum depth of -1.6 m CD (JFA 2004) and approximately 9820 m^3 of material was dredged and disposed to the beach immediately west of the rock wall.

More recently, maintenance dredging in Beadon Creek was undertaken in 2012 and 2013, to maintain a navigable channel for access to the Maritime Facility. During these maintenance dredging campaigns, ~40 000 m^3 of material was dredged from the bell mouth, entrance channel and berth pockets during May to September 2012 and ~13 000 m^3 of material[2] was dredged from the entrance channel and cyclone moorings during March to May 2013. The dredge material was disposed to the dune swales to the west of the channel entrance.

Table 2.2 History of dredging at Beadon Creek

Date	Volume (m^3)	Depth (m CD)	Disposal site	Reference	Comments
1964–1968	Unknown	-0.7	Unknown	HGM (1998)	Capital dredging
1999	40 900	Bell mouth: -1.6 Basin: -2.6	Dune swale to the west of the rock wall and quarry	HGM (1999)	Dredged sand bar at mouth of creek
2003	9820	Bell mouth: -1.6 Channel: -1.6	Dune swale to the west of the rock wall	JFA (2004)	Maintenance dredging
2011	Unknown	Berth pocket adjacent to channel	Onshore adjacent to berth pocket	Oceanica (2012c)	Very small scale dredging
2012	~40 000	Bell mouth: -1.6 Channel: -1.5 to -2.6	Dune swale to the west of the rock wall	BMT JFA (2012)	Maintenance dredging
2013	~13 000	Channel: -1.5 to -2.6 Cyclone moorings: -1.5	Dune swale to the west of the rock wall	-	Maintenance dredging
2013	~5000	Berth pocket adjacent to channel: -1.6 to -2.65	Dune swale to the west of the rock wall	-	Very small scale dredging

2.3 Review of existing information on sediment contamination

Two sediment surveys have recently (2009 and 2011) been carried out within Beadon Creek. The 2009 sampling was undertaken in support of the 2012 and 2013 maintenance dredging (Oceanica 2010). In 2011 samples were tested for acid sulfate soil (ASS) characteristics on material that had been excavated to create a small berth pocket adjacent to the maintenance dredge channel within the creek (Oceanica 2012c). These studies tested potential contaminants of concern and provide context for the proposed capital dredging works.

2.3.1 2009 sediment sampling

In 2009, nine manual sediment cores and three benthic grab samples were obtained from the proposed maintenance dredging area in the Beadon Creek bell mouth and basin.

Seven of the nine cores and one grab sample were analysed for:

- particle size distribution
- total organic carbon and total carbonate
- nutrients:
  - total Kjeldahl nitrogen (TKN), total phosphorus (TP)
  - elutriate nutrients – ammonium (NH_4), nitrate+nitrite (NO_2+NO_3), filterable reactive phosphorus (FRP)
- tributyltin, dibutyltin and monobutyltin
- total and elutriate metals (Al, As, Cd, Cr, Cu, Fe, Hg, Ni, Ag, Se and Zn)
- acid sulfate soils (SCr).

[2] *Note that this is an estimate as the post dredge hydrographic survey has not been completed.*

The dredge material consisted of silty-sands to sands with some shell fragments. Four of the eight samples had sulfur values exceeding the 0.03% S (S_{Cr}) Action Criteria (DEC 2009) indicating that there were potential acid sulfate soils (PASS) at these sites. However, further analysis indicated that the potential acidity (31.2–56.1 mol H+/tonne) would be effectively buffered by the alkaline components (acid neutralising capacity—ANC of 1658–1198 mol H+/tonne) of the sediments. There were no exceedances of the relevant guidelines for nutrients, metals, or the boat antifoulant ingredient tributyltin (TBT).

These results were reported in a DEIA (Oceanica 2010), which stated a low likelihood of environmental impacts due to dredging.

2.3.2 2011 sediment sampling

Due to previous concerns, expressed by the OEPA, of possible acidity within the Beadon Creek sediments, on 14 December 2011 three samples were taken of the disposed material from the excavation of the small berth pocket in 2011 (Table 2.2). Sediment samples were analysed using the chromium reducible sulfur suite method. For all samples, the pH values were 9.5–9.7, %S (S_{Cr}) value was 0.01% or less and total acidity was <1 mol H+/tonne (Oceanica 2012b). This further sampling indicates a low likelihood of dredged sediments developing acidity following disposal.

2.4 Review of return water acidity quality during dredging

During the 2012 maintenance dredging campaign, measurements of return water and ambient water acidity were obtained. On one occasion the pH of the return water was below 7 (6.39) while the pH at the reference sites was above 7. However, the pH of the return water returned to above 7 on the following day. This slight increase in acidity was of short duration and unlikely to cause harm to the environment. For the remaining observations, the pH of the return water was either above 7 or above the pH recorded at the reference sites.

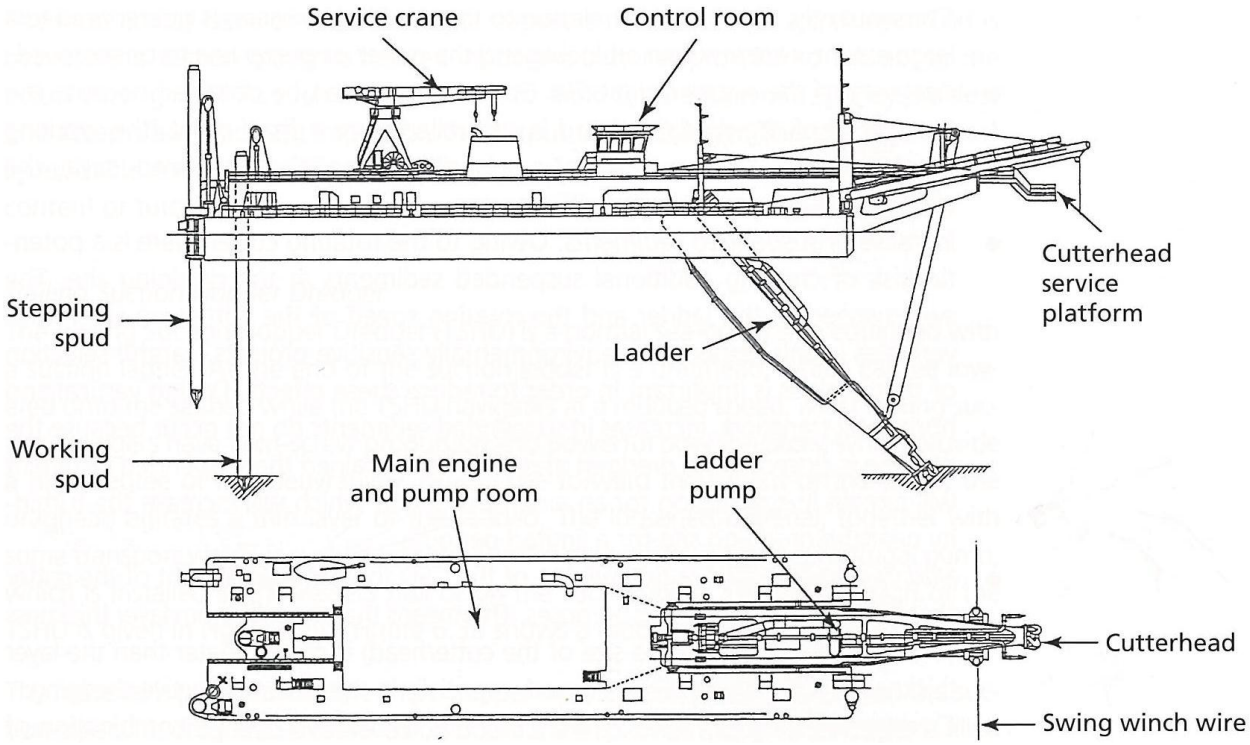
Laboratory analysis of return water samples collected during the dredging campaign indicated that the return water total titratable acidity was less than 40 mg/L. This, in conjunction with the in situ pH readings of >6, indicates that the acidity of the return water does not require neutralising treatment in accordance with the Acid Sulfate Soils Guideline Series (DEC 2009). Additionally, the alkalinity of the return water was greater than 180 mg/L and therefore adequate to maintain an acceptable pH level (DEC 2009).

In summary, there were no issues relating to return water acidity observed during the 2012 maintenance dredging campaign.

3. Dredging Operation and Disposal

3.1 Dredging operation

The DoT is planning to undertake capital dredging in Beadon Creek with disposal to a reclamation area on the western side of the creek. This dredging campaign is likely to be conducted using a small cutter-suction dredge (Figure 3.1). This type of dredge uses a rotating cutter head to loosen the sediment and create a slurry, which is immediately recovered by a suction tube directly behind the cutter head. Due to the rapid intake velocity at the cutting head, sediment release into the water column at the cutting head is generally minimal. The dredge will pump slurry through a suction line which will then deliver the material directly to the disposal site.



Source: Bray (2008)

Figure 3.1 Typical cutter-suction dredge

3.2 Dredge and disposal area

The capital dredging proposed by the DoT involves dredging an estimated 65 000 m^3 of material to create a berth pocket and turning basin on the western side of the channel immediately north of the existing harbour lots (Figure 1.2, Appendix B). The dredge material will be pumped to a reclamation area immediately to the west of the dredge area to form a land-backed wharf that will be secured with a rock revetment or sheet pile wall (Figure 1.2, Appendix B). The design depth of the berth pocket is -2.6 m Chart Datum (CD) and the design depth of the turning basin is -1.6 m CD (Appendix B). Approximately 5000 m^3 of material may also be excavated from the intertidal area at the southern end of the reclamation area (termed excavation area) as preliminary geotechnical information suggests this material may be unsuitable for building foundations (Figure 1.2). If this material is excavated, it will be placed on the disposal site previously used for the 2013 and 2012 maintenance dredging campaigns (the dune swale located west of the channel, refer to Section 2.2 and "Disposal Site: Beach 1999 & 2003" in Appendix A). The anticipated duration of the dredging campaign is 22 weeks.

4. Sediment Sampling and Analysis

4.1 Sediment sampling

To characterise the dredge material a number of randomly-distributed sites were selected for sampling; site selection was constrained to ensure that areas of seabed already at target depth within the dredge area were not sampled and that sampling was not undertaken near the edge of the dredge area (Oceanica 2012a). Sample cores were collected from 15 sites on 4 and 5 December 2012 and the target core depths varied between 0.7 m and 3.1 m (Figure 4.1, Table 4.1). The majority recovered core lengths were less than the targets due to core refusal.

Table 4.1 Sediment sample site locations and core lengths

Site	Easting	Northing	Target core length (m)	Actual core penetration length (m)
B1	306578	7605330	2.0	2.0
B2	306596	7605260	2.0	2.0
B3	306620	7605220	2.3	1.0
B4	306604	7605169	2.9	2.0
B5	306648	7605167	0.9	0.8
B6	306626	7605098	2.9	3.0
B7	306641	7605041	2.6	2.3
B8	306670	7605037	1.2	0.8
B9	306619	7605009	3.1	2.0
B10	306670	7604975	1.0	1.0
B11	306627	7604944	2.9	2.0
B12	306663	7604910	0.7	1.0
B13	306585	7605006	1.0	1.0
B14	306570	7604986	1.0	1.0
B15	306553	7604927	1.0	0.4

Notes:
1. Actual coordinates in GDA94 (established using hand-held GPS)

Each sediment core was divided into 0.5 m depth intervals and samples were taken at each interval. Previous sediment sampling (see Section 2.3) suggested a low likelihood of contamination of the proposed dredge sediments; therefore, the following risk-based screening approach was used to select the samples for analysis (Table 4.2), as per the EMF (Oceanica 2012b) and the SAP (Oceanica 2012a).

- The surface sample from each core was analysed. These were considered to have the highest risk of contamination.
- All samples from the Site B11 were analysed to determine the contaminant status of the deeper sediments. Site B11 is located adjacent to the existing wharf and was considered as having the highest risk of contamination, in addition, this site is located in a shallow area where the proposed dredging will remove a relatively large volume of sediment.
- All samples from Sites B15 and B14 were also analysed due to their proximity to the storm water drain.
- All the remaining samples were stored frozen for further analysis, if required.

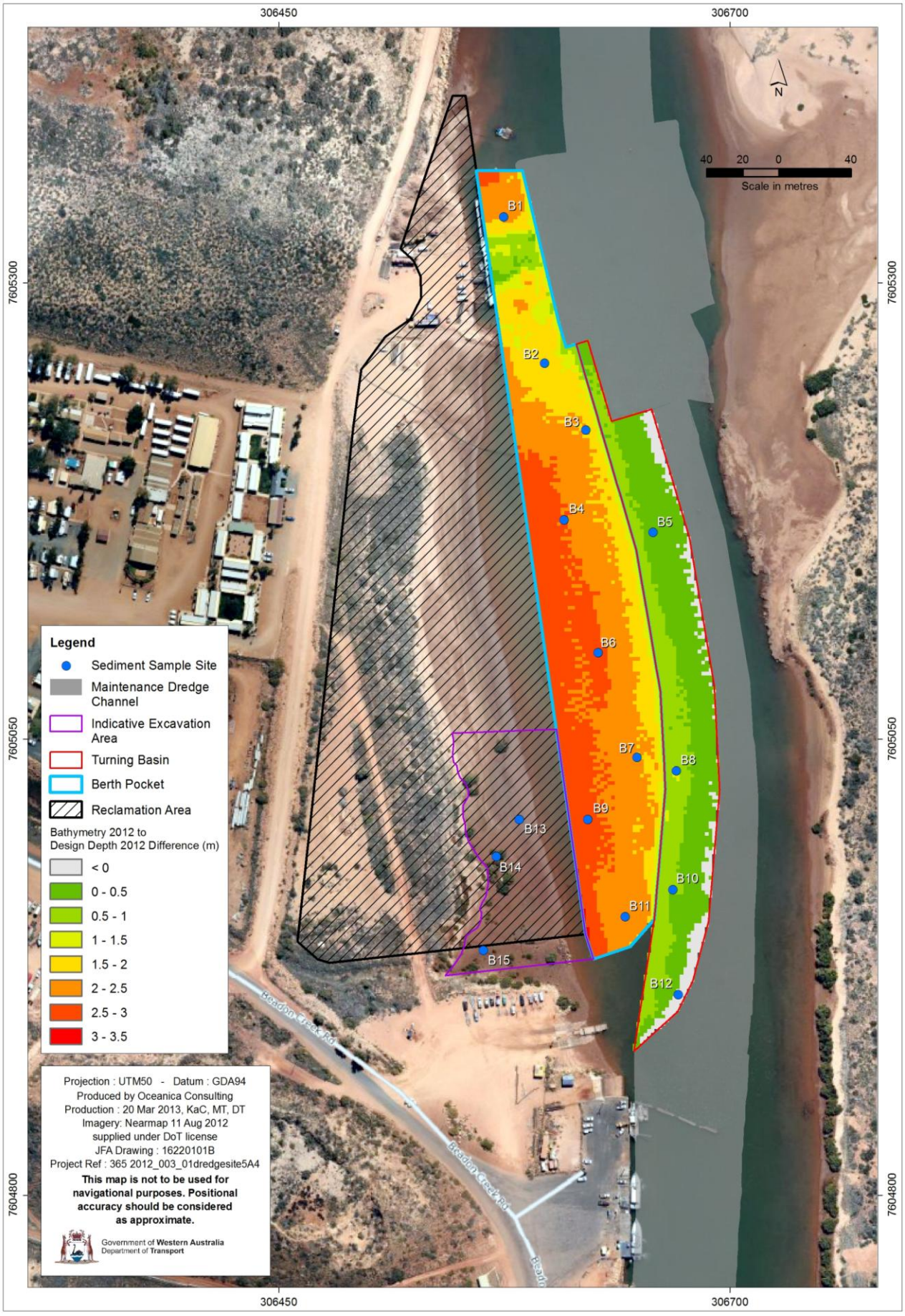


Figure 4.1 Beadon Creek capital dredge area and sediment sample sites

Table 4.2 Samples analysed and preserved

	Samples (Nominal depth increment in metres)							No. samples	No. samples
Site	**0–0.5**	**0.5–1.0**	**1.0–1.5**	**1.5–2.0**	**2.0–2.5**	**2.5–3.0**	**3.0–3.5**	**analysed**	**preserved**
B1	Y*	P	P	P				3*	3
B2	Y	P	P	P				1	3
B3	Y	P	-	-	-			1	1
B4	Y	P	P	P	-	-		1	3
B5	Y	P						1	1
B6	Y	P	P	P	P	P		1	5
B7	Y	P	P	P	-	-		1	3
B8	Y	P	-					1	1
B9	Y*	P	P	P	-	-	-	3*	3
B10	Y	P						1	1
B11	Y	Y	Y	Y	-	-		4	0
B12	Y	P						1	1
B13	Y	P						1	1
B14	Y	Y						2	0
B15	Y	-						1	0
Totals								**23**	**26**

Notes:
1. Y = sample analysed initially
2. P = sample preserved frozen for analysis if required
3. - = depth increment was not recovered in the cores
4. Shaded cells indicate areas below the depth of dredging
5. * = an additional two samples were collected and analysed at these sites for QC/QC purposes, refer to Section 4.1.1

The sediment cores were collected by a tethered-diver, using an acid-washed PVC core with a minimum diameter of 50 mm. For cores with target depths of less than ~1.5 m, the cores were obtained manually whereas for target core depths greater than ~1.5 m, a vibrating unit was used to assist penetration of the core. Each 0.5 m depth interval was removed from the core and placed into a clean bowl. The sediment was then homogenised to an even consistency, sub-sampled into appropriate jars and stored refrigerated or frozen until analysis. Seawater for elutriate analysis of the sediment samples was collected from the middle of the channel on the last day of sampling.

4.1.1 Sample quality assurance/quality control

The NAGD (CA 2009) recommends two types of quality assurance and quality control (QA/QC) samples for nutrient and contaminant analysis taken at randomly selected sites:

1. Inter-laboratory split: At 5% of sites, the sample from a single depth increment was thoroughly mixed and then split into three containers, each sample split to be analysed individually. Two of these sample splits were analysed by the primary laboratories (laboratory duplicates) to examine the consistency of their analytical methods. The primary laboratories were Marine and Freshwater Research Laboratory for nutrients and metals and National Measurement Institute for organics, organotins and chromium suite. The third sample split was sent to a reference laboratory to examine inter-laboratory consistency. The inter-laboratory split sample was tested for all analytes by MPL Laboratories.
2. Field triplicate: At 10% of sites, three separate cores were taken and a single depth increment of each was sampled and analysed individually by the primary laboratory. This analysis determines the variability of the sediment physical and chemical characteristics at the scale of sampling (CA 2009).

These controls were implemented in addition to the sampling program outlined in this section and in the SAP (Oceanica 2012a).

Table 4.3 QA/QC sampling from the proposed dredge areas

QA/QC sampling	Site and depth increment	Number of QA/QC samples
Inter-laboratory split	B1 0–0.5 m	2
Field triplicate	B9 0–0.5 m	2
Total additional QA/QC samples		4

4.2 Sediment analysis

4.2.1 Contaminants of concern

The DoT's EMF (Oceanica 2012b) recommends, as a minimum, that the material proposed for dredging should be analysed for:

- physical composition (particle size distribution and sediment settling velocity)
- total organic carbon and total carbonate (TOC and TCO_3)
- total and elutriate nutrients (total Kjeldahl nitrogen—TKN, total phosphorus—TP, ammonium—NH_4, nitrate+nitrite—NO_2+NO_3, and filterable reactive phosphorus—FRP)
- total and elutriate metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn).

The Beadon Creek Maritime Facility is primarily used for mooring of commercial and recreational vessels. Boat mooring areas may have specific contaminants such as TBT (banned in Australia since 2008), polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPHs) that warrant further assessment (CA 2009, Oceanica 2012b). Additionally the EMF recommends that for dredging projects occurring in estuaries, the sediments should be also tested for acid sulfate soils (ASS).

The disposal of the material from the potential excavation area (Figure 1.2) will be to the disposal area previously used during the 2013 and 2012 maintenance dredging campaign. This is adjacent to a recreational beach therefore samples were also tested for benzene, toluene, ethylbenzene and xylene (BTEX) in accordance with the EMF (Oceanica 2012b).

In summary, the sediment samples were analysed for:

- particle size distribution (PSD)
- total organic carbon (TOC)/Total carbonate (TCO_3)
- nutrients:
  - total Kjeldahl nitrogen (TKN), total phosphorus (TP)
  - elutriate nutrients – ammonium (NH_4), nitrate+nitrite (NO_2+NO_3), filterable reactive phosphorus (FRP)
- total and elutriate metals:
  - arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc
- total and elutriate tributyltin (total TBT normalised to 1% TOC)
- total petroleum hydrocarbons (TPHs, normalised to 1%TOC)
- polycyclic aromatic hydrocarbons (PAHs, normalised to 1%TOC)
- acid sulfate soils (S_{Cr})
- benzene, toluene, ethylbenzene and xylene (BTEX) for samples within the potential excavation area.

4.2.2 Laboratories

The sediment particle size distribution was analysed by Microanalysis Australia Pty Ltd. Murdoch University's Marine and Freshwater Research Laboratory analysed the metals and nutrients and the National Measurement Institute analysed the organics, organotins and chromium suite. MPL Laboratories was the reference laboratory for the analyses of the laboratory split samples for metals, nutrients, organics, organotins and chromium suite.

4.2.3 Laboratory quality assurance/quality control

As part of their standard procedures, each of the laboratories undertake testing of blanks, spikes and standards and complete laboratory duplicates as required by the NAGD (CA 2009). These data are reported in full in Appendix E.

4.3 Data analysis

4.3.1 Normalisation of organics

Organic and hydrocarbon data including sediment TBT, PAHs, TPHs and BTEX are required to be normalised to 1% TOC prior to reporting. TOC is the main binding constituent for organic substances and normalisation provides a measure of contaminant bioavailability (CA 2009). Where the TOC is significantly greater than 1%, the additional binding capacity will result in organics being less biologically available and therefore normalisation will reduce the measured value proportionally (the reverse also applies). In samples where the TOC is less than 0.2% or greater than 10%, these limit values (i.e. 0.2% or 10%, respectively) are used. If the analyte concentration is below the laboratory limit of reporting (LoR), half the LoR of the analyte is used for normalisation purposes.

4.3.2 Assessment against the guidelines

Sediments

NAGD guidelines

The NAGD (CA 2009) is a framework for environmental impact assessment for the ocean disposal of dredge material. Although ocean disposal is not proposed for the Beadon Creek capital dredging campaign, the material to be dredged is marine sediment and therefore the NAGD are a useful reference and have been used to inform this DEIA. Sediment contaminant concentrations from Beadon Creek capital dredge area were compared to the NAGD screening levels and the ANZECC/ARMCANZ (2000) Interim Sediment Quality Guideline (ISQG) High Values for metals and organics.

Comparison of sediment contaminant concentrations to the NAGD Screening Levels requires calculation of the 95% upper confidence limit (UCL) of the mean (CA 2009). The data are first tested for normality using the software ProUCL 4.0 (USEPA 2007). Depending on the distribution of the data, size of the dataset and the proportion of values below LoR (which introduce statistical complexities into the analysis), the software recommends the most appropriate method for calculating the 95% UCL of the mean (e.g. parametric (such as Student's-t UCL) and non-parametric (such as boot-strap) methods). The 95% UCL of the mean for the contaminant data was calculated, using the recommended method, for comparison against the NAGD screening levels and the ISQG-High Values.

Ecological Investigation Levels and Health Investigation Levels

The Beadon Creek Capital dredge material will be disposed to land, therefore sediment contaminant concentrations were compared to the guidelines presented in the *Contaminated Sites Management Series: Assessment Levels for Soil, Sediment and Water* (DEC 2010). These guidelines consist of Ecological Investigation Levels (EILs) and Health Investigation Levels (HILs). Health Investigation Level F was chosen as the intended use of the reclamation area is consistent with "commercial/industrial purposes including premises such as shops and offices as well as factories and industrial sites" (DEC 2010). Health Investigation Level E, for parks, recreational open space and playing fields including secondary schools (DEC 2010), was applied to the sediments within the potential excavation area as this material would be disposed to an area adjacent to a recreational beach.

The statistical basis for comparison against EILs is not specified in DEC (2010), and so the 95% UCL of the mean was used for this purpose, on the basis that this is used to assess marine ecological risks in the NAGD (CA 2009). For assessment against the relevant HILs, the following criteria are specified in DEC (2010):

- the arithmetic mean of the sample data must meet the relevant HIL(s)
- the standard deviation of the sample data must be less than 50% of the relevant HIL(s)
- no single value must exceed 250% of the relevant HIL(s).

As HIL E and F values are at least an order of magnitude higher than the NAGD guidelines, a staged approach was used for assessment: the 95% UCL of the mean was used as the first basis for assessment against HILs, with specific comparison using HIL metrics only invoked if a NAGD guideline was exceeded.

Sediment elutriates—ANZECC/ARMCANZ (2000) water quality guidelines

The ANZECC/ARMCANZ (2000) *Guidelines for Fresh and Marine Water Quality* were used to assess elutriates of the sediments to be dredged. Elutriate analysis of the sediment samples is designed to simulate the potential release of contaminants from the sediment during dredging and disposal (CA 2009). There are two sub-categories of the ANZECC/ARMCANZ (2000) water quality guidelines: trigger values for physical and chemical stressors and trigger values for toxicants.

The trigger values for toxicants have been derived for different levels of environmental protection based around the percentage of species expected to be protected. In Western Australian marine waters, a high level of ecosystem protection applies, and the ANZECC/ARMCANZ (2000) trigger value for toxicants typically assigned are a species protection level of 99% for all contaminants except cobalt (which is assigned a 95% species protection level). Areas within harbours and marinas are, however, considered more disturbed environments that are typically assigned a moderate level of ecosystem protection, and ANZECC/ARMCANZ (2000) 90% species protection guidelines applied: this level of protection was considered applicable for the waters adjacent to the Beadon Creek Maritime Facility. For assessment against the ANZECC/ARMCANZ (2000) water quality guidelines, the mean of sediment elutriate data was used in accordance with the NAGD guidelines (CA 2009).

4.3.3 Acid sulfate soils

The Acid Sulfate Soils Guidelines (DEC 2009) outline how to identify ASS risk areas and the subsequent assessment methods, including sampling and reporting for dredge material that is planned to be disposed on land. As the dredge material is planned to be disposed onshore, and the proposed dredging will be undertaken in an estuarine environment, the actual and potential acidity of the Beadon Creek capital dredge area sediments were analysed.

The chromium reducible sulfur suite method was used, this method involves a series of steps that yield an estimate of the actual and potential acidity, the acid neutralising capacity (ANC) and the total net acidity of a sediment sample (Figure 4.2). The soil pH, in potassium chloride suspension (pH_{KCl}), gives an estimate of the actual acidity of the sediment. The reduced inorganic sulfur content (S_{Cr}) provides an estimate of the potential sulfidic acidity of the sediment, which is assessed against the DEC Action Criteria (DEC 2009). Titratable Actual Acidity (TAA_{KCl}) and/or Net Acid Soluble Sulfur (S_{NAS}) are analysed if pH_{KCl} is <6.5. The ANC provides an estimate of the ability of the sediment to naturally neutralise any acid produced (e.g. due to the presence of carbonate material).

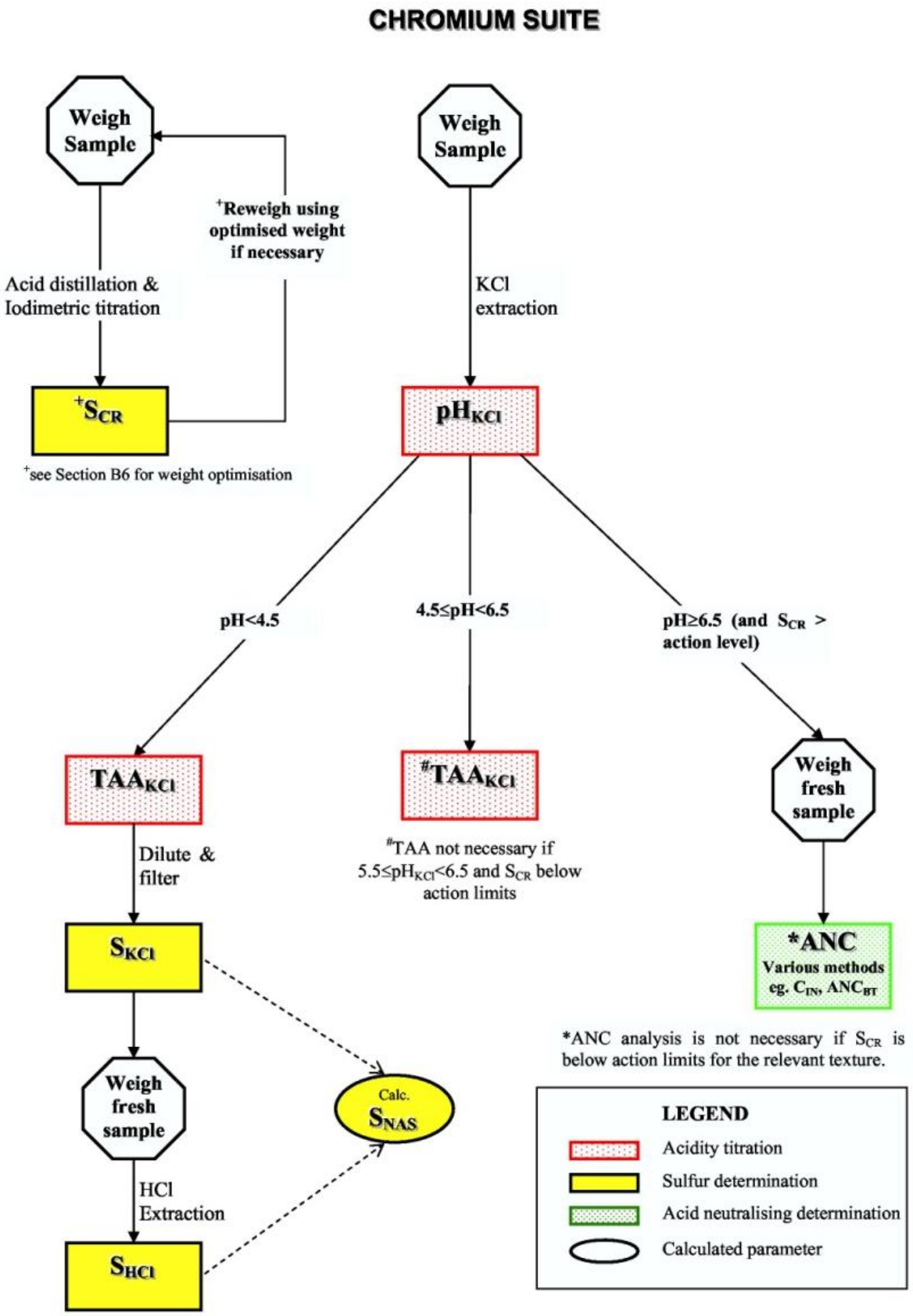
The total net acidity is calculated via Acid-Base Accounting (ABA), using the following equation (QASSIT et al. 2004):

$$\text{Net Acidity} = \text{Potential Sulfidic Acidity} + \text{Existing Acidity} - \frac{\text{ANC}}{\text{FF}}$$

where:

- Potential Sulfidic Acidity is represented by S_{Cr} (converted from %S to mol H+/tonne by multiplying by 623.7).
- If there is no existing acidity, i.e. the sample has a pH_{KCl} greater than 6.5, the TAA_{KCl} is assumed to be zero and the Existing Acidity term is neglected. If the pH_{KCl} is less than 6.5, the TAA_{KCl} is measured and used for the Existing Acidity term in mol H+/tonne.
- ANC is represented by ANC_{BT} (converted from $\%CaCO_3$ to mol H+/tonne by multiplying by 199.8).
- FF is the fineness factor.

As the samples are finely ground in the laboratory, the ANC likely to be experienced in the field could be overestimated and therefore the net acid risk, underestimated. To allow for this, the measurements of ANC are divided by a fineness factor (FF) during ABA. A fineness factor of 1.5 was selected for this study to ensure a conservative calculation of the neutralising capacity for the fine shell and carbonate silts.



Source: QASSIT et al. (2004)

Figure 4.2 Chromium suite flow diagram

4.3.4 Computation of test statistics for comparison to the guidelines

Generally, half the laboratory LoR value was used as a substitute for data below the LoR (CA 2009). However, a large proportion of the data below the LoR has the capacity to bias subsequent analyses. In particular, USEPA (2007) does not consider the 95% UCL, when calculated using only a few detected values, to be reliable. Therefore, where values below the LoR are present the following protocol was applied (based on ANZECC/ARMCANZ 2000):

- Where >25% of values were below the LoR, descriptive statistics (means and percentiles) or inferential analysis (including the calculation of confidence limits) were not calculated. Instead, individual results were compared to the triggers and discussed accordingly.
- Where ≤25% but >0% of values were below the LoR, confidence limits were calculated via two methods, once using the normalised estimate based on half the LoR as the replacement value and once using zero as a replacement value. This then informed the interpretation of the results; in particular, whether the choice of replacement value affects the outcome of the analysis.

4.4 QA/QC assessment

The results of the sample QA/QC are analysed by calculating the relative percent difference (RPD) for sample splits or the relative standard deviation (RSD) for triplicates. The RPD is calculated as follows:

$$\text{RPD (\%)} = \frac{(\text{difference between sample splits}) \times 100}{(\text{average of sample splits})}$$

The laboratory duplicates should agree within an RPD of ±35% and the laboratory splits should agree within an RPD of ±50%. If the RPD for a measured analyte falls outside of these limits, the values of the measured analyte will be flagged as estimates rather than precise values (CA 2009).

The RSD is calculated as follows:

$$\text{RSD (\%)} = \frac{(\text{standard deviation of field triplicates}) \times 100}{(\text{average of field triplicates})}$$

The field triplicates should agree within an RSD of ±50%. The guidelines note that this may not always be the case where the sediments are heterogeneous or greatly differ in grain size (CA 2009). The results of the QA/QC analysis are presented in Section 5.9.

5. Nature of Material to be Dredged

The sample cores were mainly composed of brown to red-brown medium sand (Table 5.1). There were shell fragments and clay/silt sized particles present in many of the cores, sometimes occurring as horizons in the sediment. There was organic material present in a few of the cores.

Table 5.1 Description of the sediment cores taken from the Beadon Creek capital dredge area

Sample Site	Interval	Sediment interval description	Photo
B1	0–0.5	Red-brown, medium to coarse sands, 5–10% fines	
	0.5–1		
	1–1.5	Red-brown, medium to coarse sands, 5–10% fines, shell fragments	
	1.5–2	Red-brown fine sand to clay, large shell fragments	
B2	0–0.5	Red-brown medium to coarse sand, 10% fines	No core photo taken
	0.5–1		
	1–1.5	Red-brown sand	
	1.5–2	Red-brown sand, 20–40% fines, coarse shell fragments	
B3	0–0.5	Red-brown medium to coarse sand, 10% shell fragments	
	0.5–1	Red-brown medium to coarse sand, 10% shell fragments, black organics at 0.9–1.0 m	
B4	0–0.5	Brown medium sand, small shell fragments	
	0.5–1	Brown medium sand, 10% fines	
	1–1.5	Brown medium sand, 10% fines, large shell fragments	
	1.5–2	Brown medium sand, 10% fines, large shell fragments	

Sample Site	Interval	Sediment interval description	Photo
B5	0–0.5	Brown medium sand, large shell fragments	
	0.5–1		
B6	0–0.5	Brown medium sand, small shell fragments	
	0.5–1	Brown medium sand, medium shell fragments	
	1–1.5	Brown medium sand, some clay/silt sections, large shell fragments at 1.2 m	
	1.5–2	Brown medium sand, some fines, small shell fragments	
	2–2.5	Brown medium sand, small shell fragments	
	2.5–3	Brown medium sand, clay/silt at 2.8 m, medium shell fragments	
B7	0–0.5	Brown medium sand, small shell fragments	
	0.5–1	0.5–0.7 cm brown medium sand, shell fragments 0.7–0.9 m brown clay/silt	
	1–1.5	Brown medium sand, large shell fragments	
	1.5–2	Brown medium sand, 10% fines, small shell fragments	
B8	0–0.5	Red-brown medium to coarse sand, some organics	
	0.5–1	Red-brown medium to coarse sand, clay/silt at 0.8 m, 10% shell fragments some organics	

Sample Site	Interval	Sediment interval description	Photo
B9	0–0.5	Brown medium grain sand, small shell fragments	
	0.5–1		
	1–1.5	Brown medium grain sand, larger shell fragments	
	1.5–2	Brown medium grain sand, 40% fines	
B10	0–0.5	Red-brown medium to coarse sand, 10–20% fines, some shell fragments, some organics	
	0.5–1		
B11	0–0.5	Brown-black medium grain sand, some clays at 0.2 m	
	0.5–1	Brown medium sand, small shell fragments down to 0.8 m, below this, larger shell fragments	
	1–1.5	Brown medium sand, large shell fragments, core refusal due to shell fragments starting at 1 m	
B12	0–0.5	Brown medium, well sorted sand, some organics	
	0.5–1	0.5–0.6 m brown coarse sand, 10–20% fines 50% shell fragments, some organics	

Sample Site	Interval	Sediment interval description	Photo
B13	0–0.5	Brown fine to coarse homogenous sand, 20% fines	
	0.5–1		
B14	0–0.5	0–0.2 m red-brown medium sand, 15–20% fines 0.2–0.5 m black medium sand rich in organics, 15–20% fines	
	0.5–1	Black medium sand rich in organics, 15–20% fines	
B15	0–0.5	0–0.2 m red-brown medium sand, 10–15% fines 0.2–0.4 m black medium sand rich in organics, 10–15% fines	

5.1 Particle size analysis

To assess the potential elevation in turbidity resulting from dredging and disposal, sediments sampled from the proposed dredge area were analysed for particle size distribution using laser diffraction (0.02–500 µm) and wet sieving (500–10 000 µm).

5.1.1 Particle size distribution

Particle size analysis of the sediment core samples collected in the Beadon Creek capital dredge area (presented in Table 5.2 and Figure 5.1) indicate that the sediments to be dredged were mainly composed of sand size particles (~74–99%), with the largest sand fraction in each sample composed of medium sand in the majority of samples (~28–60%). Gravel fractions of >20% occurred at sites B4, B10, B11 and B12. Most samples contained no clay or silt-sized particles; the exceptions were at sites B9, B11, B12, B13, B14 and B 15, which contained ~0.3–1.8% total clay and ~0.4–3.5% total silt. Additionally, the particle size distribution modes in sediment samples at sites B1, B13, B14 and B15 were finer relative to the other sediment samples (Figure 5.1). Note that sites B13, B14 and B15 are located in the intertidal excavation area (Figure 4.1) where finer sediments may be expected to be deposited.

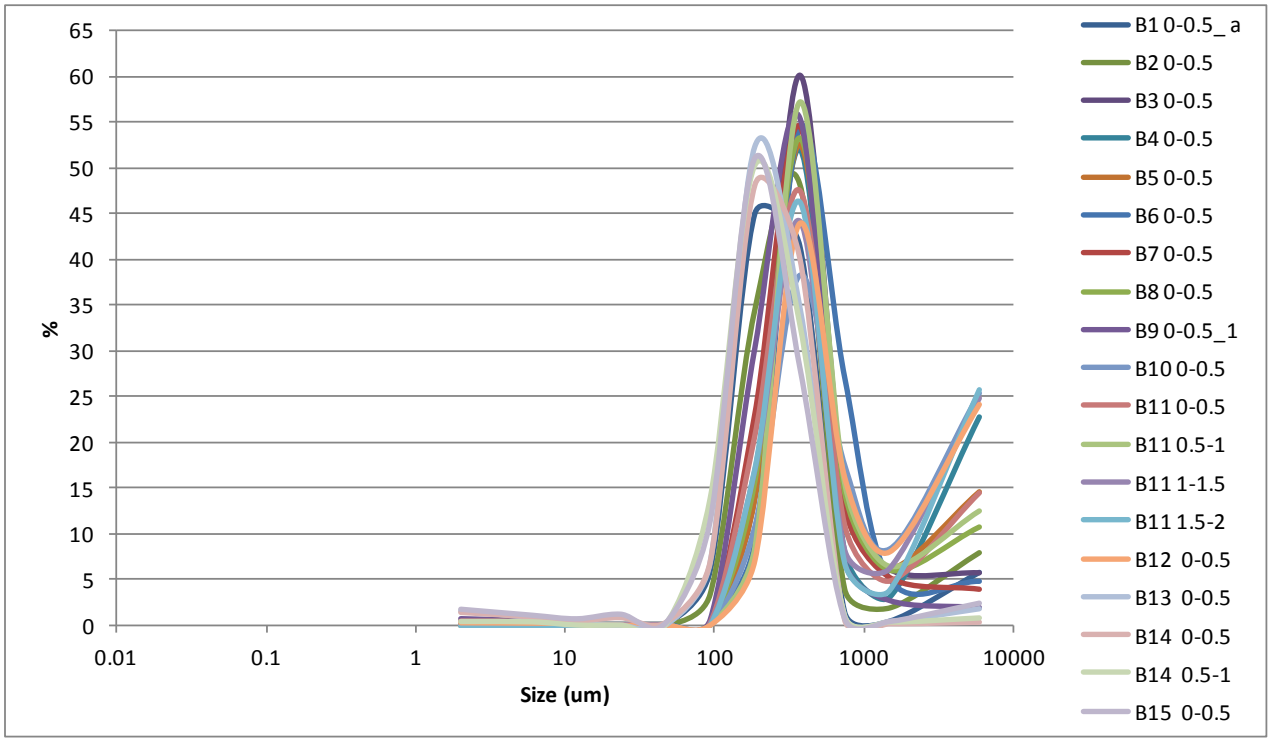


Figure 5.1 **Modal plot of particle size distribution for sediment samples from the Beadon Creek capital dredge area**

5.1.2 Settling velocity

The time taken for 90% and 50% of particles to settle through 1 m of water, estimated using Stokes Law, was <2 min and <1 min, respectively, for all Beadon Creek samples analysed (Table 5.3). The results indicated a very low potential for generation of turbidity during dredging and disposal.

Table 5.2 Particle size distribution of sediment samples from the Beadon Creek capital dredge area

Sediment composition	Wentworth size category	% by Volume																	
		B1 0–0.5_ a	B2 0–0.5	B3 0–0.5	B4 0–0.5	B5 0–0.5	B6 0–0.5	B7 0–0.5	B8 0–0.5	B9 0–0.5_1	B10 0–0.5	B11 0–0.5	B11 0.5–1	B11 1–1.5	B11 1.5–2	B12 0–0.5	B13 0–0.5	B14 0–0.5	B14 0.5–1	B15 0–0.5
Total gravel	**>2000 µm**	**5.7**	**8.0**	**5.7**	**22.7**	**14.6**	**4.7**	**3.9**	**10.7**	**2.0**	**25.3**	**14.5**	**12.5**	**24.7**	**25.8**	**24.1**	**1.8**	**0.3**	**0.8**	**2.5**
Sand	Very coarse 1000–2000 µm	0.4	1.9	6.1	3.0	6.1	5.0	5.2	5.9	2.8	8.3	4.8	6.4	6.1	3.9	8.0	0.4	0.1	0.3	0.5
	Coarse 500–1000 µm	1.4	4.0	14.1	8.0	12.9	27.0	13.0	14.4	7.1	17.5	10.9	15.5	8.1	6.9	16.2	1.0	0.6	1.0	0.8
	Medium 250–500 µm	41.6	48.2	60.1	52.0	52.6	54.3	54.6	53.3	55.5	38.2	47.6	57.1	44.1	46.3	43.9	34.9	40.2	33.0	28.3
	Fine 125–250 µm	45.1	34.5	14.1	14.4	13.8	8.9	23.1	15.7	30.3	10.7	20.8	8.4	16.9	17.1	7.1	52.4	48.1	50.3	51.1
	Very fine 63–125 µm	5.9	3.4	0	0.0	0.0	0.0	0.1	0.0	0.7	0.0	0.2	0.0	0.0	0.0	0.0	6.9	6.9	13.8	11.4
Total sand	**63–2000 µm**	**94.3**	**92.0**	**94.3**	**77.3**	**85.4**	**95.3**	**96.1**	**89.3**	**96.4**	**74.7**	**84.4**	**87.5**	**75.3**	**74.2**	**75.2**	**95.5**	**96.0**	**98.5**	**92.2**
Silt	Coarse 31–63 µm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3
	Medium 16–31 µm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.3
	Fine 8–16 µm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.5	0.0	0.8
	Very fine 4–8 µm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.4	0.0	0.0	0.0	0.2	0.9	0.9	0.4	1.2
Total Silt	**4–63 µm**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**0.0**	**0.6**	**0.0**	**0.0**	**0.0**	**0.4**	**1.1**	**2.4**	**0.4**	**3.5**
Total Clay	**0–4 µm**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**0.0**	**0.5**	**0.0**	**0.0**	**0.0**	**0.3**	**1.6**	**1.4**	**0.4**	**1.8**

Table 5.3 Settling velocities for sediment samples from the Beadon Creek capital dredge area

	B1 0–0.5_ a	B2 0–0.5	B3 0–0.5	B4 0–0.5	B5 0–0.5	B6 0–0.5	B7 0–0.5	B8 0–0.5	B9 0–0.5_1	B10 0–0.5	B11 0–0.5	B11 0.5–1	B11 1–1.5	B11 1.5–2	B12 0–0.5	B13 0–0.5	B14 0–0.5	B14 0.5–1	B15 0–0.5
90% of particles																			
Minimum settling velocity of 90% of particles (mm/s)	16.10	20.25	44.64	43.82	44.79	54.08	34.45	41.85	25.49	49.80	32.47	54.83	39.82	39.61	57.39	13.26	12.41	10.60	8.89
Time for 90% of particles to settle over 1 m (min)	1.04	0.82	0.37	0.38	0.37	0.31	0.48	0.40	0.65	0.33	0.51	0.30	0.42	0.42	0.29	1.26	1.34	1.57	1.87
Estimated mean diameter of particles falling at this speed (µm)	131.91	147.96	219.52	217.53	219.89	241.77	192.92	212.80	165.98	231.92	187.39	243.37	207.41	206.84	248.85	119.78	115.74	107.10	97.98
50% of particles																			
Minimum settling velocity of 50% of particles (mm/s)	50.59	70.80	119.63	129.54	130.09	154.44	94.89	125.24	76.71	245.00	111.98	142.31	134.17	127.92	196.78	39.94	42.37	35.46	33.27
Time for 50% of particles to settle over 1 m (min)	0.33	0.24	0.14	0.13	0.13	0.11	0.18	0.13	0.22	0.07	0.15	0.12	0.12	0.13	0.08	0.42	0.39	0.47	0.50
Estimated mean diameter of particles falling at this speed (µm)	233.82	276.45	359.28	374.32	375.14	408.30	319.97	367.79	287.72	491.02	347.68	391.91	380.90	371.85	461.85	207.71	214.05	195.65	189.74

Note:
1. The minimum settling velocities were calculated using the geometric mean of particle sizes, the 90th and 50th percentiles of particle sizes and Stokes Law, which is dependent on the diameter and density of particles.

5.2 Total organic carbon and carbonate

In general the sediment samples from the Beadon Creek capital dredge area had very low percentages of organic carbon (0.10–0.17%) and low percentages of total carbonate (0.47–1.83%) (Table 5.4). These ranges of organic carbon and carbonate content are similar to those found in sediment samples collected in 2009 to support the 2012 and 2013 maintenance dredging campaigns in Beadon Creek (Oceanica 2010). Results are presented in full in Appendix E.

Table 5.4 Total organic carbon and total carbonate content for sediment samples from the Beadon Creek capital dredge area

Sample	Total organic carbon (%)	Total carbonate (%)
B1 0–0.5 a	0.13	0.81
B2 0–0.5	0.17	1.83
B3 0–0.5	0.16	1.24
B4 0–0.5	0.15	0.47
B5 0–0.5	0.14	0.70
B6 0–0.5	0.16	1.34
B7 0–0.5	0.15	1.05
B8 0–0.5	0.13	0.73
B9 0–0.5_1	0.11	0.51
B10 0–0.5	0.14	1.06
B11 0–0.5	0.12	1.38
B11 0.5–1	0.10	0.90
B11 1–1.5	0.12	1.28
B11 1.5–2	0.11	0.99
B12 0–0.5	0.16	1.54
B13 0–0.5	0.10	0.52
B14 0–0.5	0.14	0.50
B14 0.5–1	0.10	0.83
B15 0–0.5	0.13	0.73

5.3 Nutrients (total and elutriate)

The total and elutriate nutrient concentration in the sediment samples from the Beadon Creek capital dredge area are presented in Table 5.5, results are presented in full in Appendix E. There are currently no guidelines for TKN in sediments. The range of TKN concentrations in the Beadon Creek capital dredge area (Table 5.5) were similar to those reported in the 2010 DEIA (Oceanica 2010). The TP concentrations in all the sediment samples (Table 5.5) were below the EILs defined in the *Contaminated Site Management Series: Assessment Levels for Soils* (DEC 2010).

Table 5.5 Total and elutriate nutrient concentrations in sediment samples from the Beadon Creek capital dredge area

Analytes		Total nutrients		Elutriate nutrients		
		TKN (mg.N/g)	TP (mg.P/g)	NH_4 (µg.N/L)	NO_2+NO_3 (µg.N/L)	FRP (µg.P/L)
EILs[1]		**-**	**2**	**-**	**-**	**-**
ANZECC/ ARMCANZ[2]	**Stressors[3]**	**-**	**-**	**15**	**30**	**5**
	Toxicants[4] - high (99%) protection	**-**	**-**	**500**	**-**	**-**
	Toxicants[4] - moderate (90%) protection	**-**	**-**	**1200**	**-**	**-**
B1 0–0.5 a		<0.1	0.14	24	8	9
B2 0–0.5		<0.1	0.16	74	6	17
B3 0–0.5		<0.1	0.14	110	4	9
B4 0–0.5		<0.1	0.08	100	4	8
B5 0–0.5		<0.1	0.13	63	6	5
B6 0–0.5		<0.1	0.10	<3	3	6
B7 0–0.5		<0.1	0.13	180	5	6
B8 0–0.5		<0.1	0.24	300	5	7
B9 0–0.5_1		<0.1	0.12	53	3	6
B10 0–0.5		<0.1	0.19	140	4	6
B11 0–0.5		<0.1	0.14	180	3	<2
B11 0.5–1		<0.1	0.13	89	5	12
B11 1–1.5		<0.1	0.15	38	8	13
B11 1.5–2		<0.1	0.13	<3	4	13
B12 0–0.5		<0.1	0.14	17	19	6
B13 0–0.5		<0.1	0.13	84	5	4
B14 0–0.5		<0.1	0.16	<3	2	<2
B14 0.5–1		<0.1	0.17	10	7	<2
B15 0–0.5		0.3	0.17	95	4	5
Mean[6]		**n/a**	**n/a**	**82.2**	**7.1**	**5.5**

Notes:
1. Ecological Investigation Levels (EILs) in the Contaminated Sites Managements Series: Assessment Levels for Soils (DEC 2010).
2. ANZECC/ARMCANZ (2000) water quality guidelines.
3. ANZECC/ARMCANZ (2000) default trigger values for physical and chemical stressors in estuarine waters of tropical Australia. Note that no data is available for tropical WA estuaries; therefore a precautionary approach should be adopted when applying default trigger values to these systems.
4. ANZECC/ARMCANZ (2000) default guidelines for toxicants in marine waters: 90% species protection applicable to waters adjacent to marine facilities, 99% species protection for waters upstream and downstream of the marine facilities.
5. For assessment against the ANZECC/ARMCANZ (2000) water quality guidelines, the mean of the sediment data was calculated for comparison with the trigger values. Note that where data were below the laboratory limit of reporting (LoR), half the LoR value was used for calculations.
6. n/a indicates where the calculation of statistics for comparison against the guidelines was not necessary.
7. Exceedances of the guidelines are indicated in red.

Elutriate nutrient analysis was conducted to assess the impacts on water quality following the disturbance of sediments during the dredging operation. Elutriate ammonium in the Beadon Creek capital dredge area sediments ranged between <3 and 300 µg.N/L. The mean value of these results was 82.2 µg.N/L; this exceeds the ANZECC/ARMCANZ (2000) trigger value for physical and chemical stressors in the environment. However, since it is below the ANZECC/ARMCANZ (2000) trigger value for toxicants at the 90% and 99% species protection levels it does not require further investigation. Additionally, the elutriate ammonium values observed here are less than those reported in the 2010 DEIA (Oceanica 2010), which ranged between 46 and 1000 µg.N/L and subsequent dredging in 2012 and 2013 did not reveal any issues relating to nutrient release.

Elutriate nitrate+nitrite in the Beadon Creek capital dredge area sediments ranged between 2 and 19 µg.N/L. The mean value of these results is 7.1 µg.N/L; this value does not exceed the ANZECC/ARMCANZ (2000) trigger value for physical and chemical stressors in the

environment. The elutriate nitrate+nitrite values reported here are slightly elevated compared to those reported in the 2010 DEIA (Oceanica 2010).

Elutriate FRP in the Beadon Creek capital dredge area ranged between <2 and 17 µg.P/L. The median value of these results is 5.5 µg.N/L; this value slightly exceeds the ANZECC/ARMCANZ (2000) trigger value for chemical stressors in the environment. However, the elutriate FRP values reported here are similar to those reported in the 2010 DEIA (Oceanica 2010) and subsequent dredging in 2012 and 2013 did not reveal any issues relating to nutrient release, therefore do not require further investigation.

5.4 Metals (total and elutriate)

5.4.1 Total metals

The total metal concentration in the sediment samples from the Beadon Creek capital dredge area are presented in Table 5.6, results are presented in full in Appendix E. The 95% UCL of the total metal concentration for each metal analysed were below the NAGD screening levels (CA 2009) and below the EILs. The arithmetic mean of the total metal concentration for each metal analysed in the dredge area (turning basin and berth pocket) and the excavation area were below the relevant HILs (refer to Section 4.3.2), additionally the standard deviation of the total metal concentration for each metal analysed in the dredge area and the excavation area were less than 50% of relevant HILs and no single total metal concentration exceeded 250% of the relevant HILs (DEC 2010). Note that no statistics were calculated for the total Hg concentrations because all but one result were below the laboratory LoR; the value above the LoR did not exceed any of the guidelines.

5.4.2 Elutriate metals

As total metal concentrations did not exceed NAGD guidelines, EILs or HILs, no further assessment was necessary. The elutriate results are presented for information only in Appendix E.

Table 5.6 Total metal concentrations in the sediment samples from the Beadon Creek capital dredge area

Analytes		Total metals (mg/kg)							
		As	Cd	Cr	Cu	Ni	Pb	Zn	Hg
NAGD[1]		**20**	**1.5**	**80**	**65**	**21**	**50**	**200**	**0.15**
EILs[2]		**20**	**3**	**Cr III = 400** **Cr VI = 1**	**100**	**60**	**600**	**200**	**1**
HILs (E)[3]		**200**	**40**	**Cr III = 240 000** **Cr VI = 200**	**2000**	**600**	**600**	**14 000**	**30**
HILs (F)[4]		**500**	**100**	**Cr III = 600 000** **Cr VI = 500**	**5000**	**3000**	**1500**	**35 000**	**75**
B1 0–0.5 a		13	0.2	21	4.4	7.1	3	18.0	<0.01
B2 0–0.5		12	0.3	23	6.3	8.6	3	17.0	<0.01
B3 0–0.5		17	0.3	12	3.5	4.1	5	76.0	<0.01
B4 0–0.5		8	0.1	11	2.9	3.0	2	7.6	<0.01
B5 0–0.5		13	0.1	11	4.6	3.4	3	6.9	<0.01
B6 0–0.5		12	0.2	10	2.5	2.9	2	6.5	<0.01
B7 0–0.5		15	0.2	13	4.6	3.9	3	8.6	<0.01
B8 0–0.5		13	0.4	12	3.0	3.6	3	8.0	<0.01
B9 0–0.5_1		10	0.1	12	3.4	3.5	3	9.7	0.07
B10 0–0.5		18	0.2	11	3.2	3.5	3	7.8	<0.01
B11 0–0.5		14	0.2	12	3.6	3.6	3	9.2	<0.01
B11 0.5–1		14	0.2	11	3.6	3.1	4	9.2	<0.01
B11 1–1.5		17	0.2	14	3.2	4.2	3	8.9	<0.01
B11 1.5–2		13	0.1	11	2.6	3.9	2	6.3	<0.01
B12 0–0.5		17	0.3	11	3.1	3.8	3	8.0	<0.01
B13 0–0.5		11	0.3	21	4.4	6.5	4	18.0	<0.01
B14 0–0.5		13	0.3	26	7.1	8.5	5	17.0	<0.01
B14 0.5–1		15	0.3	28	6.7	9.6	4	18.0	<0.01
B15 0–0.5		22	0.3	30	10.0	11.0	7	21.0	<0.01
95% UCL[5]		**15**	**0.3**	**18**	**5.1**	**6.2**	**4**	**30.4**	*
Dredge area[6]	**Mean**	**14**	**0.2**	**13**	**3.6**	**4.2**	**3**	**13.9**	*
	St Dev[7]	**3**	**0.1**	**4**	**1.0**	**1.6**	**1**	**17.5**	*
Ex. area[6]	**Mean**	**15**	**0.3**	**26**	**7.1**	**8.9**	**5**	**18.5**	*
	St Dev[7]	**5**	**0.0**	**4**	**2.3**	**1.9**	**1**	**1.7**	*

Notes:

1. NAGD screening level (CA 2009).
2. Ecological Investigation Levels (EILs) in the Contaminated Sites Managements Series: Assessment Levels for Soils (DEC 2010).
3. Health Investigation Levels (HILs) for parks, recreational open space and playing fields including secondary schools (E) in the Contaminated Site Management Series: Assessment Levels for Soils (DEC 2010).
4. Health Investigation Levels (HILs) for commercial/industrial purposes including premises such as shops and offices as well as factories and industrial sites (F) in the Contaminated Site Management Series: Assessment Levels for Soils (DEC 2010).
5. For assessment against the NAGD screening level (CA 2009) and the EILs (DEC 2010), the 95% upper confidence limit (UCL) was calculated using the software ProUCL 4.0 (USEPA) for comparison with the trigger value. Note that where data were below the laboratory limit of reporting (LoR), half the LoR value was used for calculations.
6. For assessment against the HILs the mean and standard deviation of the data are used. As the material from the dredge area and the excavation area are to be disposed of different disposal sites it is appropriate to compare these data against different HILs (refer to Section 4.3.2). Dredge area = turning basin and berth pocket; Ex area = excavation area.
7. Standard deviation.
8. *More than 25% of data were below the LoR therefore statistics were not performed on these data as this would return an unreliable result.

5.5 Acid sulfate soils

The chromium reducible sulfur suite method for determining sediment ASS characteristics in sediments is detailed in Section 4.3.3 The pH_{KCl} and S_{Cr} results of the Beadon Creek capital dredge sediments compared to the DEC (2009) Action Criteria for ASS are presented in Table 5.7, results are presented in full in Appendix E. The pH_{KCl} in all the sediment samples was greater than 6.5 and therefore are not classified as actually acidic. However, four out of 19 samples analysed had sulfur values (%S (S_{Cr})) exceeding the DEC action criteria (DEC 2009) and therefore these sediments are identified as PASS according to the chromium suite analysis for the assessment of ASS.

To determine the net acidity of the PASS sediment samples, ABA was conducted and the findings presented in Table 5.7. The results indicate that the potential acidity of these sediments was effectively buffered as a result of their ANC and therefore there would be a negative net acidity following disturbance of these sediments.

Table 5.7 Acid sulfate soils results for the sediment samples from the Beadon Creek capital dredge area

Analytes	pH_{KCl}	%S (S_{Cr})	Potential sulfidic acidity (PASS) (mol H+/tonne)	ANC_{BT} (%$CaCO_3$)[2]	ANC (mol H+ /tonne)	FF	Net acidity (mol H+ /tonne)[4]
Action criteria for soils (%S)[1]		**0.03**					
B1 0–0.5 a	9.6	0.03	18.71	n/m			
B2 0–0.5	9.7	<0.01	3.12	n/m			
B3 0–0.5	9.7	0.01	6.24	n/m			
B4 0–0.5	9.7	0.01	6.24	n/m			
B5 0–0.5	9.7	0.01	6.24	n/m			
B6 0–0.5	9.7	0.02	12.47	n/m			
B7 0–0.5	9.6	0.02	12.47	n/m			
B8 0–0.5	9.6	0.02	12.47	n/m			
B9 0–0.5_1	9.5	0.03	18.71	n/m			
B10 0–0.5	9.5	0.02	12.47	n/m			
B11 0–0.5	9.5	**0.04**	24.95	6.8	1358.64	1.5	-880.81
B11 0.5–1	9.7	0.02	12.47	n/m			
B11 1–1.5	9.7	0.02	12.47	n/m			
B11 1.5–2	9.7	0.02	12.47	n/m			
B12 0–0.5	9.5	**0.10**	62.37	9.7	1938.06	1.5	-1229.67
B13 0–0.5	9.6	0.01	6.24	n/m			
B14 0–0.5	9.6	<0.01	3.12	n/m			
B14 0.5–1	9.3	**0.13**	81.08	8.6	1718.28	1.5	-1064.44
B15 0–0.5	9.3	**0.10**	62.37	8.2	1638.36	1.5	-1029.87

Notes:
1. Values in red exceed the DEC Action Criteria for disturbance of >1000 tonnes of soils (DEC 2009). These sediments are classified as PASS.
2. ANC is the acid neutralising capacity of the sediments.
3. n/m = not measured. ANC was not measured for sites that did not exceed the DEC Action Criteria (DEC 2009).
4. A positive number indicates excess acid. A negative value indicates excess neutralising capacity.

5.6 Organotins

5.6.1 Total organotins

The organotin (monobutyltin—MBT, dibutyltin—DBT and TBT) concentrations in the Beadon Creek capital dredge area sediments are presented in Table 5.8, results are presented in full in Appendix E. As detailed in Section 4.3.1, the TBT data have been normalised to 1% TOC for comparison with the NAGD screening level (CA 2009). The TOC concentrations in the sediments were <0.2% therefore a normalisation factor of 5 was used. Note that TBT concentrations below the laboratory LoR were not normalised to generate the 95% UCL as greater than 25% of TBT concentrations were below the LoR.

The TBT concentrations in three individual samples (B4 0–0.5, B7 0–0.5 and B9 0–0.5_3) exceeded the NAGD screening level. The TBT concentration in sample B4 0–0.5 was below the ARMCANZ/ANZECC (2000) ISQG-High value (70 µg/kg). However, samples B7 0–0.5 and B9 0–0.5_3 had very high TBT concentrations (420 and 140 µg/kg, respectively).

In accordance with the EMF (Oceanica 2012) the deeper core samples from these sites were also analysed for TBT and the results are presented in Table 5.9. The surface sample at site B7 (the sample with the highest TBT concentration) was also reanalysed to determine if the contamination was uniform throughout the sample. The reanalysed normalised TBT concentration in sample B7 0–0.5 exceeded the NAGD screening level (CA 2009) although the concentration was much less than that found in the original analysis (Table 5.9). The analysis of the deeper core sediments indicated that at site B7, TBT concentrations exceeding the screening level were found in the 0.5–1 m sediment layer but deeper core samples had TBT concentrations below the LoR. At sites B4 and B9, TBT concentrations exceeding the screening level were limited to the surface 0.5 m of sediment.

5.6.2 Elutriate organotins

In accordance with NAGD guidelines (CA 2009), elutriate organotin concentrations in those Beadon Creek capital dredge area sediments that exceeded screening levels were analysed (Table 5.10). The elutriate TBT concentrations in samples B4 0–0.5, B7 0–0.5, B9 0–0.5_1, B9 0–0.5_2 and B9 0–0.5_3 exceeded the ANZECC/ARMCANZ (2000) 99% species protection trigger value for toxicants, but only samples B7 0–0.5 and B9 0–0.5_3 exceeded the 90% species protection trigger value. As with the total TBT results (Section 5.6.1), there was considerable variability in elutriate results between the original and reanalysed samples from site B7 and between triplicate samples at site B9 (Table 5.10 and Table 5.11).

In accordance with the EMF (Oceanica 2012), the deeper core samples from sites B4, B7 and B9 were also analysed for elutriate TBT (Table 5.11). Elutriate TBT values exceeding trigger values were limited to the surface 0.5 m of sediment at sites B4 and B7. At site B9, the elutriate TBT concentration exceeded the trigger values at the 1–1.5 m depth interval, but not at the 0.5–1.0 m or 1.5–2.0 m depth intervals. The total TBT concentration for the 1–1.5 m depth interval at site B9 was, however, below the screening level (Table 5.9), indicating that the elevated TBT concentration was not widespread throughout this sample.

Table 5.8 Organotin concentrations in the sediment samples from the Beadon Creek capital dredge area

Analytes	Raw MBT[5] µg/kg	Raw DBT[5] µg/kg	Raw TBT[5] µg/kg	Normalised TBT[5] µg/kg
NAGD[1]	**-**	**-**	**-**	**9**
ANZECC/ARMCANZ ISQG-High[2]	**-**	**-**	**-**	**70**
B1 0–0.5 a	<0.5	<0.5	<0.5	<0.5
B2 0–0.5	<0.5	<0.5	<0.5	<0.5
B3 0–0.5	<0.5	<0.5	<0.5	<0.5
B4 0–0.5	<0.5	1.2	2	**10**
B5 0–0.5	<0.5	<0.5	<0.5	<0.5
B6 0–0.5	<0.5	<0.5	<0.5	<0.5
B7 0–0.5	<0.5	5.1	84	**420**
B8 0–0.5	<0.5	<0.5	<0.5	<0.5
B9 0–0.5_1	<0.5	0.57	0.73	3.7
B9 0–0.5_2[3]	<0.5	0.71	1.7	8.5
B9 0–0.5_3[3]	<0.5	4.9	28	**140**
B10 0–0.5	<0.5	<0.5	0.66	3.3
B11 0–0.5	<0.5	0.64	0.64	3.2
B11 0.5–1	<0.5	<0.5	<0.5	<0.5
B11 1–1.5	<0.5	<0.5	0.6	3.0
B11 1.5–2	<0.5	<0.5	<0.5	<0.5
B12 0–0.5	<0.5	0.54	0.73	3.7
B13 0–0.5	<0.5	<0.5	<0.5	<0.5
B14 0–0.5	<0.5	<0.5	<0.5	<0.5
B14 0.5–1	<0.5	<0.5	<0.5	<0.5
B15 0–0.5	<0.5	<0.5	<0.5	<0.5
95% UCL[4]	**n/a**	**n/a**	**n/a**	*

Notes:
1. NAGD screening level (CA 2009).
2. ARMCANZ/ANZECC (2000) Interim Sediment Quality Guideline-High.
3. The field triplicate samples have been included here as they were found to have TBT concentrations exceeding the NAGD screening level (CA 2009).
4. For assessment against the NAGD screening level (CA 2009), the 95% upper confidence limit (UCL) was calculated using the software ProUCL 4.0 (USEPA) for comparison with the trigger value. Note that where data were below the laboratory limit of reporting (LoR), half the LoR value was used for calculations.
5. MBT = monobutyltin, DBT = dibutyltin, TBT = tributyltin.
6. n/a indicates where the calculation of statistics for comparison against the guidelines was not necessary.
7. *More than 25% of data were below the LoR therefore statistics were not performed on these data as this would return an unreliable result.
8. Exceedances of the guidelines are indicated in red.

Table 5.9 Organotin concentrations in the deeper core sediment samples at sites with TBT concentrations exceeding the NAGD screening levels

Analytes	Raw MBT[4] µg/kg	Raw DBT[4] µg/kg	Raw TBT[4] µg/kg	Normalised TBT[4] µg/kg
NAGD[1]	-	-	-	**9**
ANZECC/ARMCANZ ISQG-High[2]	-	-	-	**70**
Site B4				
B4 0–0.5	<0.5	1.2	2	**10**
B4 0.5–1	<0.5	<0.5	<0.5	<0.5
B4 1–1.5	<0.5	<0.5	<0.5	<0.5
B4 1.5–2	<0.5	<0.5	<0.5	<0.5
Site B7				
B7 0–0.5	<0.5	5.1	84	**420**
B7 0–0.5_reanalysis	<0.5	0.87	23	**115**
B7 0.5–1	<0.5	<0.5	3.7	**18.5**
B7 1–1.5	<0.5	<0.5	<0.5	<0.5
B7 1.5–2	<0.5	<0.5	<0.5	<0.5
B7 2–2.5	<0.5	<0.5	<0.5	<0.5
B7 2.5–3	<0.5	<0.5	<0.5	<0.5
Site B9				
B9 0–0.5_1	<0.5	0.57	0.73	3.7
B9 0–0.5_2[3]	<0.5	0.71	1.7	8.5
B9 0–0.5_3[3]	<0.5	4.9	28	**140**
B9 0.5–1	<0.5	0.56	1.6	8.0
B9 1–1.5	<0.5	<0.5	0.82	4.1
B9 1.5–2	<0.5	<0.5	<0.5	<0.5

Notes:
1. NAGD screening level (CA 2009).
2. ARMCANZ/ANZECC (2000) Interim Sediment Quality Guideline-High.
3. The field triplicate samples have been included here as they were found to have TBT concentrations exceeding the NAGD screening level (CA 2009).
4. MBT = monobutyltin, DBT = dibutyltin, TBT = tributyltin.
5. Exceedances of the guidelines are indicated in red.

Table 5.10 Elutriate organotin concentrations in the sediment samples from the Beadon Creek capital dredge area

Analytes	Elutriate MBT[4] ng/L	Elutriate DBT[4] ng/L	Elutriate TBT[4] ng/L
ANZECC/ARMCANZ[1] - high (99%) protection	-	-	**4**
ANZECC/ARMCANZ[1] - moderate (90%) protection	-	-	**20**
B4 0–0.5	2.1	2.5	**12**
B7 0–0.5	7.3	140	**1600**
B9 0–0.5_1	2	2.7	**7.7**
B9 0–0.5_2[2]	<2	2.3	**7.9**
B9 0–0.5_3[2]	2.7	20	**24**
Mean[3]	*	*	*

Notes:
1. ANZECC/ARMCANZ (2000) default guidelines for toxicants in marine waters: 90% species protection applicable to waters adjacent to marine facilities, 99% species protection for waters upstream and downstream of the marine facilities.
2. The field triplicate samples have been included here as they were found to have TBT concentrations exceeding the NAGD screening level (CA 2009).
3. For assessment against the ANZECC/ARMCANZ (2000) water quality guidelines, the mean of the sediment data was calculated for comparison with the trigger values. Note that where data were below the laboratory limit of reporting (LoR), half the LoR value was used for calculations.
4. TBT = monobutyltin, DBT = dibutyltin, TBT = tributyltin.
5. *More than 25% of data were below the LoR therefore statistics were not performed on these data as this would return an unreliable result.
6. Exceedances of the 90% species protection guidelines are indicated in red, and exceedances of the 99% species protection guidelines are indicated in blue.

Table 5.11 Elutriate organotin concentrations in the deeper core sediment samples at sites with TBT concentrations exceeding the ANZECC/ARMCANZ (2000) water quality guidelines

Analytes	Elutriate MBT[4] ng/L	Elutriate DBT[4] ng/L	Elutriate TBT[4] ng/L
ANZECC/ARMCANZ[1] – high (99%) protection	**-**	**-**	**4**
ANZECC/ARMCANZ[1] – moderate (90%) protection	**-**	**-**	**20**
Site B4			
B4 0–0.5	2.1	2.5	**12**
B4 0.5–1	<2	<2	3
B4 1–1.5	<2	<2	<2
B4 1.5–2	<2	<2	<2
Site B7			
B7 0–0.5	7.3	140	**1600**
B7 0–0.5_reanalysis	3.9	22	**210**
B7 0.5–1	<2	<2	<2
B7 1–1.5	<2	<2	<2
B7 1.5–2	<2	<2	<2
B7 2–2.5	<2	<2	<2
B7 2.5–3	2.2	<2	<2
Site B9			
B9 0–0.5_1	2	2.7	**7.7**
B9 0–0.5_2[2]	<2	2.3	**7.9**
B9 0–0.5_3[2]	2.7	20	**24**
B9 0.5–1	2.5	2.4	2.4
B9 1–1.5	2.4	17	**26**
B9 1.5–2	3.5	<2	<2

Notes:
1. ANZECC/ARMCANZ (2000) default guidelines for toxicants in marine waters: 90% species protection applicable to waters adjacent to marine facilities, 99% species protection for waters upstream and downstream of the marine facilities.
2. The field triplicate samples have been included here as they were found to have TBT concentrations exceeding the NAGD screening level (CA 2009).
3. TBT = monobutyltin, DBT = dibutyltin, TBT = tributyltin.
4. Exceedances of the 90% species protection guidelines are indicated in red, and exceedances of the 99% species protection guidelines are indicated in blue.

5.6.3 Interpretation of the organotin results

It is inferred that the TBT contamination, as indicated by the exceedances in total TBT concentration in the sediment, is localised around sites B4, B7 and B9 (Figure 4.1) and extends down to 1 m below the surface. The isolated nature of contamination and the considerable variability in total TBT between the original and reanalysed samples from site B7 and triplicate samples at site B9 are typical of TBT contamination caused by antifoulant paint flakes (CA 2009). The surface sediments at sites B1–B3, B5, B6, B8, B10–B15 did not exceed the NAGD screening level (most were below the LoR), therefore it is reasonable to assume that deeper layers at these sites also did not exceed the NAGD screening level, and therefore that 55 of the 59 samples that characterise the material to be dredged (Table 4.2) are below the NAGD screening level.

The elutriate TBT concentration in the surface 0.5 m layer at site B4 exceeded the ANZECC/ARMCANZ (2000) 99% species protection guideline but was below the 90% species protection guideline. Only elutriate TBT concentrations in the surface 0.5 m of sediments at sites B7 and B9 exceeded the 90% species protection level, and therefore contain bioavailable TBT at levels of potential concern. As surface sediments at sites B4, B7 and B9 only characterise 5.1% of the material to be dredged and specifically the surface samples at sites B7 and B9 only characterise 3.4% of the material to be dredged, it is concluded that the proposed dredging and disposal should not cause any significant adverse environmental effects.

The absence of the breakdown product MBT—even in samples from sites B7 and B9—and low concentrations of the breakdown product DBT (Table 5.8 and Table 5.9) indicate the contamination is relatively recent (within ca. 2 years). This is supported by the results of the March 2009 sampling for the 2010 DEIA (Oceanica 2010) which indicated low TBT concentrations in the sediments within the maintenance dredge channel sediments.

The distribution of high TBT concentration in sediment appears to be in a localised area removed from the shore and does not suggest a terrestrial source, e.g. from the stormwater drain. The distribution of TBT contamination (both total and elutriate) is more indicative of either a boat breaching by accident (e.g. while seeking refuge from a cyclone) or in-water hull cleaning in the vicinity of sites B7 and B9. Oceanica therefore speculates that the source of the recent TBT contamination could be:

- minor scraping of a boat hull freshly painted with TBT-containing antifoulant paint
- major scraping of a boat hull whereby old TBT-containing antifoulant paint under layers of new TBT-free antifoulant paint has become exposed
- in water hull cleaning dislodging either new or old TBT-containing antifoulant paint.

5.7 Total petroleum hydrocarbons, polycyclic aromatic hydrocarbons and benzene, toluene, ethylbenzene and xylene

The TPH results for all the samples from the Beadon Creek capital dredge area were below the laboratory LoR (275 mg/kg) and therefore also below the NAGD screening levels (CA 2009), the EILs and HILs (DEC 2010). Note that as all the results were below LoRs, it was not necessary to normalise the values to 1% TOC. The TPH are presented in full in Appendix E.

The PAH results for all the samples from the Beadon Creek capital dredge area are presented in Table 5.12 (results are presented in full in Appendix E). All the PAH concentrations were below the laboratory LoR (and therefore were not normalised to 1% TOC) with the exception of sample B9 0–0.5_2. The total PAH concentration of sample B9 0–0.5_2 was below the NAGD guideline, EIL and HIL, and as all other samples were below the LoR (0.16 mg/kg) it was inferred that the proposed dredged material met the NAGD screening level, EIL and HILs. Similarly the concentrations of individual PAHs in sample B9 0–0.5 did not exceed the HILs or EILs, or only slightly exceeded an EIL in one triplicate sample (benzo-a-pyrene), and as all other samples were below the LoR it was inferred that the proposed dredged material met the relevant EILs and HILs.

Only sediment samples from sites B13, B14 and B15 were analysed for BTEX as these sites are in the excavation area, which if excavated will be disposed to the dune swale to the west of the creek. All the BTEX results were below LoR and therefore also below the NAGD screening levels (CA 2009), the EILs and HILs (E) (DEC 2010). The BTEX results are presented in full in Appendix E.

Table 5.12 PAH concentrations in the sediment samples from the Beadon Creek capital dredge area

Analytes (mg/kg)	Naph-thalene	Acenaph-thylene	Acenaph-thene	Fluorene	Phen-anthrene	Anth-racene	Fluor-anthene	Pyrene	Benz(a)-anthracene	Chrysene	Benzo(b+k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3,c,d)-pyrene	Dibenz(a,h)-anthracene	Benzo(g,h,i)-perylene	Total PAH
NAGD[1]																**10 000**
EILs[2]	**5**				**10**	**10**	**10**	**10**				**1**				
HILs (E)[3]												**2**				**40**
HILs (F)[4]	**190**					**170000**	**22 000**	**17 000**				**5**				**100**
B1 0–0.5 a	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B2 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B3 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B4 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B5 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B6 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B7 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B8 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B9 0–0.5_1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B9 0–0.5_2[4]	<0.01	<0.01	0.1	0.1	2.1	0.45	3.85	3.05	1.25	1.05	1.75	**1.1**	0.5	0.1	0.5	16
B9 0–0.5_3[4]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B10 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B11 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B11 0.5–1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B11 1–1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B11 1.5–2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B12 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B13 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B14 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B14 0.5–1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16
B15 0–0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.16

Notes:
1. NAGD screening level (ISGQ trigger value) (CA 2009).
2. Ecological Investigation Levels (EILs) in the Contaminated Sites Managements Series: Assessment Levels for Soils (DEC 2010).
3. Health Investigation Levels (HILs) for parks, recreational open space and playing fields including secondary schools (E) in the Contaminated Site Management Series: Assessment Levels for Soils (DEC 2010).
4. Health Investigation Levels (HILs) for commercial/industrial purposes including premises such as shops and offices as well as factories and industrial sites (F) in the Contaminated Site Management Series: Assessment Levels for Soils (DEC 2010).
5. The field triplicate samples have been included here because an exceedance of the EILs was found in one triplicate sample (DEC 2010).
6. No statistics were calculated for comparison against the guidelines because more than 25% of data were below the LoR therefore statistics were not performed on these data as this would return an unreliable result
7. Exceedances of the guidelines are indicated in red.

5.8 Summary

Sediment data from the Beadon Creek capital dredge area indicated metals and PAHs met NAGD screening levels (CA 2009), EILs and relevant HILs (DEC 2010). DEC guidelines for ASS were also met (DEC 2009).

Total TBT in sediments exceeded the NAGD guideline in surface (0–0.5 m) sediments at sites B4, B7 and B9, and elutriate TBT exceeded the 90% species protection guideline in surface sediments at sites B7 and B9. As surface sediments from sites B4, B7 and B9 only characterise 5.1% of the material to be dredged, and more specifically, the surface sediments at sites B7 and B9 only characterise 3.4% of the material to be dredged, it is inferred that the NAGD guidelines are likely to be met (there are no EILs or HILs for TBT) and the proposed dredging and disposal should not cause any significant adverse environmental effects. It is noted that total TBT concentrations in the surface 1 m of sediment in a localised area around sites B7 and B9 are high, as are elutriate results for the surface 0.5 m layer at these sites. As a precautionary measure, it is proposed that the dredging and disposal of sediments in the vicinity of site B7 and B9 be carefully managed to minimise the release of TBT into the water column in Beadon Creek (refer to Section 8.2.2).

5.9 QA/QC assessment

The precision of the analysis was determined with duplicate samples (refer to Section 4.4).

5.9.1 Nutrients (total and elutriate)

The RPD and RSD for the total and elutriate nutrient data for the B1 0–0.5 laboratory duplicates and splits and the B9 0–0.5 field triplicates are presented in Table 5.13. The RPD and RSD values for the laboratory duplicates, splits and field triplicates were within their respective ±35% and ±50% limits for all analytes except for ammonium and the nitrate+nitrite laboratory splits. These differences found in the ammonium and nitrate+nitrite results could be the result of spatial heterogeneity within the sediment. Therefore, in accordance with the NAGD (CA 2009), these measurements should be viewed as estimates rather than precise values.

Table 5.13 Relative percent difference (RPD) and relative standard deviation (RSD) values for the total and elutriate nutrient concentrations in the QA/QC sediment samples

Analytes	Laboratory duplicate RPD[1]	Laboratory split RPD[2]	Field triplicate RSD[2]
TKN	0.00	12.50	n/a
Total P	7.41	3.75	16.43
NH_4	**85.71**	**102.13**	**67.00**
NO_2+NO_3	0.00	**95.12**	10.83
FRP	28.57	31.58	0.00

Notes:
1. RPD/RSD should be below ±35% for compliance with the NAGD (CA 2009); exceedances are shown in red.
2. RPD/RSD should be below ±50% for compliance with the NAGD (CA 2009); exceedances are shown in red.
3. n/a = RPD/RSD not calculated as all the values were below the LoR and therefore would yield a meaningless RPD/RSD.

5.9.2 Metals (total and elutriate)

The RPD and RSD for the total and elutriate metal data for the B1 0–0.5 laboratory duplicates and splits and the B9 0–0.5 field triplicates are presented in Table 5.14. The RPD values for the laboratory duplicates were within the ±35% limit for all the analytes with the exception of total Cd. The total Cd values were small and therefore the difference between the values is artificially exaggerated, resulting in a high RPD value.

The RPD values for the total Hg, and elutriate Cd, Cr, Ni, Pb and Hg laboratory splits exceeded the ±50% limit. The majority of these analyte values were below the LoRs, therefore these differences were the result of the differences between the LoRs at the different laboratories.

The RSD values of the field triplicates were within the ±50% limit for all the analytes, with the exception of total Cu and total Hg. These differences are caused by the low concentrations found in the sediments which artificially exaggerate the RSD values but could also be associated with slight differences in the sampling location that could yield sediments with different metal concentrations.

Table 5.14 Relative percent difference (RPD) and relative standard deviation (RSD) values for the total and elutriate metal concentrations in the QA/QC sediment samples

Analytes	Laboratory duplicate RPD[1]	Laboratory split RPD[2]	Field triplicate RSD[2]
Total As	0.00	0.00	19.52
Total Cd	**66.67**	37.50	50.00
Total Cr	4.88	7.14	4.68
Total Cu	2.25	31.21	**143.84**
Total Ni	7.30	2.17	16.88
Total Pb	0.00	30.00	17.32
Total Zn	32.26	3.26	43.60
Total Hg	0.00	**225.00**	**140.73**
Elutriate As	9.52	4.84	18.55
Elutriate Cd	0.00	**60.00**	0.00
Elutriate Cr	0.00	**282.69**	0.00
Elutriate Cu	0.00	0.00	24.74
Elutriate Ni	0.00	**81.82**	25.00
Elutriate Pb	0.00	**225.00**	0.00
Elutriate Zn	0.00	0.00	0.00
Elutriate Hg	0.00	**60.00**	0.00

Notes:
1. RPD/RSD should be below ±35% for compliance with the NAGD (CA 2009); exceedances are shown in red.
2. RPD/RSD should be below ±50% for compliance with the NAGD (CA 2009); exceedances are shown in red.

5.9.3 Acid sulfate soils

The RPD and RSD for the %S (S_{Cr}) data for the B1 0–0.5 laboratory duplicates and splits and the B9 0–0.5 field triplicates are presented in Table 5.15. The RPD for the laboratory duplicates exceeded the ±35% limit. The %S(S_{Cr}) values of the laboratory duplicates were low and therefore the difference between the values is artificially exaggerated resulting in a high RPD value. The RPD/RSD values for the laboratory splits and field triplicates were within the ±50% limit.

Table 5.15 Relative percent difference (RPD) and relative standard deviation (RSD) values for the S_{CR} concentrations in the QA/QC sediment samples

Analytes	Laboratory duplicate RPD[1]	Laboratory split RPD[2]	Field triplicate RSD[2]
%S (S_{Cr})	**40.00**	40.91	21.65

Notes:
1. RPD/RSD should be below ±35% for compliance with the NAGD (CA 2009); exceedances are shown in red.
2. RPD/RSD should be below ±50% for compliance with the NAGD (CA 2009); exceedances are shown in red.

5.9.4 Tributyltin

The RPD and RSD for the total and elutriate TBT data for the B1 0–0.5 laboratory duplicates and splits and the B9 0–0.5 field triplicates are presented in Table 5.16. The total and elutriate TBT data for the B1 0–0.5 laboratory duplicates and splits were all below the LoRs therefore the RPDs were not calculated The RSD values of the field triplicates exceeded the ±50% limit for total and elutriate TBT. These differences could be associated with slight differences in the sampling location that could yield sediments with different TBT concentrations; this is to be expected given the typically sporadic nature of TBT occurrence in sediment.

Table 5.16 Relative percent difference (RPD) and relative standard deviation (RSD) values for the total and elutriate TBT concentrations in the QA/QC sediment samples

Analytes	Laboratory duplicate RPD[1]	Laboratory split RPD[2]	Field triplicate RSD[2]
TBT	n/a	n/a	**152.53**
Elutriate TBT	n/a	n/a	**70.86**

Notes:
1. RPD/RSD should be below ±35% for compliance with the NAGD (CA 2009); exceedances are shown in red.
2. RPD/RSD should be below ±50% for compliance with the NAGD (CA 2009); exceedances are shown in red.
3. n/a = RPD/RSD not calculated as all the values were below the LoR and therefore would yield a meaningless RPD/RSD.

5.9.5 Total petroleum hydrocarbons and polycyclic aromatic hydrocarbons

All the laboratory duplicate and split samples and field triplicates analysed for TPH were below the laboratory LoRs therefore they did not exceed their respective RPD/RSD limits.

The laboratory duplicate and split samples analysed for PAH were below the laboratory LoRs therefore they did not exceed their respective RPD limits.

The RSD values of the PAH field triplicates exceeded the ±50% limit for all the analytes, with the exception of Naphthalene and Acenaphthylene which tested below the LoRs (Table 5.17). This was due to traces of PAHs being detected in one of the three triplicates, but below LoRs in the other two triplicates: this result could be associated with slight differences in the sampling location that could yield sediments with different concentrations.

Table 5.17 Relative percent difference (RPD) and relative standard deviation (RSD) values for the PAH concentrations in the QA/QC sediment samples

Analytes	Laboratory duplicate RPD[1]	Laboratory split RPD[2]	Field triplicate RSD[2]
Naphthalene	n/a	n/a	n/a
Acenaphthylene	n/a	n/a	n/a
Acenaphthene	n/a	n/a	**86.60**
Fluorene	n/a	n/a	**86.60**
Phenanthrene	n/a	n/a	**167.16**
Anthracene	n/a	n/a	**147.22**
Fluoranthene	n/a	n/a	**169.87**
Pyrene	n/a	n/a	**169.01**
Benz(a)anthracene	n/a	n/a	**163.21**
Chrysene	n/a	n/a	**161.40**
Benzo(b+k)fluoranthene	n/a	n/a	**159.16**
Benzo(a)pyrene	n/a	n/a	**161.91**
Indeno(1,2,3,c,d)pyrene	n/a	n/a	**149.59**
Dibenz(a,h)anthracene	n/a	n/a	**86.60**
Benzo(g,h,i)perylene	n/a	n/a	**149.59**
Total PAH	n/a	n/a	**160.83**

Notes:
1. RPD/RSD should be below ±35% for compliance with the NAGD (CA 2009); exceedances are shown in red.
2. RPD/RSD should be below ±50% for compliance with the NAGD (CA 2009); exceedances are shown in red.
3. n/a = RPD/RSD not calculated as all the values were below the LoR and therefore would yield a meaningless RPD/RSD.

5.9.6 Summary of QA/QC assessment

Analysis of the QA/QC samples has indicated that there may be inconsistencies within the sediment elutriate ammonium and nitrate+nitrite concentrations. Therefore, in accordance with the NAGD (CA 2009), these measurements should be viewed as estimates rather than precise values. Given that the nutrients are unlikely to pose a threat to the local environment, this is an acceptable result.

Differing total Cu, total Hg, total TBT, elutriate TBT and PAH concentrations in the field triplicate sediments was largely a function of low concentrations leading to exaggeration of the degree of difference, resulting in a high RPD value. However this result may also indicate that these analyte concentrations are spatially variable over small distances in the Beadon Creek capital dredge area, for sediment TBT concentrations such results are common given its typically sporadic occurrence in sediment.

The total Cd and %S (SCr) laboratory duplicate values were small and therefore the difference between these values was exaggerated resulting in a high RPD value. Differences in the LoRs at the different laboratories also exaggerated RPD values of the laboratory splits for total Hg, and elutriate Cd, Cr, Ni, Pb and Hg.

All other QA/QC samples were within the RPD/RSD limits as specified in the NAGD (CA 2009).

6. Stakeholder Consultation

The following agencies/individuals have been contacted regarding the capital dredging works:

- Shire of Ashburton
- Hans Jacob, Office of the Environmental Protection Agency
- Gordon Motherwell, Office of the Environmental Protection Agency.

No objections to the work have been received to date.

7. Key Environmental and Socio-economic Issues

The following key environmental and socio-economic issues have been identified for the proposed capital dredging and disposal operations:

- increase in water column turbidity
- release of nutrients, metals and contaminants
- generation of acid sulfate soils
- damage to vegetation
- disturbance of threatened and migratory species
- introduction of marine species
- generation of noise, dust and safety issues
- hydrocarbon spillage
- generation of waste.

7.1 Increase in water column turbidity

Assuming a cutter suction dredge is used, a minimum release of sediment material into the water column surrounding the dredge is expected due to the rapid intake velocity at the dredge head. It is likely that there will be some turbidity associated with the return water from the reclamation area and the construction of the rock revetment/sheet pile wall will likely cause turbidity in a localised area in the creek. However, the dredge material has a high settling velocity as a result of the large sand fraction in the sediments and the dredging operation and rock revetment/sheet pile wall construction is in an area where there are no known seagrass, macroalgal and/or coral communities with high light requirements. Therefore, if an issue at all, turbidity will be an aesthetic concern rather than an environmental one.

The proposed capital dredge area is located in an area that experiences naturally high and extensive turbidity plumes that cover many square kilometres of near- and offshore waters over extended periods (days to weeks), as a result of the intermittent discharge of turbid plumes from the Ashburton River. Therefore, the community of Onslow is accustomed to the natural occurrence of high turbidity levels in the nearshore waters, particularly following heavy rains and cyclones. As a result, it is unlikely that the public will express concerns over the creation of small-scale localised turbidity associated with the proposed dredging activity, which is not expected to be significantly greater than Beadon Creek's natural turbidity levels. Visual inspection during the 2012 maintenance dredging campaign indicated that the turbidity resulting from dredging and disposal was no greater than natural turbidity levels (Figure 7.1).

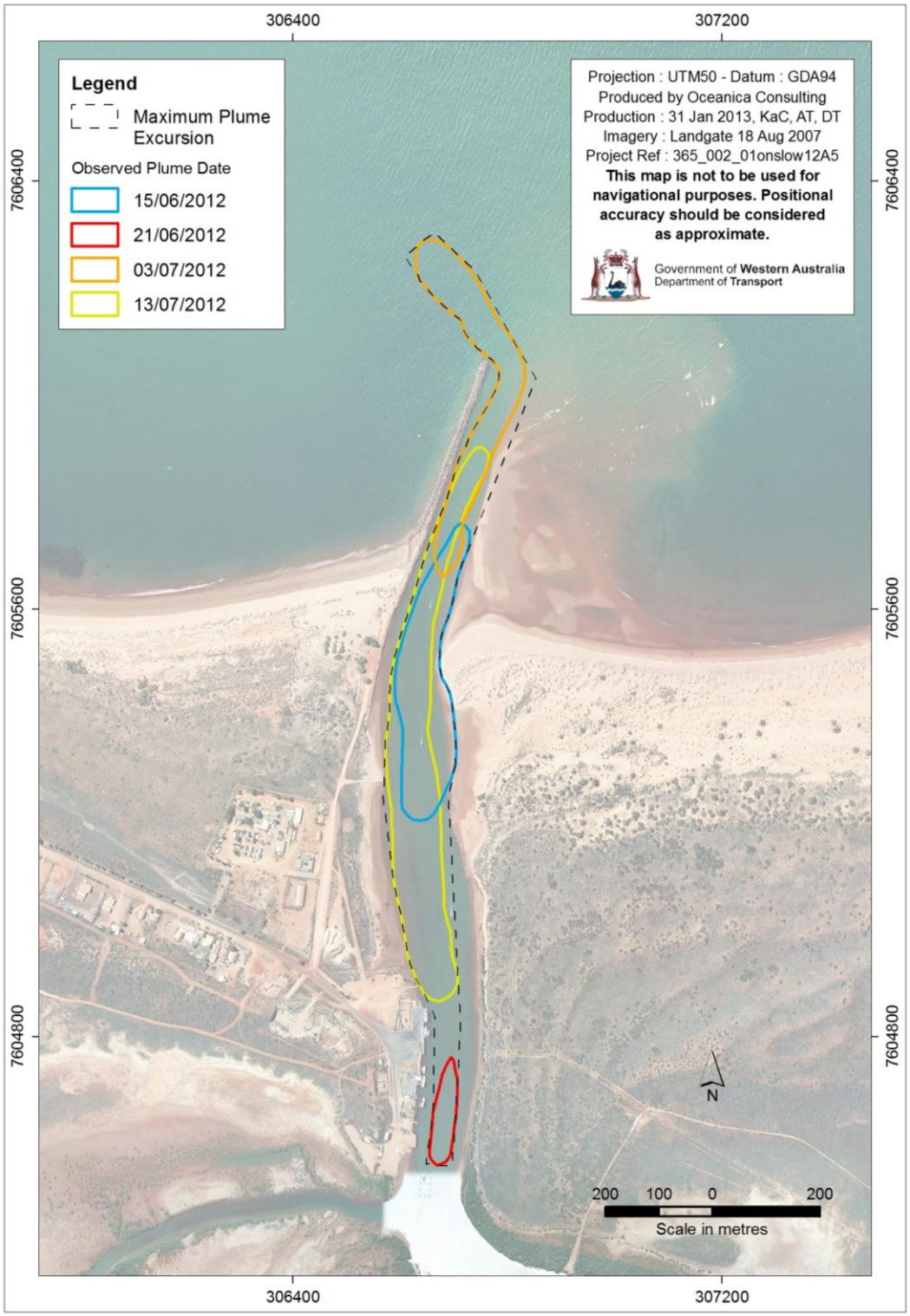


Figure 7.1 **Maximum excursion of the turbid plume during the 2012 maintenance dredging campaign**

7.2 Release of nutrients, metals and contaminants

Disturbance of sediments within the Beadon Creek proposed capital dredge area and the deposition of these sediments in the reclamation area (and beach disposal site) has been investigated regarding the potential release of nutrients, metals and other contaminants (Section 5).

Nutrient analyses of sediment samples taken from the Beadon Creek proposed capital dredge area indicated very low nutrient concentrations. Therefore there is a low likelihood of algal blooms occurring in Beadon Creek as a result of the disturbance of sediments during dredging and release of any porewater nutrients during this activity.

Comparison of data for metal and PAH concentrations in the sediments indicated NAGD guidelines, EILs and HILs were met. As such, it is unlikely that the dredging and land disposal of these sediments will result in adverse effects on the environment due to metals or PAHs.

The TBT concentrations exceeded the NAGD screening level in the surface 0.5 m of sediments at sites B4 and B9 and in the surface 1 m of sediment at site B7. Elutriate TBT analysis has indicated that the surface sediments with high total TBT concentrations also have high elutriate TBT concentrations that exceed the ANZECC/ARMCANZ (2000) default 99% species protection trigger value at all three sites and the 90% species protection trigger values at sites B7 and B9. The surface sediments from sites B4, B7 and B9 represent approximately 5.1% of the material to be dredged, and the surface sediments with the highest TBT observations (sites B7 and B9) represent approximately 3.4% of the material to be dredged. Due to the relatively low volume and proportion of these elevated TBT sediments it is inferred that the NAGD guidelines are likely to be met for the dredging works overall and the proposed dredging and disposal should not cause any significant adverse environmental effects. However, as a precautionary measure, it is proposed that the dredging and disposal of the surface (top 0.5 m) sediments in the area of contamination (as interpreted in Figure 7.2) be carefully managed to minimise the release of TBT into the water column in Beadon Creek (refer to Section 8.2.2). Note that Oceanica has prepared a memorandum on behalf of the DoT which details the nature of the TBT contamination in Beadon Creek (Appendix F). This has been provided to the DEC for their information.

7.3 Acid sulfate soils

Chromium reducible sulfur suite analysis of sediment samples from the Beadon Creek proposed capital dredge area was undertaken to determine the risk of ASS. Characterisation of the sediments found that the dredge material does not pose a risk of disturbance of ASS. Four sediment samples were classified as PASS as they contained reduced inorganic sulfur (S_{Cr}) concentrations above the DEC (2009) action criteria, however the high ANC in the sediment resulted in a net negative acidity and therefore indicated that there was no existing acidity in these sediments.

7.4 Vegetation

The clearance of the vegetation within the reclamation area is covered by a vegetation clearing permit issued to the DoT in 2011 (Appendix D). An application for an amendment to the current vegetation clearing permit to extend the clearing area by 0.77 ha and the timeframe for clearing to 3 October 2015 was made to the DEC on 17 June 2013 (Appendix G). The original vegetation clearing permit allows for the clearance of a maximum of 6 ha of native vegetation.

The vegetation in the reclamation area partly consists of mangroves (0.08 ha) and is in a degraded condition (Appendix D). The structure is severely disturbed and there are no known occurrences of rare or priority flora have been recorded within 10 km of the reclamation area and the vegetation type within the reclamation area is well represented (approximately 100% of its pre-European extent remains) in the Pilbara bioregion (Appendix D, Shepherd et al. 2002).

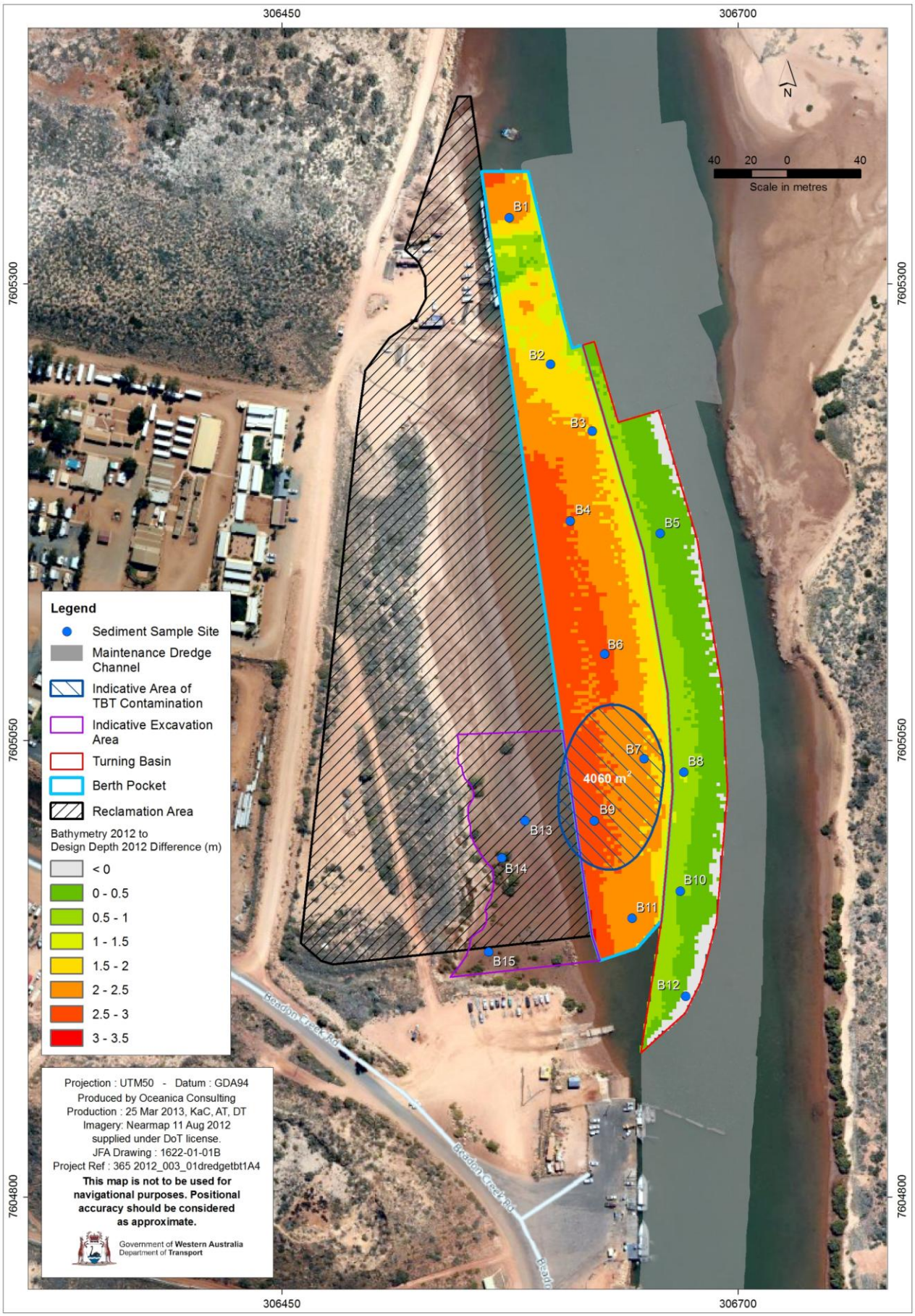


Figure 7.2 Beadon Creek capital dredge areas and area of TBT contamination

Due to the presence of mangroves within the reclamation area, Environmental Assessment Guidelines No. 3—EAG3 (EPA 2009) has been considered as part of this DEIA. The area immediately adjacent to the entire length of Beadon Creek is considered to be an appropriate Local Assessment Unit within which to calculate cumulate loss of mangrove area. There are 0.08 ha of mixed mangroves in the reclamation area and previous loss of mangrove habitat as a result of the construction of the existing wharf at Beadon Creek has been estimated to be 0.46 ha (based on the area of mangrove currently observed on the eastern side of the creek). Therefore the proposed cumulative loss of mangrove area in Beadon Creek is 0.54 ha. This is 0.6% of the total pre-development mangrove area along the length of Beadon Creek (91.56 ha—estimated using the sum of total digitised area of mangrove along the length of Beadon Creek, the past area of mangrove loss and the proposed area of mangrove loss). Thus the proposed cumulative mangrove area loss is below the threshold loss for non-designated areas (Category D in EAG3). Therefore vegetation clearance in the reclamation area is not considered environmentally significant.

The removal of vegetation will not be necessary on the dune area behind the beach to the west of the channel if material from the excavation area is disposed there. It is a requirement of the dredging contract that no vegetation shall be unnecessarily damaged during any stage of the dredging works without approval.

7.5 Threatened and migratory species

Under the EPBC Act, there is a provision for the protection of threatened and migratory species. The significant impact criteria defined under the EPBC Policy Statement 1.1 for threatened and migratory species have been considered with regard to the planned capital dredging campaign. Seven threatened and migratory species may occur within the Beadon Creek area (Table 2.1); these include turtles, sawfish quolls and migratory birds.

Beadon Creek is not a known turtle nesting area and therefore impacts to turtles during dredging and reclamation is considered unlikely. Sawfish are not naturally inquisitive and are therefore not expected to approach the dredge vessel whilst in operation (Dr Glen Young, 2013, pers. comm., 25 June). The dredge vessel to be used for the proposed capital dredging is a relatively small cutter suction dredge and will move relatively slowly therefore it is considered that the risk of impacts on sawfish in Beadon Creek will be relatively low. Additionally, this is a relatively small-scale project and the noise generated and the vessel movements associated with the dredging will be similar to those associated with the previous maintenance dredging works and there were no known impacts to any sawfish in Beadon Creek during the previous maintenance dredging works. A large proportion of native habitat in the local and regional context will remain undisturbed by the works. Consequently, the clearance of the habitat within the reclamation area (~4.4 ha), which is considered degraded, is not considered likely to result in a significant impact on the quolls and migratory birds.

7.6 Introduced marine species

A key risk of dredging campaigns is the introduction of marine species on dredging vessels. Introduced marine species are marine plants or animals that are not native to Australia but have been introduced by human activities such as shipping (CA 2013). They have the potential to significantly impact marine industries and the environment. Australia has over 250 introduced marine species, most remain relatively harmless but some have become aggressive pests (Wells et al. 2009). These species have had significant impacts on marine ecosystems and marine industries.

The primary ways that foreign marine species are introduced are through ballast water[3] and biofouling[4]. The dredge vessel has no ballast water and will be travelling from another location within Western Australian state waters prior to arriving in Beadon Creek and has been operating solely in Western Australian waters for more than 10 years. It is therefore considered unlikely that any non-native marine species will be in introduced into Beadon Creek with appropriate management measures in place (Section 8.1.2).

[3] *Ballast water refers to water that a ship takes on board at a port before commencing a voyage in order to provide stability in unladen ships, with marine organisms taken on board as well.*

[4] *Biofouling refers to the attachment of biological material (microorganisms, plants, algae and animals) on submerged structures such as ships hulls and internal areas.*

7.7 Noise, dust and safety

The majority of the dredging will take place during normal working hours (6 am to 6 pm Monday to Saturday with no dredging on Sundays or public holidays). During this time, noise from the dredge will be heard at the floating accommodation within the creek and may be heard at the caravan park approximately 100 m from the proposed dredging operation. The prevailing west and north-west winds should act to mitigate noise heard at the adjacent homes. Oceanica is also not aware of any noise complaints made during the 2012 and 2013 dredging campaigns in which dredging was undertaken in similar working hours.

Dust can adversely impact on the social and biological values of the environment. It is anticipated that dust impacts will be minor with management measures in place (Section 8.2.4).

To minimise the impacts on the access of the local community to the disposal areas, there will be a public notification of the dredging works and temporary signage and fencing will be used around the disposal areas.

The DoT shall maintain a complaints register during the dredging operation to ensure that any complaints are addressed.

7.8 Hydrocarbon spillage

With the use of various hydrocarbons on site, including fuel, oil and lubricants for the dredge and support vessel, there will be a risk of hydrocarbon spillage to the marine environment.

7.9 Waste

Release of waste material can adversely impact on the environment. Wastes requiring management include solid wastes, hazardous wastes and sewage and grey water.

7.10 Summary of environmental and socio-economic issues and potential impacts

The key environmental and socio-economic issues and their corresponding potential impacts are summarised in Table 7.1.

Table 7.1 Key environmental and socio-economic issues and potential impacts

Issue	Potential impacts	Risk factor	Monitoring/Management action
Biophysical			
Turbidity and sedimentation	• Light limitation to benthic flora • Smothering of benthic habitat • Abrasion of marine organisms	Low	Requires monitoring (Sections 8.2.1)
Nutrient release from sediment	• Nuisance algal growth	Low	None
Mobilisation of contaminants (TBT)	• Deteriorating water quality • Contamination of marine organisms	Low in large majority of sediments High in small proportion of sediments	Requires monitoring and management (Section 8.2.2)
Acid sulfate soils	• Acidification of waters • De-oxygenation of the water column • Release of heavy metals	Low	None
Vegetation	• Destruction of habitat • Destruction of rare or priority flora	Low	Requires management (Section 8.2.2)
Threatened migratory species	• Destruction of habitat • Disturbances to marine and terrestrial fauna	Low	None
Introduced marine species	• Harm to local environment	Low	Requires management (Section 8.1.2)
Dust	• Reduction air quality for terrestrial fauna	Medium	Requires management (Section 8.2.4)
Hydrocarbon spill	• Contamination of marine organisms	Medium	Requires management (Section 8.2.5)
Waste	• Contamination of marine organisms	Medium	Requires management (Section 8.2.6)
Social			
Turbid plume	• Reduced aesthetics and recreational values	Medium	Requires monitoring (Sections 8.2.1)
Exposure to contaminants in dredge material	• Reduced health of local community	Low	None
Noise and dust	• Reduced aesthetics and health of local community	Medium	Requires management (Section 8.2.4)
Safety: reduced public access to disposal areas	• Restricted commercial and/or recreational values	Low	None
Waste	• Reduced aesthetics and health of local community	Medium	Requires management (Section 8.2.6)

8. Monitoring and Management Program

Environmental monitoring and management will be undertaken by the DoT during the dredging and disposal operations to quantify the biophysical and social impacts and to ensure that any impacts are minimised.

8.1 Pre-dredging

8.1.1 Sediment sampling and analysis

Prior to the dredging and disposal campaign, sediment samples should be collected and tested for the relevant contaminants in accordance with EMF (Oceanica 2012). The sampling prior to the currently proposed capital dredging campaign has been completed and reported herein (Section 5).

8.1.2 Introduced marine species

The dredge vessel will be travelling via road from another location within Western Australian state waters prior to arriving in Beadon Creek. As part of the contractor's normal operating procedures the dredge vessel will be cleaned and the dredge pipes are emptied prior to transport to new dredging sites. Additionally, there is no ballast water on the vessel so it is unlikely that any water will be transferred into the creek from elsewhere. During each dredging campaign the dredge vessel is brushed and cleaned with fresh water weekly such that there is minimal biofouling. The contractor will photograph the dredge vessel when it is on the trailer as confirmation that the vessel has been cleaned and the DoT will confirm with the contractor that these procedures have been completed prior to transport to Beadon Creek.

8.2 During dredging

8.2.1 Turbidity monitoring

Plume sketch

A sketch of the turbid plume associated with the works shall be undertaken daily during the construction of the rock revetment/sheet pile wall and the dredging campaign. During the dredging campaign, the sketch will need to include the plume associated with both the dredging and disposal sites. These sketches shall be completed using a template consisting of an aerial photograph of the dredge area, a grid for use as scale, and a weather conditions form (see Appendix H). Following the completion of the dredge campaign, the plume sketches will be used to define the maximum extent of the plume excursion. The figure shall be included in the Close-Out Report.

Site photographs

Photographs of the dredging and disposal site shall be taken daily from a fixed position. The site location and timing of these photographs should be selected to enable best capture of the plume extent and minimise the effect of sun glint. These photographs shall be compiled, dated and included (in digital format) in the Close-Out Report.

Remote imagery

A camera shall be installed on the dredge vessel. This camera will automatically capture time- and date-stamped images to a maximum resolution of 8 megapixels at set intervals. Daily (low-resolution) images from the camera will be emailed to Oceanica. Following retrieval of the camera the high-resolution images shall be compiled to form a time-lapse video of the dredging campaign.

Aerial photography

Semi-oblique aerial photography shall be captured on one occasion during the dredging campaign (while the dredge is operating at full capacity) as a visual record of the spatial extent of turbidity.

8.2.2 TBT contamination management and monitoring

It is proposed that the dredge material be disposed of to a reclamation area adjacent to the dredge area; this is appropriate and will act to remediate the TBT contamination as exposure to oxygen and UV light causes TBT to degrade relatively rapidly (Fletcher & Lewis 1999, Hoch 2001). Therefore, the potential environmental issues during dredging will relate to the addition of TBT to the water column through the stirring up of sediments during dredging and the return of overflow water from the dredge area.

Due to laboratory turnaround time for TBT analysis, reactive management is not feasible. Hence, to manage the dredging of the TBT contaminated area, the surface 0.5 m of sediment in this area (Figure 7.2) will be dredged first and disposed to a separately bunded and sealed cell within the broader bunded reclamation area (Area A in Figure 8.1, Appendix I). The overflow water from this sealed cell will flow into the broader bunded reclamation area (Area B) and will not initially be discharged to the marine environment. The overflow water from Area A will be sampled and tested for TBT and total suspended solids (necessary to assess the amount of TBT in suspension) three times over the 8 days that dredging of the TBT contaminated area is anticipated to occur. It is anticipated that this strategic data collection will inform management plans for future dredge programs where elevated TBT concentrations are observed in a proportion of the sediments.

Once dredging of the TBT contaminated area is complete, the dredge material from the remaining dredge area will be disposed to Area B, and up to 20 000m^3 of the material disposed to Area B will be stockpiled in Area A to cap the TBT contaminated sediments and allow for a larger volume in Area B to act as a settling pond.

The capacity of Area B (35 000 m^3) is not large enough to accommodate all the dredge material/water from the remaining dredge area, therefore once Area B reaches capacity, there will be overflow of water into the creek. Allowing for a worst-case scenario in which no degradation of the TBT in the contaminated sediments and water in Area A has occurred, such that all overflow from Area A to Area B has a TBT concentration equal to the mean of the elutriate TBT concentration in the TBT contaminated sediments, the dilution of the overflow from Area A with clean overflow water in Area B will not be sufficient to yield acceptable TBT levels. However it is anticipated that, allowing for 4 hours of initial dilution (as per the NAGD; CA 2009), the dilution of the overflow discharged from Area B (when at capacity) in the creek waters will be sufficient to reduce the TBT levels to below the ANZECC/ARMCANZ (2000) water quality guideline (Table 8.1).

Table 8.1 Elutriate tributyltin (TBT) initial dilution calculations for the discharge from Area B to the creek

Elutriate TBT concentration in Area A overflow	
Mean elutriate TBT concentration in TBT contaminated sediments	369.9 ng/L
Elutriate TBT concentration in Area B overflow	
Volume of TBT contaminated sediment	2030 m^3
Volume of TBT contaminated overflow water	8120 m^3
Volume of Area B	35 000m^3
Volume of clean overflow water before overflow to creek waters	26 880 m^3
TBT concentration in Area B overflow (a)	**111.76 ng/L**
Elutriate TBT concentration after initial dilution	
Overflow discharge every 4 hours (discharge flux of 600m^3/hour) (b)	**2400 m^3**
Volume of creek water that overflow is discharged to over 4 hours (c) (assuming low current speed of 2 cm/s, channel width of 160 m and average depth of 1 m)	**46 080 m^3**
Elutriate TBT concentration after initial dilution ($= a \times b/c$)	**5.8 ng/L**
ANZECC/ARMCANZ (2000) 90% species protection trigger value	**20 ng/L**

Although the release of TBT into the marine environment is considered unlikely given the above management measures, a bivalve monitoring program (opportunistically using bivalves that live within Beadon Creek) will also be implemented to test for TBT contamination in Beadon Creek before, during and after dredging.

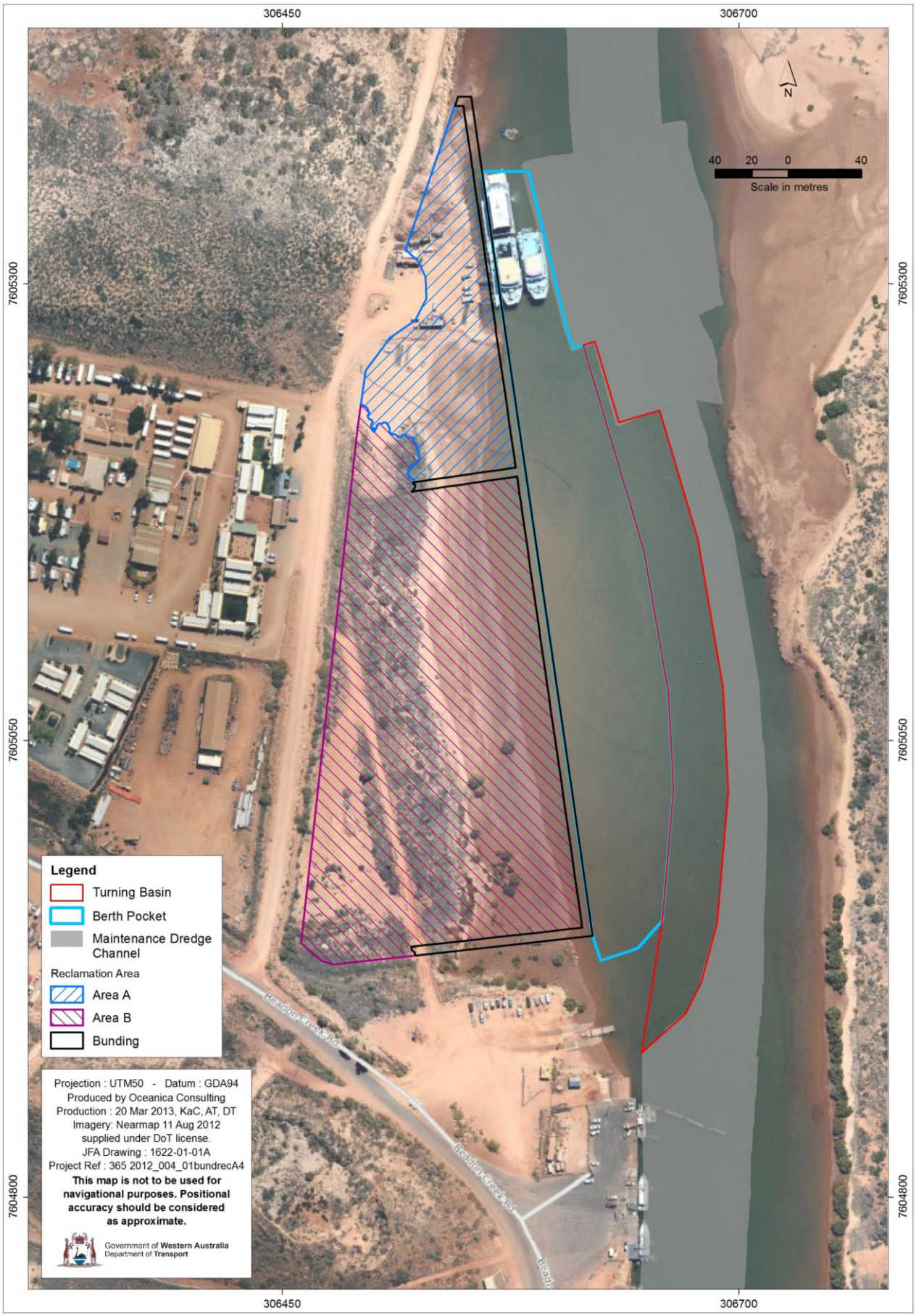


Figure 8.1 Reclamation area with proposed bunding and disposal areas

8.2.3 Management of vegetation clearance

Vegetation clearance will only be required within the current permitted area (Appendix D). The beach and foreshore will be re-contoured following the completion of the dredging-related activities, to return the beach to its previous condition, should the material from the excavation area be disposed here.

8.2.4 Dust management

The DoT will ensure dust emissions are reduced as low as possible during the construction of the rock revetment/sheet pile wall and the dredging and disposal of sediment. The temporary stockpile in Area A will be sprayed with a dust suppressant. It will be ensured that the dust suppressant used will not have any detrimental environmental impact.

8.2.5 Hydrocarbon spill management

All hazardous substances on site must be appropriately stored such that they do not pose a threat to the health and safety of personnel and the environment. All necessary material for mitigation of accidental spillage of hydrocarbons should be kept onsite at all times. In the event of accidental spillage, the Contractor should cease work immediately and ensure contamination is cleaned up prior to recommencing. A comprehensive environmental incident report shall then be completed and provided to the DoT.

8.2.6 Waste management

Waste management will be implemented in accordance with contractor management plans. Segregation of wastes will occur and wastes will be secured to avoid the potential for wind-blown wastes entering the marine environment or terrestrial areas of Beadon Creek.

8.3 Contingencies

Contingency plans for the dredging operation are shown in Table 8.2. Should any incident occur, the Superintendent's Representative shall be notified without delay. The cause of the incident shall be identified and rectified immediately under the direction of the Superintendent's Representative. If necessary, the dredging and disposal operations will cease until the required contingency measures can be implemented. The DEC and the Shire of Ashburton will be notified immediately of any incident as outlined in Table 8.2.

Table 8.2 Contingency plans for the dredging program

Incident	Contingency measures
Monitoring indicates continuous and excessive turbidity adjacent to dredging site	Contractor to notify the Superintendent's Representative Revise dredging strategy If necessary, notify the DEC and Shire of Ashburton
Leakage of dredge slurry through the bunding around Area A or B or a through the weir box between Area B and the creek causing discharge of overflow water to the creek either during the dredging of the TBT contaminated sediment or before Area B has reached capacity	Contractor to notify the Superintendent's Representative Dredging to stop while the leak is repaired. If necessary, notify the DEC and Shire of Ashburton
Leakage of dredge slurry en route to reclamation disposal site	Contractor to notify the Superintendent's Representative Clean up leaked material
Fuel spill to the environment	Contractor to notify the Superintendent's Representative and the DoT/Marine Safety Oil Spill Response Unit (24 hour reporting number: 08 9480 9224) and contact the DEC Pollution Response Branch and the Shire of Ashburton
Community complaints regarding the dredging	Maintain complaints register Contact the Superintendent's Representative Assess complaints and respond appropriately Notify the DEC and the Shire of Ashburton of any registered complaints and the response

8.4 Monitoring summary

A summary of monitoring for the Beadon Creek capital dredging campaign is presented in Table 8.3.

Table 8.3 Monitoring requirements for Beadon Creek capital dredging

Monitoring	Frequency	Responsibility
Pre-dredging		
Sediment sampling (carried out and documented herein)	Less than 5 years prior to dredging[1]	Proponent
Confirmation that dredge vessel is clear of potential introduced marine species	Prior to transport of the dredge vessel to Beadon Creek	Proponent and Contractor
TBT analysis of bivalves	Prior to dredging	Proponent
During dredging		
Plume sketch	Daily during dredging	Contractor
Site photographs	Daily during dredging	Contractor
Remote imagery on dredge	Half-hourly during daylight hours during dredging	Proponent
Aerial photography	Once per campaign	Proponent
TBT and TSS analysis of overflow water from Area A	Three times during the dredging of the TBT contaminated area	Proponent
TBT analysis of bivalves	1–2 days after dredging is complete dredging of the TBT contaminated area	Proponent
Post dredging		
TBT analysis of bivalves	1–2 days after dredging is complete	Proponent

Notes:
1. Unless contamination if the site is likely to have increased or new pollution sources are present (CA 2009)

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Appendix A

2012 Maintenance Dredging Design Drawing

307350mE 7606400mN

307350mE 7604400mN

7606000mN

7605500mN

7605000mN

7604500mN

307000mE

306500mE

306100mE 7606400mN

306100mE 7760440mN

DREDGE DESIGN AREA

20m

DESIGN -1.6mCD

DESIGN -1.9mCD

DESIGN -2.2mCD

DESIGN -2.6mCD

DESIGN -1.5mCD

SSM B394

PROPOSED DISPOSAL SITE: (2012)

DISPOSAL SITE: BEACH (1999 & 2003)

2.5m

HARBOUR

BOUNDARY

BEADON CREEK ROAD

DISPOSAL SITE: QUARRY (1999)

AREA	VOLUME TO DESIGN m^3	VOLUME TO DESIGN+OVERDREDGE (VER -0.3m, HOR 1m) m^3 UNLESS NOTED OTHERWISE
1 BELL MOUTH	2,010	4,570
2 BELL MOUTH SILT TRAP	14,320	20,150
3 OUTER ENTRANCE CHANNEL	0	540
4 MID ENTRANCE CHANNEL A	5,290	10,750
5 MID ENTRANCE CHANNEL B	0	250
6 INNER ENTRANCE CHANNEL A	15	320
7 INNER ENTRANCE CHANNEL B	0	160
8 BASIN (EXCLUDING CYCLONE MOORINGS)	5,600	11,230
9 CYCLONE MOORINGS	3,210	5,540
10 BASIN SILT TRAP	810	1,190
TOTAL	31,255	54,700

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
A	09/01/2012	INITIAL ISSUE FOR CLIENT REVIEW	CJL	

ORIG SIZE A3 | ARCHIVE 14190401A.dgn | PROJECT No

NOTES
1- TOPOGRAPHIC DETAIL SUPPLIED DPI
2- POSITION OF NAVAIDS IS INDICATIVE ONLY

SCALE 1 : 5000

50 0 200

METRES

DATUM

VERTICAL LAT WHICH IS 3.505m BELOW PWD BM B934 AND 1.492m BELOW A.H.D.

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
ENGINEER	T.Green		09/01/2012
DRAWN	C.Livingstone		09/01/2012
ENGINEERING CHECK			
CARTOGRAPHY CHECK			
APPROVED PROJECT MGR			

BMT JFA Consultants

BebbCart Marine, Cadastral & Topographic Mapping, Civil Drafting.

Department of Transport

Spatial Information

ONSLOW - BEADON CREEK 2012 DREDGING GENERAL ARRANGEMENT

DRAWING NUMBER DPI 1419 - 4 - 1

REVN A

Appendix B

2012 Capital Dredging and Land-backed Wharf Design Drawing

Beadon Creek

TO BE RELOCATED

WIDENING

CHANNEL

FUTURE DREDGING
DEVELOPMENT POCKET -2.6m CD

464m PROPOSED REVETMENT

WHARF EXTENSION

HARDSTANDING BEHIND
WHARF INCREASED

REFURBISH

1009
1
(EXISTING)

192
2
(EXISTING)

1031
3
(EXISTING)

1054
G

184
E, F

1025
D, C

183
B
Relocated

191
N

935
P

HV

LEGEND

- HARBOUR BOUNDARY
- PROPOSED LOT BOUNDARY
- MARINE RELATED LIGHT COMMERCIAL / TOURISM / ACCOMMODATION
- LIGHT - MEDIUM INDUSTRIAL
- OPEN DRAINAGE CHANNEL
- PUBLIC WHARF
- ACCESS & SERVICE CORRIDOR

ENQUIRIES: JASON BRADFORD (9435 7563)

0 20 40 60 80
1:1250

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
E	05.02.13	ISSUED FOR COMMENT - ON_LAYOUT11D	BS	
D	13.12.12	ISSUED FOR COMMENT - ON_LAYOUT11A	BS	
C	21.11.12	MODIFICATION TO LAND USE BOUNDARY-ON_LAYOUT11A	BS	
B	01.11.12	MODIFICATION TO LAND USE BOUNDARY	CJL	
A	03.10.12	ISSUED FOR COMMENT	CJL	

ORIG SIZE A1 | M/FILM | FILE No |

GENERAL NOTES

1. ONSLOW_BEADON_CREEK_JUL_2012_MOSAIC.ECW AERIAL PHOTOGRAPHY BASE

CONCEPT ONLY

SCALE: 1 : 1250 @ A1

UNLESS OTHERWISE STATED DIMENSIONS IN METRES

HORIZ: MAP GRID OF AUSTRALIA BASED ON GDA 94 - ZONE 50

VERT : CHART DATUM (approx LAT) WHICH IS 3.620m BELOW TIDAL BENCHMARK B879 AND 3.505m BELOW TIDAL BENCHMARK B 934 AND 3.499m BELOW DOT 001

0 10 20 30 40 50 100 150mm
BAR MEASURE INDICATES IF SCALES HAVE BEEN VARIED

DESIGNED | CHECKED | DRAWN B. STEPHENS | CHECKED | PROJECT MANAGER J. BRADFORD

APPROVED | APPROVED | APPROVED | AUTHORISED MANAGER NEW COASTAL ASSETS

Department of Transport

ONSLOW - BEADON CREEK
DEVELOPMENT & INVESTIGATIONS
CONCEPT LAYOUT - LAND USE FEBRUARY 2013

DRAWING NUMBER 0094 - 20 - 01 | REVN E

Appendix C

OEPA Section 38(1) Referral Form

Environmental Protection Authority

GOVERNMENT OF WESTERN AUSTRALIA

EPA REFERRAL FORM PROPONENT

Referral of a Proposal by the Proponent to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that where a development proposal is likely to have a significant effect on the environment, a proponent may refer the proposal to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a proponent.

Proponents are encouraged to familiarise themselves with the EPA's *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) of the EP Act by a proponent to the EPA must be made on this form. A request to the EPA for a declaration under section 39B (derived proposal) must be made on this form. This form will be treated as a referral provided all information required by Part A has been included and all information requested by Part B has been provided to the extent that it is pertinent to the proposal being referred. Referral documents are to be submitted in two formats – hard copy and electronic copy. The electronic copy of the referral will be provided for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, please check that you have:

	Yes	No
Completed all the questions in Part A (essential).	✓	
Completed all applicable questions in Part B.	✓	
Included Attachment 1 – location maps.	✓	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	✓	
Included Attachment 3 – confidential information (if applicable).		✓
Enclosed an electronic copy of all referral information, including spatial data and contextual mapping but excluding confidential information.	✓	

Following a review of the information presented in this form, please consider the following question (a response is optional).

Do you consider the proposal requires formal environmental impact assessment?		
☐ Yes	✓ No	☐ Not sure
If yes, what level of assessment?		
☐ Assessment on Proponent Information		☐ Public Environmental Review

PROPONENT DECLARATION (to be completed by the proponent)

I, Donna West, *(full name)* declare that I am authorised on behalf of Dept. of Transport (being the person responsible for the proposal) to submit this form and further declare that the information contained in this form is true and not misleading.

Signature Donna West.	Name (print) Donna West
Position A/general Manager	Company Dept of Transport
Date 8 August 2013	

PART A - PROPONENT AND PROPOSAL INFORMATION
(All fields of Part A must be completed for this document to be treated as a referral)

1 PROPONENT AND PROPOSAL INFORMATION

1.1 Proponent

Name	Department of Transport (DoT)
Joint Venture parties (if applicable)	n/a
Australian Company Number (if applicable)	
Postal Address (where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State)	1 Essex Street Fremantle WA 6160
Key proponent contact for the proposal: • name • address • phone • email	 Peter Wilkins 1 Essex Street, Fremantle, WA 6160 (08) 9435-7522 Peter.Wilkins@transport.wa.gov.au
Consultant for the proposal (if applicable): • name • address • phone • email	Katharine Cox Oceanica Consulting Pty Ltd PO Box 462, Wembley, WA 6913 (08) 6272-0000 Katharine.cox@oceanica.com.au

1.2 Proposal

Title	Beadon Creek Capital Dredging
Description	The capital dredging proposed by the DoT involves dredging an estimated 65 000 m^3 of material to create a berth pocket and turning basin on the western side of the channel immediately north of the existing harbour lots. The dredge material will be disposed to a reclamation area immediately to the west of the dredge area to form a land-backed wharf that will be secured with a rock revetment or sheet pile wall. It is also proposed that approximately 5000 m^3 of material might be excavated from the intertidal area at the southern end of the reclamation area as preliminary geotechnical information suggests it may be unsuitable for building purposes. If the material is excavated, it will be disposed to the beach disposal site which is an existing stockpile from the 2013 and 2012 maintenance dredging in the dune area behind the beach that is immediately to the west of the channel (refer to attached site plan).

Extent (area) of proposed ground disturbance.	7.92 ha in total: Proposed reclamation area: 4.42 ha Proposed dredge area: 3.05 ha Beach disposal site: 0.45 ha
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	The dredging is planned to occur in late-2013/early-2014. It is anticipated that the dredging and reclamation will take approximately 22 weeks.
Details of any staging of the proposal.	n/a
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal? If so, provide the following information on the strategic assessment within which the referred proposal was identified: • title of the strategic assessment; and • Ministerial Statement number.	No
Please indicate whether, and in what way, the proposal is related to other proposals in the region.	n/a
Does the proponent own the land on which the proposal is to be established? If not, what other arrangements have been established to access the land?	Yes
What is the current land use on the property, and the extent (area in hectares) of the property?	Vacant land

1.3 Location

Name of the Shire in which the proposal is located.	Shire of Ashburton
For urban areas: • street address; • lot number; • suburb; and • nearest road intersection.	Lot 561 on plan 174170 Beadon Creek Road Onslow 6710
For remote localities: • nearest town; and • distance and direction from that town to the proposal site.	n/a
• Electronic copy of spatial data - GIS or CAD, geo-referenced and conforming to the following parameters: • GIS: polygons representing all activities and named; • CAD: simple closed polygons representing all activities and named; • datum: GDA94; • projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA); • format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD.	Enclosed?: Yes

1.4 Confidential Information

Does the proponent wish to request the EPA to allow any part of the referral information to be treated as confidential?	No
If yes, is confidential information attached as a separate document in hard copy?	

1.5 Government Approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.		No	
Is approval required from any Commonwealth or State Government agency or Local Authority for any part of the proposal? If yes, please complete the table below.		Yes	
Agency/Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
DER	Vegetation Clearing Permit Amendment	Yes	Jessica Burton, DER

PART B - ENVIRONMENTAL IMPACTS AND PROPOSED MANAGEMENT

2. ENVIRONMENTAL IMPACTS

Describe the impacts of the proposal on the following elements of the environment, by answering the questions contained in Sections 2.1-2.11:

2.1 flora and vegetation;

2.2 fauna;

2.3 rivers, creeks, wetlands and estuaries;

2.4 significant areas and/ or land features;

2.5 coastal zone areas;

2.6 marine areas and biota;

2.7 water supply and drainage catchments;

2.8 pollution;

2.9 greenhouse gas emissions;

2.10 contamination; and

2.11 social surroundings.

These features should be shown on the site plan, where appropriate.

For all information, please indicate:

(a) the source of the information; and

(b) the currency of the information.

2.1 Flora and Vegetation

2.1.1 Do you propose to clear any native flora and vegetation as a part of this proposal?

[A proposal to clear native vegetation may require a clearing permit under Part V of the EP Act (Environmental Protection (Clearing of Native Vegetation) Regulations 2004)]. Please contact the Department of Environment and Conservation (DEC) for more information.

(please tick) ✓ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section

2.1.2 How much vegetation are you proposing to clear (in hectares)?

4.42 ha.

2.1.3 Have you submitted an application to clear native vegetation to the DEC (unless you are exempt from such a requirement)?

✓ Yes ☐ No **If yes**, on what date and to which office was the application submitted of the DEC?

The Vegetation Clearing Permit (CPS 4495/1) issued by the Native Vegetation Conservation Branch of the DEC on 8 September 2011 (permit attached as Appendix D of the Dredging Environmental Impact Assessment—DEIA) covers the area in which vegetation is present in the reclamation area. An application for an amendment to the current Vegetation Clearing Permit to extend the timeframe for clearing to 3 October 2015 was made to the DER on 17 June 2013 (application attached as Appendix G in DEIA).

2.1.4 Are you aware of any recent flora surveys carried out over the area to be disturbed by this proposal?

☐ Yes ✓ No

If yes, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

2.1.5 Has a search of DEC records for known occurrences of rare or priority flora or threatened ecological communities been conducted for the site?

✓ Yes ☐ No

If you are proposing to clear native vegetation for any part of your proposal, a search of DEC records of known occurrences of rare or priority flora and threatened ecological communities will be required. Please contact DEC for more information.

Please refer to the NatureMap report attached.

2.1.6 Are there any known occurrences of rare or priority flora or threatened ecological communities on the site?

☐ Yes ✓ No

If yes, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

2.1.7 If located within the Perth Metropolitan Region, is the proposed development within or adjacent to a listed Bush Forever Site? (You will need to contact the Bush Forever Office, at the Department for Planning and Infrastructure)

☐ Yes ☐ No

If yes, please indicate which Bush Forever Site is affected (site number and name of site where appropriate).

n/a

2.1.8 What is the condition of the vegetation at the site?

Degraded condition:

- Structure severely disturbed;
- regeneration to good condition would require intensive management.
- Refer to the Vegetation Clearing Permit (attached as Appendix D in the DEIA).

2.2 Fauna

2.2.1 Do you expect that any fauna or fauna habitat will be impacted by the proposal?

(please tick) ✓ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.2.2 Describe the nature and extent of the expected impact.

Please refer to Sections 2.1.4 and 7.5 of the attached DEIA regarding species or species habitat likely to occur within the area and the likely impacts on them.

2.2.3 Are you aware of any recent fauna surveys carried out over the area to be disturbed by this proposal?

☐ Yes ✓ No **If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

2.2.4 Has a search of DEC records for known occurrences of Specially Protected (threatened) fauna been conducted for the site?

✓ Yes ☐ No (please tick)

Please refer to the NatureMap report attached.

2.2.5 Are there any known occurrences of Specially Protected (threatened) fauna on the site?

✓ Yes ☐ No **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

Please refer to Section 2.1.4 of the attached DEIA regarding threatened species that are known to occur within the area.

2.3 Rivers, Creeks, Wetlands and Estuaries

2.3.1 Will the development occur within 200 metres of a river, creek, wetland or estuary?

(please tick) ✓ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?

✓ Yes ☐ No **If yes**, please describe the extent of the expected impact.

Up to 4.42 ha of vegetation will be cleared adjacent to the creek for land reclamation.

2.3.3 Will the development result in the filling or excavation of a river, creek, wetland or estuary?

✓ Yes ☐ No **If yes**, please describe the extent of the expected impact.

A target volume of 65 000 m^3 will be dredged from the western side of the creek to form a berth pocket and turning basin and a target volume of 5000 m^3 may be excavated from the intertidal area to the west of this. Please refer to Section 3 of the attached DEIA.

2.3.4 Will the development result in the impoundment of a river, creek, wetland or estuary?

☐ Yes ✓ No **If yes**, please describe the extent of the expected impact.

2.3.5 Will the development result in draining to a river, creek, wetland or estuary?

✓ Yes ☐ No **If yes**, please describe the extent of the expected impact.

The return water from dredging will drain back into the creek after appropriate management measures are taken to reduce the risk of TBT contamination. Note that turbidity will also be monitored for the duration of the proposed works and that the use of part of the proposed reclamation area as a settling pond will also reduce the generation of turbidity from the drainage of the return water. Please refer to Sections 8.2.1 and 8.2.2 of the attached DEIA.

2.3.6 Are you aware if the proposal will impact on a river, creek, wetland or estuary (or its buffer) within one of the following categories? (please tick)

Conservation Category Wetland	☐ Yes	✓ No	☐ Unsure
Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998	☐ Yes	✓ No	☐ Unsure
Perth's Bush Forever site	☐ Yes	✓ No	☐ Unsure
Environmental Protection (Swan & Canning Rivers) Policy 1998	☐ Yes	✓ No	☐ Unsure
The management area as defined in s4(1) of the *Swan River Trust Act 1988*	☐ Yes	✓ No	☐ Unsure
Which is subject to an international agreement, because of the importance of the wetland for waterbirds and waterbird habitats (e.g. Ramsar, JAMBA, CAMBA)	✓ Yes	☐ No	☐ Unsure

2.4 Significant Areas and/ or Land Features

2.4.1 Is the proposed development located within or adjacent to an existing or proposed National Park or Nature Reserve?

☐ Yes ✓ No **If yes**, please provide details.

2.4.2 Are you aware of any Environmentally Sensitive Areas (as declared by the Minister under section 51B of the EP Act) that will be impacted by the proposed development?

☐ Yes ✓ No **If yes**, please provide details.

2.4.3 Are you aware of any significant natural land features (e.g. caves, ranges etc) that will be impacted by the proposed development?

☐ Yes ✓ No **If yes**, please provide details.

2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

2.5.1 Will the development occur within 300metres of a coastal area?

(please tick) ✓ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.5.2 What is the expected setback of the development from the high tide level and from the primary dune?

The proposal involves dredging and reclamation for the construction of a land-backed wharf, setback is not appropriate.

2.5.3 Will the development impact on coastal areas with significant landforms including beach ridge plain, cuspate headland, coastal dunes or karst?

☐ Yes ✓ No **If yes**, please describe the extent of the expected impact.

2.5.4 Is the development likely to impact on mangroves?

✓ Yes ☐ No **If yes**, please describe the extent of the expected impact.

Up to 4.42 ha of vegetation (0.08 ha of which is mangrove) will be cleared adjacent to the creek. Please refer to Sections 2.1.4 and 7.4 of the attached DEIA and the Vegetation Clearing Permit and amendment application in Appendices D and G in the attached DEIA.

2.6 Marine Areas and Biota

2.6.1 Is the development likely to impact on an area of sensitive benthic communities, such as seagrasses, coral reefs or mangroves?

✓ Yes ☐ No **If yes**, please describe the extent of the expected impact.

0.08 ha of the vegetation be cleared in the proposed reclamation area consists of mangrove which is in a degraded condition. EAG3 has been considered with respect to this clearance. Please refer to Sections 2.1.4 and 7.4 of the attached DEIA and the Vegetation Clearing Permit and amendment application in Appendices D and G in the attached DEIA.

2.6.2 Is the development likely to impact on marine conservation reserves or areas recommended for reservation (as described in *A Representative Marine Reserve System for Western Australia*, CALM, 1994)?

☐ Yes ✓ No **If yes**, please describe the extent of the expected impact.

2.6.3 Is the development likely to impact on marine areas used extensively for recreation or for commercial fishing activities?

☐ Yes ✓ No **If yes**, please describe the extent of the expected impact, and provide any written advice from relevant agencies (e.g. Fisheries WA).

2.7 Water Supply and Drainage Catchments

2.7.1 Are you in a proclaimed or proposed groundwater or surface water protection area?

(You may need to contact the Department of Water (DoW) for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

✓ Yes ☐ No **If yes**, please describe what category of area.

The proposal is within the proclaimed Pilbara groundwater area and the proclaimed Pilbara surface water area.

2.7.2 Are you in an existing or proposed Underground Water Supply and Pollution Control area?

(You may need to contact the DoW for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

☐ Yes ✓ No **If yes**, please describe what category of area.

2.7.3 Are you in a Public Drinking Water Supply Area (PDWSA)?

(You may need to contact the DoW for more information or refer to the DoW website. A proposal to clear vegetation within a PDWSA requires approval from DoW.)

☐ Yes ✓ No **If yes**, please describe what category of area.

2.7.4 Is there sufficient water available for the proposal?

(Please consult with the DoW as to whether approvals are required to source water as you propose. Where necessary, please provide a letter of intent from the DoW)

✓ Yes ☐ No (please tick)

No significant water volume is required for the proposed works. Some may be required for use as a dust suppressant.

2.7.5 Will the proposal require drainage of the land?

☐ Yes ✓ No **If yes**, how is the site to be drained and will the drainage be connected to an existing Local Authority or Water Corporation drainage system? Please provide details.

2.7.6 Is there a water requirement for the construction and/ or operation of this proposal?

(please tick) ☐ Yes **If yes**, complete the rest of this section.

✓ No **If no**, go to the next section.

2.7.7 What is the water requirement for the construction and operation of this proposal, in kilolitres per year?

n/a

2.7.8 What is the proposed source of water for the proposal? (e.g. dam, bore, surface water etc.)

n/a

2.8 Pollution

2.8.1 Is there likely to be any discharge of pollutants from this development, such as noise, vibration, gaseous emissions, dust, liquid effluent, solid waste or other pollutants?

(please tick) ✓ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.8.2 Is the proposal a prescribed premise, under the Environmental Protection Regulations 1987?

(Refer to the EPA's *General Guide for Referral of Proposals to the EPA under section 38(1) of the EP Act 1986* for more information)

☐ Yes ✓ No **If yes**, please describe what category of prescribed premise.

2.8.3 Will the proposal result in gaseous emissions to air?

☐ Yes ✓ No **If yes**, please briefly describe.

2.8.4 Have you done any modelling or analysis to demonstrate that air quality standards will be met, including consideration of cumulative impacts from other emission sources?

☐ Yes ✓ No **If yes**, please briefly describe.

2.8.5 Will the proposal result in liquid effluent discharge?

✓ Yes ☐ No **If yes**, please briefly describe the nature, concentrations and receiving environment.

Please refer to Sections 7.2 and 8.2.2 in the attached DEIA.

2.8.6 If there is likely to be discharges to a watercourse or marine environment, has any analysis been done to demonstrate that the State Water Quality Management Strategy or other appropriate standards will be able to be met?

✓ Yes ☐ No **If yes**, please describe.

Please refer to Sections 4, 5, 7.2 and 8.2.2 in the attached DEIA.

2.8.7 Will the proposal produce or result in solid wastes?

✓ Yes ☐ No **If yes**, please briefly describe the nature, concentrations and disposal location/ method.

Please refer to Section 3.2, 7.9 and 8.2.6 in the attached DEIA regarding the beach disposal of material excavated from the intertidal area and the disposal of wastes during the works.

2.8.8 Will the proposal result in significant off-site noise emissions?

✓ Yes ☐ No **If yes**, please briefly describe.

There will be no significant off-site noise emissions. Please refer to Section 7.7 in the attached DEIA for details.

2.8.9 Will the development be subject to the Environmental Protection (Noise) Regulations 1997?

✓ Yes ☐ No **If yes**, has any analysis been carried out to demonstrate that the proposal will comply with the Regulations?

Please attach the analysis.

No analyses have been carried out however it is considered unlikely that the noise emitted during the proposed capital dredge works will reach sensitive premises at unacceptable levels during unacceptable hours; please refer to section 7.7 in the attached DEIA.

2.8.10 Does the proposal have the potential to generate off-site, air quality impacts, dust, odour or another pollutant that may affect the amenity of residents and other "sensitive premises" such as schools and hospitals (proposals in this category may include intensive agriculture, aquaculture, marinas, mines and quarries etc.)?

☐ Yes ✓ No **If yes**, please describe and provide the distance to residences and other "sensitive premises".

2.8.11 If the proposal has a residential component or involves "sensitive premises", is it located near a land use that may discharge a pollutant?

☐ Yes ☐ No ✓ Not Applicable

If yes, please describe and provide the distance to the potential pollution source

2.9 Greenhouse Gas Emissions

2.9.1 Is this proposal likely to result in substantial greenhouse gas emissions (greater than 100 000 tonnes per annum of carbon dioxide equivalent emissions)?

☐ Yes ✓ No **If yes**, please provide an estimate of the annual gross emissions in absolute and in carbon dioxide equivalent figures.

2.9.2 Further, if yes, please describe proposed measures to minimise emissions, and any sink enhancement actions proposed to offset emissions.

n/a

2.10 Contamination

2.10.1 Has the property on which the proposal is to be located been used in the past for activities which may have caused soil or groundwater contamination?

✓ Yes ☐ No ☐ Unsure **If yes**, please describe.

Please refer to Sections 5.6, 7.2 and 8.2.2 of the attached DEIA regarding TBT contamination.

2.10.2 Has any assessment been done for soil or groundwater contamination on the site?

✓ Yes ☐ No **If yes**, please describe.

Please refer to Sections 4 and 5 of the attached DEIA regarding sediment sampling program.

2.10.3 Has the site been registered as a contaminated site under the *Contaminated Sites Act 2003*? (on finalisation of the CS Regulations and proclamation of the CS Act)

☐ Yes ✓ No **If yes**, please describe.

2.11 Social Surroundings

2.11.1 Is the proposal on a property which contains or is near a site of Aboriginal ethnographic or archaeological significance that may be disturbed?

☐ Yes ✓ No ☐ Unsure **If yes**, please describe.

2.11.2 Is the proposal on a property which contains or is near a site of high public interest (e.g. a major recreation area or natural scenic feature)?

☐ Yes ✓ No **If yes**, please describe.

2.11.3 Will the proposal result in or require substantial transport of goods, which may affect the amenity of the local area?

☐ Yes ✓ No **If yes**, please describe.

There may be transport of goods to and from the proposed land-backed wharf; this is dependent on the nature of the different leasees of this land.

3. PROPOSED MANAGEMENT

3.1 Principles of Environmental Protection

3.1.1 Have you considered how your project gives attention to the following Principles, as set out in section 4A of the EP Act? (For information on the Principles of Environmental Protection, please see EPA Position Statement No. 7, available on the EPA website)

1. The precautionary principle.	✓ Yes	☐ No
2. The principle of intergenerational equity.	✓ Yes	☐ No
3. The principle of the conservation of biological diversity and ecological integrity.	✓ Yes	☐ No
4. Principles relating to improved valuation, pricing and incentive mechanisms.	✓ Yes	☐ No
5. The principle of waste minimisation.	✓ Yes	☐ No

3.1.2 Is the proposal consistent with the EPA's Environmental Protection Bulletins/Position Statements and Environmental Assessment Guidelines/Guidance Statements (available on the EPA website)?

✓ Yes ☐ No

Environmental Assessment Guideline No. 3 has been considered with respect to the proposed clearance of mangroves in the reclamation area. The area immediately adjacent to the entire length of Beadon Creek is considered to be an appropriate Local Assessment Unit within which to calculate cumulate loss of mangrove area. There are 0.08 ha of mixed mangroves in the reclamation area and previous loss of mangrove habitat as a result of the construction of the existing wharf at Beadon Creek has been estimated to be 0.46 ha (based on the area of mangrove currently observed on the eastern side of the creek). Therefore the proposed cumulative loss of mangrove area in Beadon Creek is 0.54 ha. This is 0.6% of the total pre-development mangrove area along the length of Beadon Creek (91.56 ha—estimated using the sum of total digitised area of mangrove along the length of Beadon Creek, the past area of mangrove loss and the proposed area of mangrove loss). Thus the proposed cumulative mangrove area loss is below the threshold loss for non-designated areas (Category D). Please refer to Section 7.4 of the attached DEIA.

3.2 Consultation

3.2.1 Has public consultation taken place (such as with other government agencies, community groups or neighbours), or is it intended that consultation shall take place?

✓ Yes ☐ No **If yes**, please list those consulted and attach comments or summarise response on a separate sheet.

The Shire of Ashburton has been consulted regarding this proposal. Please refer to Section 6 of the attached DEIA.


306300
307000
7605900
7605200
7604500
Projection : UTM50 - Datum : GDA94
Produced by Oceanica Consulting
Production : 26 Mar 2013, KaC, AT, DT
Imagery : Nearmap 11 Aug 2012
supplied under DoT license.
JFA Drawing : 1622-02-01A
Project Ref : 365 2012_004_01epaA4
This map is not to be used for navigational purposes. Positional accuracy should be considered as approximate.
Government of Western Australia
Department of Transport
Legend
Proposed Reclamation Footprint
Proposed Dredge Footprint
Beach Disposal Site
Indicative TBT Contamination Area
Vegetation Clearance Permit Area
Entire Map Is Covered By:
• Pilbara Surface Water Area
• Pilbara Groundwater Area
• Onslow Coast Drainage Area
Beadon Creek Road
N
100 50 0 100
Scale in metres

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 25/06/2013

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°07' 50" E,21°38' 49" S
Buffer 1km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	30833	*Amphibolurus longirostris*			
2.	-14387	*Butis amboinensis*			
3.	25716	*Cacatua sanguinea (Little Corella)*			
4.	-17136	*Caranx sexfasciatus*			
5.	-13885	*Ctenotrypauchen microcephalus*			
6.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
7.	24041	*Felis catus (Cat)*	Y		
8.	24952	*Gehyra australis*			
9.	25637	*Larus novaehollandiae (Silver Gull)*			
10.	25380	*Litoria caerulea (Green Tree Frog)*			
11.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
12.	24223	*Mus musculus (House Mouse)*	Y		
13.	25497	*Nephrurus levis*			
14.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
15.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
16.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D

Vegetation Clearing Permit

GOVERNMENT OF
WESTERN AUSTRALIA

CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

PERMIT DETAILS
Area Permit Number: 4495/1
File Number: 2011/006380-1
Duration of Permit: From 3 October 2011 to 3 October 2013

PERMIT HOLDER
Minister for Transport

LAND ON WHICH CLEARING IS TO BE DONE
Lot 561 on Deposited Plan 174170 (Onslow 6710 – Reserve 30711)
Lot 460 on Deposited Plan 210532 (Onslow 6710 – Reserve 30711)

AUTHORISED ACTIVITY
The Permit Holder shall not clear more than 6 hectares of native vegetation within the area hatched yellow on attached Plan 4495/1.

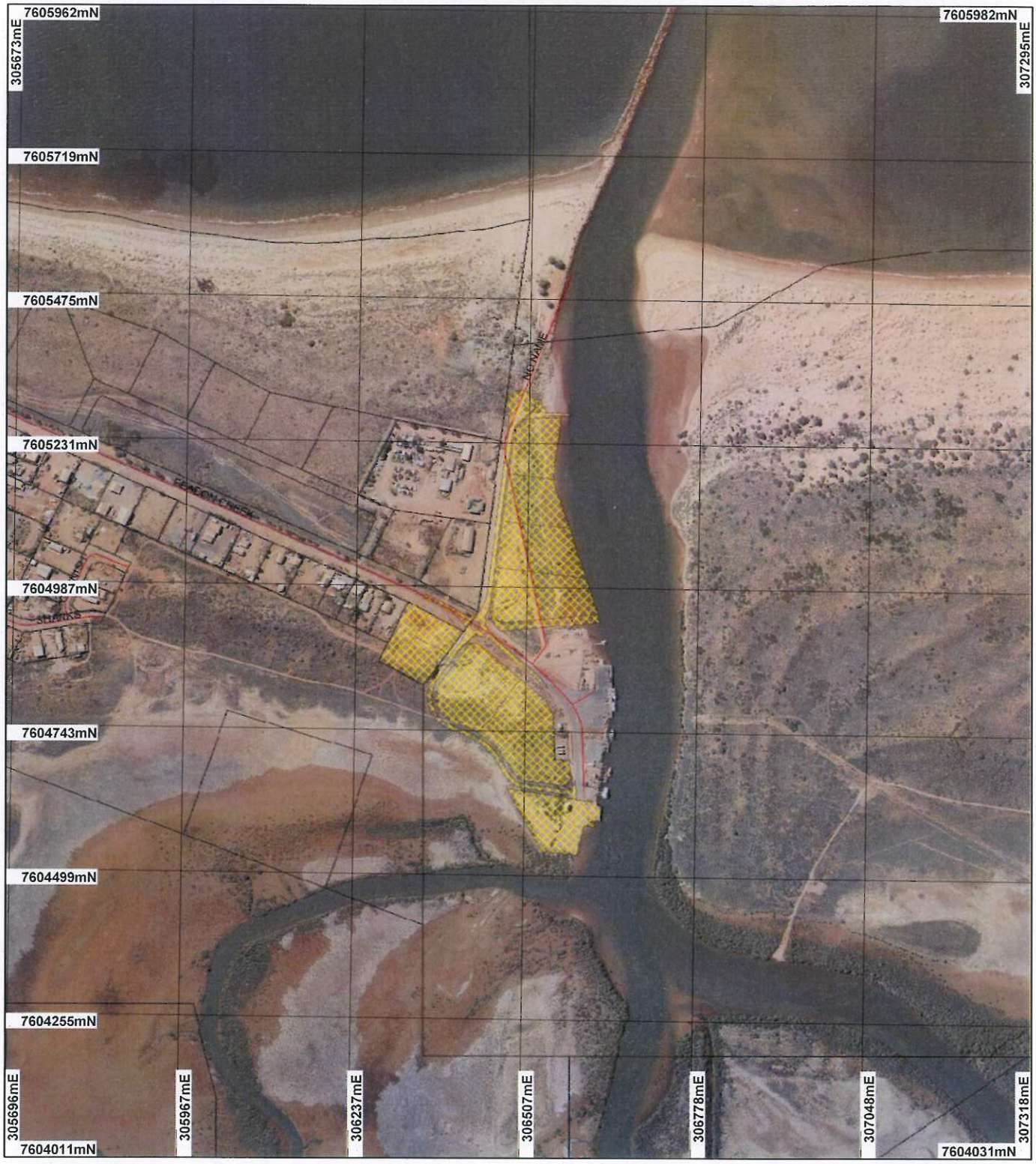
CONDITIONS
Nil.

Kelly Faulkner
MANAGER
NATIVE VEGETATION CONSERVATION BRANCH

Officer delegated under Section 20
of the Environmental Protection Act 1986

8 September 2011

Plan 4495/1



LEGEND

Clearing Instruments

- Areas Approved to Clear
- Road Centrelines
- Cadastre

Pilbara Coastline Exmouth Cape Preston 50cm Orthomosaic - Landgate

N

0 ~250 m

Scale 1:8968
(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

K Faulkner ..... Date 8/9/04

Officer with delegated authority under Section 20 of the Environmental Protection Act 1986

Information derived from this map should be confirmed with the data custodian acknowleged by the agency acronym in the legend.

Department of Environment and Conservation

Our environment, our future

Department of Environment and Conservation

Clearing Permit Decision Report

1. Application details

1.1. Permit application details

Permit application No.: 4495/1
Permit type: Area Permit

1.2. Proponent details

Proponent's name: Minister for Transport

1.3. Property details

Property: LOT 561 ON PLAN 174170 (Lot No. 561 BEADON CREEK ONSLOW 6710)
LOT 460 ON PLAN 210532 (Lot No. 460 BEADON CREEK ONSLOW 6710)
Local Government Area: Shire of Ashburton
Colloquial name: Onslow (Beadon Creek) Maritime Facility

1.4. Application

Clearing Area (ha)	No. Trees	Method of Clearing	For the purpose of:
6		Mechanical Removal	Building or Structure

1.5. Decision on application

Decision on Permit Application: Grant
Decision Date: 8 September 2011

2. Site Information

2.1. Existing environment and information

2.1.1. Description of the native vegetation under application

Vegetation Description	Clearing Description	Vegetation Condition	Comment
The area under application is mapped as Beard Vegetation Association 676 which is described as 'Succulent steppe; samphire' (Shepherd, 2009).	This application proposes to clear 6 hectares of native vegetation for the purpose of constructing marine and harbour facilities and an access road. The area under application has historically been subjected to numerous disturbances and is consequently in a degraded (Keighery, 1994) condition.	Degraded: Structure severely disturbed; regeneration to good condition requires intensive management (Keighery 1994)	The condition of the vegetation was determined via digital imagery (Pilbara Coastline Exmouth Cape Preston 50cm Orthomosaic - Landgate 2004).

3. Assessment of application against clearing principles

Comments

Proposal is not likely to be at variance to this Principle

This application proposes to clear six hectares of native vegetation within Lot 561 on Plan 174170 and Lot 460 on Plan 210532 (Reserve 30711), Onslow, for the purpose of constructing marine and harbour facilities and an access road.

The proposed marine and harbour facilities are located on Beadon Creek in Onslow. This area at Beadon Creek has traditionally been used for recreational, fishing and charter operations. Due to the previous/ongoing land use the area has been subjected to numerous disturbances and is consequently in a degraded (Keighery, 1994) condition.

No rare or priority flora has been recorded within a 10km radius of the area under application.

The area under application is located within the Pilbara Interim Biogeographic Regionalisation of Australia (IBRA) bioregion. This IBRA bioregion has approximately 100 per cent of its Pre European vegetation extent remaining (Shepherd, 2009).

The vegetation under application is mapped as Beard Vegetation Association 676 which has approximately 100 per cent of its Pre European extent remaining in the Pilbara bioregion (Shepherd, 2009).

Given the large proportion of native vegetation remaining in the local and regional context the six hectares of vegetation under application is not considered to be a significant remnant.

The area proposed to be cleared is located on Beadon Creek and consequently vegetation associated with a watercourse is likely to be removed. The disturbance caused by the clearing may increase sedimentation levels in Beadon Creek, however this impact will be short term and is not predicted to cause any significant deterioration in the quality of surface water.

Therefore this application may be at variance to principle (f) and is not likely to be at variance to any of the remaining clearing principles.

Methodology

References:
Keighery (1994)
Shepherd (2009)

GIS Database:
- Hydrography linear
- Pre European Vegetation
- SAC Biodatasets - accessed 2 August 2011

Planning instrument, Native Title, Previous EPA decision or other matter.

Comments

The care, control and management of Reserve 30711 is under a Management Order to the Minister for Transport for the designated purpose of 'Harbour Purposes'.

Under Section 9 of the Marine and Harbours Act 1981 the Minister for Transport has the power to lease the land. Under this power the Minister for Transport is leasing land at Beadon Creek and in currently seeking approval to clear the lease areas. Once the land is leased it will be the responsibility of the Lessees to obtain development approval from the Shire. The Department of Transport requires all non government lessees of its land to seek and obtain normal statutory planning and building approvals with respect to areas under lease and development can not proceed prior to these approvals being received.

The area under application falls within the Pilbara Groundwater Area which is an area proclaimed under the Right in Water and Irrigation Act 1914.

The area under application is zoned as 'industry'.

Methodology

GIS databases:
- RIWI Act, Groundwater Areas
- Town Planning Scheme Zones

4. References

Keighery, B.J. (1994) Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Shepherd, D.P. (2009) Adapted from: Shepherd, D.P., Beeston, G.R., and Hopkins, A.J.M. (2001), Native Vegetation in Western Australia. Technical Report 249. Department of Agriculture Western Australia, South Perth.

5. Glossary

Term	Meaning
BCS	Biodiversity Coordination Section of DEC
CALM	Department of Conservation and Land Management (now BCS)
DAFWA	Department of Agriculture and Food
DEC	Department of Environment and Conservation
DEP	Department of Environmental Protection (now DEC)
DoE	Department of Environment
DoIR	Department of Industry and Resources
DRF	Declared Rare Flora
EPP	Environmental Protection Policy
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
TEC	Threatened Ecological Community
WRC	Water and Rivers Commission (now DEC)

Appendix E

Laboratory Reports

Marine and Freshwater
Research Laboratory
Environmental Science
Telephone: +61 8 93602907 Facsimile: +61 8 93606613

Accreditation Number: 10603
This document is issued in accordance with
NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.

Murdoch UNIVERSITY

1+4 SEDIMENT ELUTRIATION

Contact: Katharine Cox
Customer: Oceanica
Address: PO Box 462, Wembley WA 6913

Date of Issue: 31/01/2013
Date Received: 06/12/2012
Our Reference: OCA12-38
Your Reference: 365_003

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	MS001 Filtered Cr µg/L	MS001 Filtered Ni µg/L	MS001 Filtered Cu µg/L	MS001 Filtered Zn µg/L	MS001 Filtered As µg/L	MS001 Filtered Cd µg/L	MS001 Filtered Pb µg/L	ICP006 Hg µg/L
Reporting Limit		<3	<2	<2	<0.2	<0.3	<0.2	<1	<0.5	<0.1	<0.1	<0.1
File			12121801		12121801, 2001	12121801	12121801	12121801	12121801	12121801, 2001	12121801	12121902
B1 0-0.5_a	5/12/2012	24	9	8	<0.2	1.4	0.5	<1	2.0	0.1	<0.1	<0.1
B1 0-0.5_b	5/12/2012	60	9	6	<0.2	1.4	0.5	<1	2.2	0.1	<0.1	<0.1
B2 0-0.5	5/12/2012	74	17	6	<0.2	1.4	0.7	<1	1.9	0.1	<0.1	<0.1
B3 0-0.5	5/12/2012	110	9	4	<0.2	0.9	0.6	<1	1.7	<0.1	<0.1	<0.1
B4 0-0.5	5/12/2012	100	8	4	<0.2	1.0	0.3	<1	1.7	<0.1	<0.1	<0.1
B5 0-0.5	4/12/2013	63	5	6	<0.2	0.8	0.8	<1	1.6	<0.1	<0.1	<0.1
B6 0-0.5	5/12/2012	<3	6	3	<0.2	6.0	0.3	<1	2.0	<0.1	<0.1	<0.1
B7 0-0.5	5/12/2012	180	6	5	<0.2	1.1	0.3	1	1.6	<0.1	<0.1	<0.1
B8 0-0.5	4/12/2013	300	7	5	<0.2	1.7	0.3	<1	1.5	<0.1	<0.1	<0.1
B9 0-0.5_1	4/12/2013	53	6	3	<0.2	1.2	0.3	<1	1.6	<0.1	<0.1	<0.1
B9 0-0.5_2	4/12/2013	38	5	3	<0.2	1.6	0.2	<1	1.5	<0.1	<0.1	<0.1
B9 0-0.5_3	4/12/2013	130	5	3	<0.2	2.0	0.2	<1	2.1	<0.1	<0.1	<0.1
B10 0-0.5	4/12/2013	140	6	4	<0.2	1.6	<0.2	<1	1.7	<0.1	<0.1	<0.1
B11 0-0.5	5/12/2012	180	<2	3	<0.2	1.0	<0.2	<1	1.6	<0.1	<0.1	<0.1
B11 0.5-1	5/12/2012	89	12	5	<0.2	1.4	0.5	<1	2.3	<0.1	<0.1	<0.1
B11 1-1.5	5/12/2012	38	13	8	<0.2	1.2	0.3	<1	3.4	<0.1	<0.1	<0.1
B11 1.5-2	5/12/2012	<3	13	4	<0.2	2.0	0.3	<1	2.8	<0.1	<0.1	<0.1
B12 0-0.5	4/12/2013	17	6	19	<0.2	2.8	0.4	<1	2.0	<0.1	<0.1	<0.1
B13 0-0.5	4/12/2013	84	4	5	<0.2	1.4	0.3	<1	2.8	<0.1	<0.1	<0.1
B14 0-0.5	4/12/2013	<3	<2	2	<0.2	2.4	0.4	<1	4.9	0.1	<0.1	<0.1
B14 0.5-1	4/12/2013	10	<2	7	<0.2	7.9	0.4	<1	6.5	0.7	<0.1	<0.1
B15 0-0.5	4/12/2013	95	5	4	<0.2	1.6	0.3	<1	3.4	0.1	<0.1	<0.1

Signatory:

Date: 31/01/2013

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Telephone: +61 8 93602907 Facsimile: +61 8 93606613

Accreditation Number: 10603
This document is issued in accordance with
NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.

Murdoch UNIVERSITY

1+4 SEDIMENT ELUTRIATION

Contact: Katharine Cox
Customer: Oceanica
Address: PO Box 462, Wembley WA 6913

Date of Issue: 31/01/2013
Date Received: 06/12/2012
Our Reference: OCA12-38
Your Reference: 365_003

METHOD	Sampling	2000	4100	2100	MS001	MS001	MS001	MS001	MS001	MS001	MS001	ICP006
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	Filtered Cr	Filtered Ni	Filtered Cu	Filtered Zn	Filtered As	Filtered Cd	Filtered Pb	Hg
		µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Reporting Limit		<3	<2	<2	<0.2	<0.3	<0.2	<1	<0.5	<0.1	<0.1	<0.1
File			12121801		12121801, 2001	12121801	12121801	12121801	12121801	12121801, 2001	12121801	12121902
Elutriate Blank		6	<2	4	<0.2	<0.3	0.5	<1	1.2	<0.1	<0.1	<0.1

Note: Elutriation is outside the scope of accreditation.

Signatory:

Date: 31/01/2013

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Telephone: +61 8 93602907 Facsimile: +61 8 93606613

Accreditation Number: 10603
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Murdoch UNIVERSITY

SEDIMENT DATA

Contact: Katharine Cox
Customer: Oceanica
Address: PO Box 462, Wembley WA 6913

Date of Issue: 31/01/2013
Date Received: 06/12/2012
Our Reference: OCA12-38
Your Reference: 365_003

METHOD SAMPLE CODE Reporting Limit	Sampling Date	ICP002 Total Ext As mg/kg <2	ICP002 Total Ext Cd mg/kg <0.1	ICP002 Total Ext Cr mg/kg <0.2	ICP002 Total Ext Cu mg/kg <0.2	ICP002 Total Ext Ni mg/kg <0.7	ICP002 Total Ext Pb mg/kg <1	ICP002 Total Ext Zn mg/kg <0.5	ICP007 Total Ext Hg mg/kg <0.01	2600 TKN mg.N/g <0.1	4500 TOTAL P mg.P/g <0.05
File					13011501-2401				13011802	13011101	
B1 0-0.5_a	5/12/2012	13	0.2	21	4.4	7.1	3	18	<0.01	<0.1	0.14
B1 0-0.5_b	5/12/2012	13	0.4	20	4.5	6.6	3	13	<0.01	<0.1	0.13
B2 0-0.5	5/12/2012	12	0.3	23	6.3	8.6	3	17	<0.01	<0.1	0.16
B3 0-0.5	5/12/2012	17	0.3	12	3.5	4.1	5	76	<0.01	<0.1	0.14
B4 0-0.5	5/12/2012	8	0.1	11	2.9	3.0	2	7.6	<0.01	<0.1	0.08
B5 0-0.5	4/12/2013	13	0.1	11	4.6	3.4	3	6.9	<0.01	<0.1	0.13
B6 0-0.5	5/12/2012	12	0.2	10	2.5	2.9	2	6.5	<0.01	<0.1	0.10
B7 0-0.5	5/12/2012	15	0.2	13	4.6	3.9	3	8.6	<0.01	<0.1	0.13
B8 0-0.5	4/12/2013	13	0.4	12	3.0	3.6	3	8.0	<0.01	<0.1	0.24
B9 0-0.5_1	4/12/2013	10	0.1	12	3.4	3.5	3	9.7	0.07	<0.1	0.12
B9 0-0.5_2	4/12/2013	9	0.2	12	3.1	3.2	3	14	<0.01	<0.1	0.11
B9 0-0.5_3	4/12/2013	13	0.3	13	51	4.4	4	23	<0.01	<0.1	0.15
B10 0-0.5	4/12/2013	18	0.2	11	3.2	3.5	3	7.8	<0.01	<0.1	0.19
B11 0-0.5	5/12/2012	14	0.2	12	3.6	3.6	3	9.2	<0.01	<0.1	0.14
B11 0.5-1	5/12/2012	14	0.2	11	3.6	3.1	4	9.2	<0.01	<0.1	0.13
B11 1-1.5	5/12/2012	17	0.2	14	3.2	4.2	3	8.9	<0.01	<0.1	0.15
B11 1.5-2	5/12/2012	13	0.1	11	2.6	3.9	2	6.3	<0.01	<0.1	0.13
B12 0-0.5	4/12/2013	17	0.3	11	3.1	3.8	3	8.0	<0.01	<0.1	0.14
B13 0-0.5	4/12/2013	11	0.3	21	4.4	6.5	4	18	<0.01	<0.1	0.13
B14 0-0.5	4/12/2013	13	0.3	26	7.1	8.5	5	17	<0.01	<0.1	0.16
B14 0.5-1	4/12/2013	15	0.3	28	6.7	9.6	4	18	<0.01	<0.1	0.17
B15 0-0.5	4/12/2013	22	0.3	30	10	11	7	21	<0.01	0.3	0.17

Signatory:

Date: 31/01/2013

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 129903

Client:
Oceanica Consulting Pty Ltd
PO Box 462
WEMBLEY
WA 6913

Attention: Katharine Cox

Sample log in details:

Your Reference:	**365_003 Beadon Creek Capital Dredging**
No. of samples:	1 Soil, 1 elutriate
Date samples received:	7/12/12
Date completed instructions received:	7/12/12
Location:	

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	2/01/13
Date of Preliminary Report:	Not issued
Issue Date:	2/01/13

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

Joshua Lim
Operations Manager

NATA ACCREDITED FOR TECHNICAL COMPETENCE

vTRH(C6-C10)/MBTEXN in soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Date extracted	-	10/12/12
Date analysed	-	11/12/12
TRHC$_6$ - C$_9$	mg/kg	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25
TRHC$_6$-C$_{10}$ less BTEX (F1)	mg/kg	<25
MTBE	mg/kg	<1
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-xylene	mg/kg	<1
Naphthalene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	98

svTRH(C10-C40) in soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Date extracted	-	10/12/12
Date analysed	-	11/12/12
TRHC$_{10}$ - C$_{14}$	mg/kg	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100
TRH>C$_{10}$ - C$_{16}$	mg/kg	<50
TRH>C$_{10}$-C$_{16}$ less N (F2)	mg/kg	<50
TRH>C$_{16}$ - C$_{34}$	mg/kg	<100
TRH>C$_{34}$ - C$_{40}$	mg/kg	<100
Surrogate o-Terphenyl	%	90

PAHs in Sediment		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Date extracted	-	12/12/12
Date analysed	-	14/12/12
Naphthalene	µg/kg	<5
2-Methylnaphthalene*	µg/kg	<5
Acenaphthylene	µg/kg	<5
Acenaphthene	µg/kg	<5
Fluorene	µg/kg	<5
Phenanthrene	µg/kg	<5
Anthracene	µg/kg	<5
Fluoranthene	µg/kg	<5
Pyrene	µg/kg	<5
Benzo(a)anthracene	µg/kg	<5
Chrysene	µg/kg	<5
Benzo(b+k)fluoranthene	µg/kg	<10
Benzo(e)pyrene	µg/kg	<5
Benzo(a)pyrene	µg/kg	<5
Perylene	µg/kg	<5
Indeno(1,2,3-c,d)pyrene	µg/kg	<5
Dibenzo(a,h)anthracene	µg/kg	<5
Benzo(g,h,i)perylene	µg/kg	<5
Coronene*	µg/kg	<5
p-Terphenyl-D_{14}	%	98

Organotin Compounds in Soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Monobutyltin	µgSn/kg	<0.50
Dibutyltin	µgSn/kg	<0.50
Tributyltin	µgSn/kg	<0.50
Surrogate (Tripropyltin)	%	100

Organotins in Elutriate		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Tributyltin	µgSn/L	<0.0050
Surrogate (Tripropyltin)	%	73

Nutrients in Soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Total Kjeldahl Nitrogen	mg/kg	44
Total P in soil	mg/kg	130

Nutrients in Water		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Nitrate as N in elutriate	mg/L	<0.005
Nitrite as N in elutriate	mg/L	<0.005
Ammonia as N in elutriate	mg/L	0.010
Phosphate as P in elutriate	mg/L	<0.005

Acid Extractable metals in soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Date digested	-	11/12/12
Date analysed	-	11/12/12
Arsenic	mg/kg	13
Cadmium	mg/kg	<0.4
Chromium	mg/kg	22
Copper	mg/kg	6
Lead	mg/kg	4
Mercury	mg/kg	<0.1
Nickel	mg/kg	7
Zinc	mg/kg	15

Metals in Water - Dissolved		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Arsenic-Dissolved	mg/L	0.002
Cadmium-Dissolved	mg/L	<0.0001
Chromium-Dissolved	mg/L	<0.001
Copper-Dissolved	mg/L	<0.001
Lead-Dissolved	mg/L	<0.001
Mercury-Dissolved	mg/L	<5 x 10^{-005}
Nickel-Dissolved	mg/L	<0.001
Zinc-Dissolved	mg/L	<0.001

Miscellaneous Inorg - soil		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Total Carbon	%	1.0
Total Organic Carbon (Combustion)	%	0.05

Chromium Suite - SCr		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Chromium Reducible Sulfur	%w/w	0.016

Moisture		
Our Reference:	UNITS	129903-1
Your Reference	----------	B1
Depth	----------	0.0-0.5
Date Sampled		5/12/2012
Type of sample		Soil
Date prepared	-	10/12/12
Date analysed	-	13/12/12
Moisture	%	20

Method ID	Methodology Summary
ORG-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 draft Guideline on Investigation Levels for Soil and Groundwater.
ORG-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
ORG-003	Soil samples are extracted with Dichloromethane/Acetone, and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 draft Guideline on Investigation Levels for Soil and Groundwater
ORG-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM draft B1 Guideline on Investigation Levels for Soil and Groundwater.
Ext-038	Analysed by Advanced Analytical Australia Pty Ltd. NATA accreditation 15109.
Ext-054	Analysed by Envirolab Services Sydney, accreditation number 2901
METALS-020	Metals in soil and water by ICP-OES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
SAL	Analysis subcontracted to Sydney Analytical Laboratories. NATA Accreditation No: 1884
INORG-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
INORG-008	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.

QUALITY CONTROL vTRH(C6-C10)/MBTEXN in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ǁ Duplicate ǁ %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/11/12	[NT]	[NT]	LCS	10/12/12
Date analysed	-			11/12/12	[NT]	[NT]	LCS	11/12/12
TRHC$_6$ - C$_9$	mg/kg	25	ORG-016	<25	[NT]	[NT]	LCS	91%
TRHC$_6$ - C$_{10}$	mg/kg	25	ORG-016	<25	[NT]	[NT]	LCS	90%
TRHC$_6$-C$_{10}$ less BTEX (F1)	mg/kg	25	ORG-016	<25	[NT]	[NT]	[NR]	[NR]
MTBE	mg/kg	1	ORG-014	<1	[NT]	[NT]	[NR]	[NR]
Benzene	mg/kg	0.2	ORG-016	<0.2	[NT]	[NT]	LCS	115%
Toluene	mg/kg	0.5	ORG-016	<0.5	[NT]	[NT]	LCS	88%
Ethylbenzene	mg/kg	1	ORG-016	<1	[NT]	[NT]	LCS	82%
m+p-xylene	mg/kg	2	ORG-016	<2	[NT]	[NT]	LCS	86%
o-xylene	mg/kg	1	ORG-016	<1	[NT]	[NT]	LCS	82%
Naphthalene	mg/kg	1	ORG-014	<1	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		ORG-016	131	[NT]	[NT]	LCS	95%

QUALITY CONTROL svTRH(C10-C40) in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ǁ Duplicate ǁ %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/12/12	[NT]	[NT]	LCS	10/12/12
Date analysed	-			11/12/12	[NT]	[NT]	LCS	11/12/12
TRHC$_{10}$ - C$_{14}$	mg/kg	50	ORG-003	<50	[NT]	[NT]	LCS	96%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	ORG-003	<100	[NT]	[NT]	LCS	91%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	ORG-003	<100	[NT]	[NT]	LCS	100%
TRH>C$_{10}$ - C$_{16}$	mg/kg	50	ORG-003	<50	[NT]	[NT]	LCS	88%
TRH>C$_{10}$-C$_{16}$ less N (F2)	mg/kg	50	ORG-003	<50	[NT]	[NT]	[NR]	[NR]
TRH>C$_{16}$ - C$_{34}$	mg/kg	100	ORG-003	<100	[NT]	[NT]	LCS	96%
TRH>C$_{34}$ - C$_{40}$	mg/kg	100	ORG-003	<100	[NT]	[NT]	[NR]	[NR]
Surrogate o-Terphenyl	%		ORG-003	113	[NT]	[NT]	LCS	82%

QUALITY CONTROL PAHs in Sediment	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/12/12	[NT]	[NT]	LCS	12/12/12
Date analysed	-			14/12/12	[NT]	[NT]	LCS	14/12/12
Naphthalene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	72%
2-Methylnaphthalene*	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Acenaphthylene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	83%
Phenanthrene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	92%
Anthracene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	96%
Pyrene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	96%
Benzo(a)anthracene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	73%
Benzo(b+k)fluoranthene	µg/kg	10	ORG-012	<10	[NT]	[NT]	[NR]	[NR]
Benzo(e)pyrene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/kg	5	ORG-012	<5	[NT]	[NT]	LCS	105%
Perylene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Indeno(1,2,3-c,d)pyrene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
Coronene*	µg/kg	5	ORG-012	<5	[NT]	[NT]	[NR]	[NR]
p-Terphenyl-D_{14}	%		ORG-012	106	[NT]	[NT]	LCS	108%

QUALITY CONTROL Organotin Compounds in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Monobutyltin	µgSn/kg	0.5	Ext-038	<0.50	[NT]	[NT]	LCS	129%
Dibutyltin	µgSn/kg	0.5	Ext-038	<0.50	[NT]	[NT]	LCS	103%
Tributyltin	µgSn/kg	0.5	Ext-038	<0.50	[NT]	[NT]	LCS	98%
Surrogate (Tripropyltin)	%		Ext-038	[NT]	[NT]	[NT]	LCS	67%
QUALITY CONTROL Organotins in Elutriate	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Tributyltin	µgSn/L	0.005	Ext-038	<2	[NT]	[NT]	LCS	82%
Surrogate (Tripropyltin)	%		Ext-038	[NT]	[NT]	[NT]	LCS	68%
QUALITY CONTROL Nutrients in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Total Kjeldahl Nitrogen	mg/kg	10	Ext-054	<10	[NT]	[NT]	LCS	100%
Total P in soil	mg/kg	0.1	METALS-020	<0.1	[NT]	[NT]	LCS	101%
QUALITY CONTROL Nutrients in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Nitrate as N in elutriate	mg/L	0.005	Ext-054	<0.005	[NT]	[NT]	LCS	98%
Nitrite as N in elutriate	mg/L	0.005	Ext-054	<0.005	[NT]	[NT]	LCS	91%
Ammonia as N in elutriate	mg/L	0.005	Ext-054	<0.005	[NT]	[NT]	LCS	94%
Phosphate as P in elutriate	mg/L	0.005	Ext-054	<0.005	[NT]	[NT]	LCS	94%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			11/12/12	[NT]	[NT]	LCS	11/12/12
Date analysed	-			11/12/12	[NT]	[NT]	LCS	11/12/12
Arsenic	mg/kg	2	METALS-020	<2	[NT]	[NT]	LCS	101%
Cadmium	mg/kg	0.4	METALS-020	<0.4	[NT]	[NT]	LCS	105%
Chromium	mg/kg	1	METALS-020	<1	[NT]	[NT]	LCS	103%
Copper	mg/kg	1	METALS-020	<1	[NT]	[NT]	LCS	106%
Lead	mg/kg	1	METALS-020	<1	[NT]	[NT]	LCS	103%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	[NT]	[NT]	LCS	96%
Nickel	mg/kg	1	METALS-020	<1	[NT]	[NT]	LCS	102%
Zinc	mg/kg	1	METALS-020	<1	[NT]	[NT]	LCS	101%

QUALITY CONTROL Metals in Water - Dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Arsenic-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	97%
Cadmium-Dissolved	mg/L	0.0001	Metals-022 ICP-MS	<0.0001	[NT]	[NT]	LCS	93%
Chromium-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	98%
Copper-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	94%
Lead-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	98%
Mercury-Dissolved	mg/L	0.00005	Metals-021 CV-AAS	<5 x 10^{-00} 5	[NT]	[NT]	LCS	104%
Nickel-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	96%
Zinc-Dissolved	mg/L	0.001	Metals-022 ICP-MS	<0.001	[NT]	[NT]	LCS	96%

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank
Total Carbon	%	0.1	SAL	<0.10
Total Organic Carbon (Combustion)	%	0.01	SAL	<1000

QUALITY CONTROL Chromium Suite - SCr	UNITS	PQL	METHOD	Blank
Chromium Reducible Sulfur	%w/w	0.005	INORG-068	<0.005

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			10/12/12
Date analysed	-			13/12/12
Moisture	%	0.1	INORG-008	<0.10

Report Comments:

Organotin, TKN, TC, TOC in sediment, Organotin, Metals, Nutrients in elutriate analysed by Envirolab report 82916

Asbestos was analysed by Approved Identifier: Not applicable for this job
Airborne fibres were analysed by Approved Counter: Not applicable for this job

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested
NS: Not specified; NEPM: National Environmental Protection Measure
DOL: Sample rejected due to particulate overload

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics;
10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.

REPORT OF ANALYSIS

Report No. RN950382

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019740	B1 0-0.5_a	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019741	B1 0-0.5_b	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019742	B2 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019743	B3 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12

Lab Reg No.		W12/019740	W12/019741	W12/019742	W12/019743	
Sample Reference	Units	B1 0-0.5_a	B1 0-0.5_b	B2 0-0.5	B3 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Surrogate: Tripropyltin	%REC	130	121	124	103	NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No.		W12/019740	W12/019741	W12/019742	W12/019743	
Sample Reference	Units	B1 0-0.5_a	B1 0-0.5_b	B2 0-0.5	B3 0-0.5	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1300	1300	1700	1600	NW_S15
Carbon - Total	mg/kg	9400	7600	20000	14000	NW_S15

Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019740	W12/019741	W12/019742	W12/019743	
Sample Reference	Units	B1 0-0.5_a	B1 0-0.5_b	B2 0-0.5	B3 0-0.5	Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluorene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Phenanthrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluoranthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Chrysene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02	WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16	< 0.16	< 0.16	WL206
BTEX						
Benzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Toluene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Ethylbenzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Xylene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Total BTEX	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Miscellaneous						
Moisture	%	29	17	17	17	WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25	< 25	< 25	WL230
TPH C10 - C14	mg/kg	< 50	< 50	< 50	< 50	WL230
TPH C15 - C28	mg/kg	< 100	< 100	< 100	< 100	WL230
TPH C29 - C36	mg/kg	< 100	< 100	< 100	< 100	WL230
Total TPH	mg/kg	< 275	< 275	< 275	< 275	WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012	10-DEC-2012	10-DEC-2012	
Date analysed		11-DEC-2012	11-DEC-2012	11-DEC-2012	11-DEC-2012	
Sample condition on receipt		COLD	COLD	COLD	COLD	

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.	Units	W12/019740	W12/019741	W12/019742	W12/019743	Method
Sample Reference		B1 0-0.5_a	B1 0-0.5_b	B2 0-0.5	B3 0-0.5	
Inorganics						
ANC bt as CaCO3	%	Not Tested	Not Tested	Not Tested	Not Tested	WL281-19A2
pH kcl		9.6	9.6	9.7	9.7	WL281-23A
Scr	%	0.03	0.02	< 0.01	0.01	WL281-22B

W12/019740
to W12/019761

Acid sulfate soil analytes were determined on the samples after they were dried and ground in a ring mill (i.e. reported on a dry weight basis).

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Report No. RN950382

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

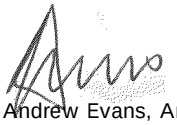
Lab Reg No.	Sample Ref	Sample Description
W12/019744	B4 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019745	B5 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019746	B6 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019747	B7 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12

Lab Reg No. / Sample Reference	Units	W12/019744 B4 0-0.5	W12/019745 B5 0-0.5	W12/019746 B6 0-0.5	W12/019747 B7 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	1.2	< 0.5	< 0.5	5.1	NR_35
Tributyltin as Sn	ng/g	2.0	< 0.5	< 0.5	84	NR_35
Surrogate: Tripropyltin	%REC	136	141	129	133	NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No. / Sample Reference	Units	W12/019744 B4 0-0.5	W12/019745 B5 0-0.5	W12/019746 B6 0-0.5	W12/019747 B7 0-0.5	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1500	1400	1600	1500	NW_S15
Carbon - Total	mg/kg	6200	8400	15000	12000	NW_S15



Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019744	W12/019745	W12/019746	W12/019747	
Sample Reference	Units	B4 0-0.5	B5 0-0.5	B6 0-0.5	B7 0-0.5	Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluorene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Phenanthrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluoranthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Chrysene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02	WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16	< 0.16	< 0.16	WL206
BTEX						
Benzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Toluene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Ethylbenzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Xylene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Total BTEX	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Miscellaneous						
Moisture	%	17	17	18	19	WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25	< 25	< 25	WL230
TPH C10 - C14	mg/kg	< 50	< 50	< 50	< 50	WL230
TPH C15 - C28	mg/kg	< 100	< 100	< 100	< 100	WL230
TPH C29 - C36	mg/kg	< 100	< 100	< 100	< 100	WL230
Total TPH	mg/kg	< 275	< 275	< 275	< 275	WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012	10-DEC-2012	10-DEC-2012	
Date analysed		11-DEC-2012	11-DEC-2012	11-DEC-2012	11-DEC-2012	
Sample condition on receipt		COLD	COLD	COLD	COLD	

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019744	W12/019745	W12/019746	W12/019747	
Sample Reference	Units	B4 0-0.5	B5 0-0.5	B6 0-0.5	B7 0-0.5	Method
Inorganics						
ANC bt as CaCO3	%	Not Tested	Not Tested	Not Tested	Not Tested	WL281-19A2
pH kcl		9.7	9.7	9.7	9.6	WL281-23A
Scr	%	0.01	0.01	0.02	0.02	WL281-22B

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

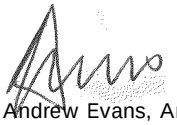
Lab Reg No.	Sample Ref	Sample Description
W12/019748	B8 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019749	B9 0-0.5_1	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019750	B9 0-0.5_2	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019751	B9 0-0.5_3	Beadon Creak Capital Dredging SEDIMENT 04/12/12

Lab Reg No. / Sample Reference	Units	W12/019748 B8 0-0.5	W12/019749 B9 0-0.5_1	W12/019750 B9 0-0.5_2	W12/019751 B9 0-0.5_3	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	0.57	0.71	4.9	NR_35
Tributyltin as Sn	ng/g	< 0.5	0.73	1.7	28	NR_35
Surrogate: Tripropyltin	%REC	124	128	139	123	NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No. / Sample Reference	Units	W12/019748 B8 0-0.5	W12/019749 B9 0-0.5_1	W12/019750 B9 0-0.5_2	W12/019751 B9 0-0.5_3	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1300	1100	1200	1300	NW_S15
Carbon - Total	mg/kg	8600	6200	35000	22000	NW_S15



Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019748	W12/019749	W12/019750	W12/019751	
Sample Reference	Units	B8 0-0.5	B9 0-0.5_1	B9 0-0.5_2	B9 0-0.5_3	Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthene	mg/kg	< 0.01	< 0.01	0.02	< 0.01	WL206
Fluorene	mg/kg	< 0.01	< 0.01	0.02	< 0.01	WL206
Phenanthrene	mg/kg	< 0.01	< 0.01	0.42	< 0.01	WL206
Anthracene	mg/kg	< 0.01	< 0.01	0.09	< 0.01	WL206
Fluoranthene	mg/kg	< 0.01	< 0.01	0.77	< 0.01	WL206
Pyrene	mg/kg	< 0.01	< 0.01	0.61	< 0.01	WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01	0.25	< 0.01	WL206
Chrysene	mg/kg	< 0.01	< 0.01	0.21	< 0.01	WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02	0.35	< 0.02	WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01	0.22	< 0.01	WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01	0.10	< 0.01	WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01	0.02	< 0.01	WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01	0.10	< 0.01	WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16	3.2	< 0.16	WL206
BTEX						
Benzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Toluene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Ethylbenzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Xylene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Total BTEX	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Miscellaneous						
Moisture	%	18	17	17	17	WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25	< 25	< 25	WL230
TPH C10 - C14	mg/kg	< 50	< 50	< 50	< 50	WL230
TPH C15 - C28	mg/kg	< 100	< 100	< 100	< 100	WL230
TPH C29 - C36	mg/kg	< 100	< 100	< 100	< 100	WL230
Total TPH	mg/kg	< 275	< 275	< 275	< 275	WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012	10-DEC-2012	10-DEC-2012	
Date analysed		11-DEC-2012	11-DEC-2012	11-DEC-2012	11-DEC-2012	
Sample condition on receipt		COLD	COLD	COLD	COLD	

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019748	W12/019749	W12/019750	W12/019751	
Sample Reference	Units	B8 0-0.5	B9 0-0.5_1	B9 0-0.5_2	B9 0-0.5_3	Method
Inorganics						
ANC bt as CaCO3	%	Not Tested	Not Tested	Not Tested	Not Tested	WL281-19A2
pH kcl		9.6	9.5	9.5	9.5	WL281-23A
Scr	%	0.02	0.03	0.02	0.03	WL281-22B

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

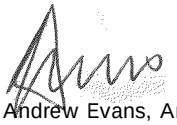
Lab Reg No.	Sample Ref	Sample Description
W12/019752	B10 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019753	B11 0-0.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019754	B11 0.5-1	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019755	B11 1-1.5	Beadon Creak Capital Dredging SEDIMENT 05/12/12

Lab Reg No.		W12/019752	W12/019753	W12/019754	W12/019755	
Sample Reference	Units	B10 0-0.5	B11 0-0.5	B11 0.5-1	B11 1-1.5	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	0.64	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	0.66	0.64	0.60	< 0.5	NR_35
Surrogate: Tripropyltin	%REC	133	136	103	121	NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No.		W12/019752	W12/019753	W12/019754	W12/019755	
Sample Reference	Units	B10 0-0.5	B11 0-0.5	B11 0.5-1	B11 1-1.5	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1400	1200	990	1200	NW_S15
Carbon - Total	mg/kg	12000	15000	10000	14000	NW_S15



Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019752	W12/019753	W12/019754	W12/019755	
Sample Reference	Units	B10 0-0.5	B11 0-0.5	B11 0.5-1	B11 1-1.5	Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluorene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Phenanthrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluoranthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Chrysene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02	WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16	< 0.16	< 0.16	WL206
BTEX						
Benzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Toluene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Ethylbenzene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Xylene	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Total BTEX	mg/kg	Not Tested	Not Tested	Not Tested	Not Tested	WL230
Miscellaneous						
Moisture	%	20	19	17	17	WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25	< 25	< 25	WL230
TPH C10 - C14	mg/kg	< 50	< 50	< 50	< 50	WL230
TPH C15 - C28	mg/kg	< 100	< 100	< 100	< 100	WL230
TPH C29 - C36	mg/kg	< 100	< 100	< 100	< 100	WL230
Total TPH	mg/kg	< 275	< 275	< 275	< 275	WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012	10-DEC-2012	10-DEC-2012	
Date analysed		11-DEC-2012	11-DEC-2012	11-DEC-2012	11-DEC-2012	
Sample condition on receipt		COLD	COLD	COLD	COLD	

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.	Units	W12/019752	W12/019753	W12/019754	W12/019755	Method
Sample Reference		B10 0-0.5	B11 0-0.5	B11 0.5-1	B11 1-1.5	
Inorganics						
ANC bt as CaCO3	%	Not Tested	6.8	Not Tested	Not Tested	WL281-19A2
pH kcl		9.5	9.5	9.7	9.7	WL281-23A
Scr	%	0.02	0.04	0.02	0.02	WL281-22B

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019756	B11 1.5-2	Beadon Creak Capital Dredging SEDIMENT 05/12/12
W12/019757	B12 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019758	B13 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019759	B14 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12

Lab Reg No.		W12/019756	W12/019757	W12/019758	W12/019759	
Sample Reference	Units	B11 1.5-2	B12 0-0.5	B13 0-0.5	B14 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	0.54	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	< 0.5	0.73	< 0.5	< 0.5	NR_35
Surrogate: Tripropyltin	%REC	113	124	136	131	NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No.		W12/019756	W12/019757	W12/019758	W12/019759	
Sample Reference	Units	B11 1.5-2	B12 0-0.5	B13 0-0.5	B14 0-0.5	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1100	1600	950	1400	NW_S15
Carbon - Total	mg/kg	11000	17000	6100	6400	NW_S15

Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019756	W12/019757	W12/019758	W12/019759	
Sample Reference	Units	B11 1.5-2	B12 0-0.5	B13 0-0.5	B14 0-0.5	Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Acenaphthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluorene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Phenanthrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Fluoranthene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Chrysene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02	WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16	< 0.16	< 0.16	WL206
BTEX						
Benzene	mg/kg	Not Tested	Not Tested	< 0.20	< 0.20	WL230
Toluene	mg/kg	Not Tested	Not Tested	< 0.20	< 0.20	WL230
Ethylbenzene	mg/kg	Not Tested	Not Tested	< 0.20	< 0.20	WL230
Xylene	mg/kg	Not Tested	Not Tested	< 0.40	< 0.40	WL230
Total BTEX	mg/kg	Not Tested	Not Tested	< 1.0	< 1.0	WL230
Miscellaneous						
Moisture	%	18	22	18	19	WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25	< 25	< 25	WL230
TPH C10 - C14	mg/kg	< 50	< 50	< 50	< 50	WL230
TPH C15 - C28	mg/kg	< 100	< 100	< 100	< 100	WL230
TPH C29 - C36	mg/kg	< 100	< 100	< 100	< 100	WL230
Total TPH	mg/kg	< 275	< 275	< 275	< 275	WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012	10-DEC-2012	10-DEC-2012	
Date analysed		11-DEC-2012	11-DEC-2012	11-DEC-2012	11-DEC-2012	
Sample condition on receipt		COLD	COLD	COLD	COLD	

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019756	W12/019757	W12/019758	W12/019759	
Sample Reference	Units	B11 1.5-2	B12 0-0.5	B13 0-0.5	B14 0-0.5	Method
Inorganics						
ANC bt as CaCO3	%	Not Tested	9.7	Not Tested	Not Tested	WL281-19A2
pH kcl		9.7	9.5	9.6	9.6	WL281-23A
Scr	%	0.02	0.10	0.01	< 0.01	WL281-22B

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019760	B15 0-0.5	Beadon Creak Capital Dredging SEDIMENT 04/12/12
W12/019761	B14 0.5-1	Beadon Creak Capital Dredging SEDIMENT 04/12/12

Lab Reg No.		W12/019760	W12/019761			
Sample Reference	Units	B15 0-0.5	B14 0.5-1			Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5			NR_35
Dibutyltin as Sn	ng/g	< 0.5	< 0.5			NR_35
Tributyltin as Sn	ng/g	< 0.5	< 0.5			NR_35
Surrogate: Tripropyltin	%REC	132	120			NR_35

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Lab Reg No.		W12/019760	W12/019761			
Sample Reference	Units	B15 0-0.5	B14 0.5-1			Method
Miscellaneous						
Carbon - Total Organic	mg/kg	1300	950			NW_S15
Carbon - Total	mg/kg	8600	9200			NW_S15

Andrew Evans, Analyst
Inorganics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019760	W12/019761			
Sample Reference	Units	B15 0-0.5	B14 0.5-1			Method
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	< 0.01	< 0.01			WL206
Acenaphthylene	mg/kg	< 0.01	< 0.01			WL206
Acenaphthene	mg/kg	< 0.01	< 0.01			WL206
Fluorene	mg/kg	< 0.01	< 0.01			WL206
Phenanthrene	mg/kg	< 0.01	< 0.01			WL206
Anthracene	mg/kg	< 0.01	< 0.01			WL206
Fluoranthene	mg/kg	< 0.01	< 0.01			WL206
Pyrene	mg/kg	< 0.01	< 0.01			WL206
Benz(a)anthracene	mg/kg	< 0.01	< 0.01			WL206
Chrysene	mg/kg	< 0.01	< 0.01			WL206
Benzo(b + k)fluoranthene	mg/kg	< 0.02	< 0.02			WL206
Benzo(a)pyrene	mg/kg	< 0.01	< 0.01			WL206
Indeno(1,2,3,c,d)pyrene	mg/kg	< 0.01	< 0.01			WL206
Dibenz(a,h)anthracene	mg/kg	< 0.01	< 0.01			WL206
Benzo(g,h,i)perylene	mg/kg	< 0.01	< 0.01			WL206
Total PAH's (as above)	mg/kg	< 0.16	< 0.16			WL206
BTEX						
Benzene	mg/kg	< 0.20	< 0.20			WL230
Toluene	mg/kg	< 0.20	< 0.20			WL230
Ethylbenzene	mg/kg	< 0.20	< 0.20			WL230
Xylene	mg/kg	< 0.40	< 0.40			WL230
Total BTEX	mg/kg	< 1.0	< 1.0			WL230
Miscellaneous						
Moisture	%	21	20			WL170
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	< 25	< 25			WL230
TPH C10 - C14	mg/kg	< 50	< 50			WL230
TPH C15 - C28	mg/kg	< 100	< 100			WL230
TPH C29 - C36	mg/kg	< 100	< 100			WL230
Total TPH	mg/kg	< 275	< 275			WL230
Dates						
Date extracted		10-DEC-2012	10-DEC-2012			
Date analysed		11-DEC-2012	11-DEC-2012			
Sample condition on receipt		COLD	COLD			

Leigh Boyd - Analyst
Organics - WA
Accreditation No. 2474

21-DEC-2012

REPORT OF ANALYSIS

Lab Reg No.		W12/019760	W12/019761			
Sample Reference	Units	B15 0-0.5	B14 0.5-1			Method
Inorganics						
ANC bt as CaCO3	%	8.6	8.2			WL281-19A2
pH kcl		9.3	9.3			WL281-23A
Scr	%	0.13	0.10			WL281-22B

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

21-DEC-2012

All results (except moisture) are expressed on a dry weight basis. Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

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Results relate only to the sample(s) tested.

This Report supersedes reports: RN948779 RN950143 RN950239 RN950364

REPORT OF ANALYSIS

Report No. RN950384

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019740/T	B1 0-0.5_a	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019741/T	B1 0-0.5_b	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019742/T	B2 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019743/T	B3 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12

Lab Reg No.		W12/019740/T	W12/019741/T	W12/019742/T	W12/019743/T	
Sample Reference	Units	B1 0-0.5_a	B1 0-0.5_b	B2 0-0.5	B3 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/L	2.7	2.7	3.1	2.8	NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Tributyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Surrogate: Tripropyltin	%REC	115	117	130	125	NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012	18-DEC-2012	
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012	20-DEC-2012	

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019744/T	B4 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019745/T	B5 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019746/T	B6 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019747/T	B7 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12

Lab Reg No.		W12/019744/T	W12/019745/T	W12/019746/T	W12/019747/T	
Sample Reference	Units	B4 0-0.5	B5 0-0.5	B6 0-0.5	B7 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/L	2.1	2.2	< 2	7.3	NR_35
Dibutyltin as Sn	ng/L	2.5	< 2	< 2	140	NR_35
Tributyltin as Sn	ng/L	12	< 2	< 2	1600	NR_35
Surrogate: Tripropyltin	%REC	110	100	100	140	NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012	18-DEC-2012	
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012	20-DEC-2012	

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Report No. RN950384

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019748/T	B8 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019749/T	B9 0-0.5_1	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019750/T	B9 0-0.5_2	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019751/T	B9 0-0.5_3	Beadon Creak Capital Dredging ELUTRIATE 04/12/12

Lab Reg No.		W12/019748/T	W12/019749/T	W12/019750/T	W12/019751/T	
Sample Reference	Units	B8 0-0.5	B9 0-0.5_1	B9 0-0.5_2	B9 0-0.5_3	Method
Organotins						
Monobutyltin as Sn	ng/L	3.0	2.0	< 2	2.7	NR_35
Dibutyltin as Sn	ng/L	< 2	2.7	2.3	20	NR_35
Tributyltin as Sn	ng/L	16	7.7	7.9	24	NR_35
Surrogate: Tripropyltin	%REC	122	123	115	134	NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012	18-DEC-2012	
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012	20-DEC-2012	

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Report No. RN950384

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019752/T	B10 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019753/T	B11 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019754/T	B11 0.5-1	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019755/T	B11 1-1.5	Beadon Creak Capital Dredging ELUTRIATE 05/12/12

Lab Reg No.		W12/019752/T	W12/019753/T	W12/019754/T	W12/019755/T	
Sample Reference	Units	B10 0-0.5	B11 0-0.5	B11 0.5-1	B11 1-1.5	Method
Organotins						
Monobutyltin as Sn	ng/L	2.8	< 2	< 2	2.1	NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	2.2	< 2	NR_35
Tributyltin as Sn	ng/L	3.2	2.2	3.5	2.4	NR_35
Surrogate: Tripropyltin	%REC	137	115	132	124	NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012	18-DEC-2012	
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012	20-DEC-2012	

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019756/T	B11 1.5-2	Beadon Creak Capital Dredging ELUTRIATE 05/12/12
W12/019757/T	B12 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019758/T	B13 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019759/T	B14 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12

Lab Reg No.		W12/019756/T	W12/019757/T	W12/019758/T	W12/019759/T	
Sample Reference	Units	B11 1.5-2	B12 0-0.5	B13 0-0.5	B14 0-0.5	Method
Organotins						
Monobutyltin as Sn	ng/L	< 2	< 2	2.0	2.0	NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Tributyltin as Sn	ng/L	< 2	2.3	< 2	< 2	NR_35
Surrogate: Tripropyltin	%REC	95	96	133	101	NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012	18-DEC-2012	
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012	20-DEC-2012	

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

REPORT OF ANALYSIS

Report No. RN950384

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/121207-1
	LEVEL 1	Quote No.	: QT-01798
	353 CAMBRIDGE STREET	Order No.	: 365_003
	WEMBLEY WA 6913	Date Sampled	: 4-DEC-2012
		Date Received	: 7-DEC-2012
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019760/T	B15 0-0.5	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019761/T	B14 0.5-1	Beadon Creak Capital Dredging ELUTRIATE 04/12/12
W12/019762	SEAWATER	Beadon Creak Capital Dredging ELUTRIATE 05/12/12

Lab Reg No.		W12/019760/T	W12/019761/T	W12/019762		
Sample Reference	Units	B15 0-0.5	B14 0.5-1	SEAWATER		Method
Organotins						
Monobutyltin as Sn	ng/L	< 2	< 2	< 2		NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	< 2		NR_35
Tributyltin as Sn	ng/L	< 2	< 2	< 2		NR_35
Surrogate: Tripropyltin	%REC	91	88	108		NR_35
Dates						
Date extracted		18-DEC-2012	18-DEC-2012	18-DEC-2012		
Date analysed		20-DEC-2012	20-DEC-2012	20-DEC-2012		

W12/019762
Trace level monobutyltin detected in this sample.

Danny Slee, Section Manager
Organics - NSW
Accreditation No. 198

21-DEC-2012

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

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This Report supersedes reports: RN950362

Acid Base Accounting for Chromium Suite Analyses

Net Acidity = Potential Sulfidic Acidity + Actual Acidity + Retained Acidity - measured ANC_{bt}/ Fineness Factor

Liming Rate = Net Acidity * Safety Factor * Soil Density

A typical Fineness Factor is 1.5 | A typical Safety Factor is 1.5 | Normal Soil Bulk Density Range is from 0.7 to 2.0 Peat can be 0.2 | Super-fine Agricultural Lime used in calculation

Note (1) : The S_{NAS} results (Retained Acidity) are multiplied by a factor of 0.75 when calculating the Net Acidity (to convert jarositic sulfur to an equivalent pyrite sulfur value)

Note (2) : A factor of 100/ 96 is applied to the Liming Rate (to account for the pure $CaCO_3$ neutralising value of 100 compared to that of agricultural lime of 96)

		ANC_{bt}	Scr	TAA	S_{NAS} (Calc)					Soil	Soil
NMI Lab Number	Client Sample Number	Acid Neutralising Capacity back titration	Potential Sulfidic Acidity	Actual Acidity	Retained Acidity	Net Acidity	Net Acidity	Fineness Factor	Safety Factor	Bulk Density	Liming Rate for Ag Lime
Units		% $CaCO_3$	% S	mol H^+/ t	% S	as % S	as mol H^+/ t			t/ m^3	kg $CaCO_3$/ t
Limit of Reporting		<0.05	<0.01	<1	<0.01						
W12/019740	B1 0-0.5_a		0.03	<1		0.03	19	1.5	1.5	1.0	1.5
W12/019740-d	B1 0-0.5_a		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019741	B1 0-0.5_b		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019742	B2 0-0.5		<0.01	<1		0.00	0	1.5	1.5	1.0	0.0
W12/019743	B3 0-0.6		0.01	<1		0.01	6	1.5	1.5	1.0	0.5
W12/019744	B4 0-0.7		0.01	<1		0.01	6	1.5	1.5	1.0	0.5
W12/019745	B5 0-0.8		0.01	<1		0.01	6	1.5	1.5	1.0	0.5
W12/019746	B6 0-0.9		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019747	B7 0-0.10		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019748	B8 0-0.11		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019749	B9 0-0.5_1		0.03	<1		0.03	19	1.5	1.5	1.0	1.5
W12/019750	B9 0-0.5_2		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019750-d	B9 0-0.5_2		0.03	<1		0.03	19	1.5	1.5	1.0	1.5
W12/019751	B9 0-0.5_3		0.03	<1		0.03	19	1.5	1.5	1.0	1.5
W12/019752	B10 0-0.5		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019753	B11 0-0.5	6.8	0.04	<1		-1.41	-881	1.5	1.5	1.0	-68.9
W12/019754	B11 0.5-1		0.02	<1		0.02	12	1.5	1.5	1.0	1.0
W12/019755	B11 1-1.5		0.02	<1		0.02	12	1.5	1.5	1.0	1.0

REPORT OF ANALYSIS

Report No. RN953552

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/130102
	LEVEL 1	Quote No.	: QT-01898
	353 CAMBRIDGE STREET	Order No.	:
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 2-JAN-2013
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/019747/1	B7 0-0.5	Beadon Creek Onslow MARINE SEDIMENT 05/12/12

Lab Reg No.	Units	W12/019747/1				Method
Sample Reference		B7 0-0.5				
Organotins						
Monobutyltin as Sn	ng/g	< 0.5				NR_35
Dibutyltin as Sn	ng/g	0.87				NR_35
Tributyltin as Sn	ng/g	23				NR_35
Surrogate: Tripropyltin	%REC	56				NR_35
Dates						
Date extracted		7-JAN-2013				
Date analysed		12-JAN-2013				

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

23-JAN-2013

All results (except moisture) are expressed on a dry weight basis. Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

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REPORT OF ANALYSIS

This Report supersedes reports: RN953410

PO Box 1246 Bentley DC WA 6983 Tel: +61 8 9368 8400 Fax: +61 8 9368 8499 www.measurement.gov.au

REPORT OF ANALYSIS

Report No. RN954067

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26_W/130102
	LEVEL 1	Quote No.	: QT-01898
	353 CAMBRIDGE STREET	Order No.	:
	WEMBLEY WA 6913	Date Sampled	: 5-DEC-2012
		Date Received	: 2-JAN-2013
Attention	: KATHARINE COX	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: KOON-BAY HO	Phone	: (08) 9368 8460

Lab Reg No.	Sample Ref	Sample Description
W12/0197471T	B7 0-0.5	Beadon Creek Onslow SEDIMENT ELUTRIATE 05/12/12

Lab Reg No.	Units	W12/0197471T				Method
Sample Reference		B7 0-0.5				
Organotins						
Monobutyltin as Sn	ng/L	3.9				NR_35
Dibutyltin as Sn	ng/L	22				NR_35
Tributyltin as Sn	ng/L	210				NR_35
Surrogate: Tripropyltin	%REC	98				NR_35
Dates						
Date extracted		22-JAN-2013				
Date analysed		25-JAN-2013				

W12/0197471T
1 part sediment was leached with 4 parts elutriate water.

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

25-JAN-2013

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

REPORT OF ANALYSIS

This Report supersedes reports: RN953988

REPORT OF ANALYSIS

Report No. RN954378

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000025	B4 0.5-1	SOIL BEADON CREEK CAPITAL DREDGING
W13/000026	B4 1-1.5	SOIL BEADON CREEK CAPITAL DREDGING
W13/000027	B4 1.5-2	SOIL BEADON CREEK CAPITAL DREDGING
W13/000028	B7 0.5-1	SOIL BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000025	W13/000026	W13/000027	W13/000028	
Sample Reference	Units	B4 0.5-1	B4 1-1.5	B4 1.5-2	B7 0.5-1	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	3.7	NR_35
Surrogate: Tripropyltin	%REC	116	113	105	106	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

Lab Reg No.		W13/000025	W13/000026	W13/000027	W13/000028	
Sample Reference	Units	B4 0.5-1	B4 1-1.5	B4 1.5-2	B7 0.5-1	Method
Trace Elements						
Total Solids	%	84.2	81.2	81.5	71.5	NT2_49

REPORT OF ANALYSIS

Report No. RN954378

Lab Reg No.		W13/000025	W13/000026	W13/000027	W13/000028	
Sample Reference	Units	B4 0.5-1	B4 1-1.5	B4 1.5-2	B7 0.5-1	Method

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

30-JAN-2013

REPORT OF ANALYSIS

Report No. RN954378

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000029	B7 1-1.5	SOIL BEADON CREEK CAPITAL DREDGING
W13/000030	B7 1.5-2	SOIL BEADON CREEK CAPITAL DREDGING
W13/000031	B7 2-2.5	SOIL BEADON CREEK CAPITAL DREDGING
W13/000032	B7 2.5-3	SOIL BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000029	W13/000030	W13/000031	W13/000032	
Sample Reference	Units	B7 1-1.5	B7 1.5-2	B7 2-2.5	B7 2.5-3	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Surrogate: Tripropyltin	%REC	105	119	111	112	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

Lab Reg No.		W13/000029	W13/000030	W13/000031	W13/000032	
Sample Reference	Units	B7 1-1.5	B7 1.5-2	B7 2-2.5	B7 2.5-3	Method
Trace Elements						
Total Solids	%	82.1	83.7	82.0	81.9	NT2_49

REPORT OF ANALYSIS

Lab Reg No.		W13/000029	W13/000030	W13/000031	W13/000032	
Sample Reference	Units	B7 1-1.5	B7 1.5-2	B7 2-2.5	B7 2.5-3	Method

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

30-JAN-2013

REPORT OF ANALYSIS

Report No. RN954378

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000033	B8 0.5-1	SOIL BEADON CREEK CAPITAL DREDGING
W13/000034	B9 0.5-1	SOIL BEADON CREEK CAPITAL DREDGING
W13/000035	B9 1-1.5	SOIL BEADON CREEK CAPITAL DREDGING
W13/000036	B9 1.5-2	SOIL BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000033	W13/000034	W13/000035	W13/000036	
Sample Reference	Units	B8 0.5-1	B9 0.5-1	B9 1-1.5	B9 1.5-2	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	< 0.5	0.56	< 0.5	< 0.5	NR_35
Tributyltin as Sn	ng/g	< 0.5	1.6	0.82	< 0.5	NR_35
Surrogate: Tripropyltin	%REC	107	113	105	108	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

Lab Reg No.		W13/000033	W13/000034	W13/000035	W13/000036	
Sample Reference	Units	B8 0.5-1	B9 0.5-1	B9 1-1.5	B9 1.5-2	Method
Trace Elements						
Total Solids	%	79.3	81.7	83.7	71.5	NT2_49

REPORT OF ANALYSIS

Lab Reg No.		W13/000033	W13/000034	W13/000035	W13/000036	
Sample Reference	Units	B8 0.5-1	B9 0.5-1	B9 1-1.5	B9 1.5-2	Method

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

30-JAN-2013

All results are expressed on a dry weight basis. This report supersedes RN954018.Amendment of sample description.

This Report supersedes reports: RN953743 RN954002
RN954018

REPORT OF ANALYSIS

Report No. RN954380

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000025/T	B4 0.5-1	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000026/T	B4 1-1.5	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000027/T	B4 1.5-2	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000028/T	B7 0.5-1	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000025/T	W13/000026/T	W13/000027/T	W13/000028/T	
Sample Reference	Units	B4 0.5-1	B4 1-1.5	B4 1.5-2	B7 0.5-1	Method
Organotins						
Monobutyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Tributyltin as Sn	ng/L	3.0	< 2	< 2	< 2	NR_35
Surrogate: Tripropyltin	%REC	84	85	82	82	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

W13/000025/T
to
W13/000036/T

1 part sediment was leached with 4 parts elutriate water.

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

REPORT OF ANALYSIS

Report No. RN954380

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000029/T	B7 1-1.5	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000030/T	B7 1.5-2	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000031/T	B7 2-2.5	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000032/T	B7 2.5-3	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000029/T	W13/000030/T	W13/000031/T	W13/000032/T	
Sample Reference	Units	B7 1-1.5	B7 1.5-2	B7 2-2.5	B7 2.5-3	Method
Organotins						
Monobutyltin as Sn	ng/L	< 2	< 2	< 2	2.2	NR_35
Dibutyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Tributyltin as Sn	ng/L	< 2	< 2	< 2	< 2	NR_35
Surrogate: Tripropyltin	%REC	83	83	83	97	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

REPORT OF ANALYSIS

Report No. RN954380

Client	: OCEANICA CONSULTING PTY LTD	Job No.	: OCEA26/130104
	LEVEL 1	Quote No.	: QT-01672
	353 CAMBRIDGE STREET	Order No.	: 365_004
	WEMBLEY WA 6913	Date Sampled	: 4-JAN-2013
		Date Received	: 4-JAN-2013
Attention	: KATHERINE COX	Sampled By	: CLIENT
Project Name	: BEADON CREEK		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W13/000033/T	B8 0.5-1	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000034/T	B9 0.5-1	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000035/T	B9 1-1.5	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING
W13/000036/T	B9 1.5-2	SOIL ELUTRIATE BEADON CREEK CAPITAL DREDGING

Lab Reg No.		W13/000033/T	W13/000034/T	W13/000035/T	W13/000036/T	
Sample Reference	Units	B8 0.5-1	B9 0.5-1	B9 1-1.5	B9 1.5-2	Method
Organotins						
Monobutyltin as Sn	ng/L	< 2	2.5	2.4	3.5	NR_35
Dibutyltin as Sn	ng/L	< 2	2.4	17	< 2	NR_35
Tributyltin as Sn	ng/L	< 2	2.4	26	< 2	NR_35
Surrogate: Tripropyltin	%REC	91	114	100	92	NR_35
Dates						
Date extracted		14-JAN-2013	14-JAN-2013	14-JAN-2013	14-JAN-2013	
Date analysed		24-JAN-2013	24-JAN-2013	24-JAN-2013	24-JAN-2013	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

30-JAN-2013

This report supersedes RN954349.Amendment of sample description.

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

Accredited for compliance with ISO/IEC 17025.
This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

REPORT OF ANALYSIS

This Report supersedes reports: RN954347
RN954349

105 Delhi Road, North Ryde NSW 2113 Tel: +61 2 9449 0111 Fax: +61 2 9449 1653 www.measurement.gov.au

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: OCEANICA CONSULTING

NMI QA Report No: OCEA26_W/121207 QA **Sample Matrix:** Sediment

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix spk
		mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
Inorganics Section				**W12/019761**				**W12/019761**
Carbon - Total Organic	NW_S15	100	<100	910	990	8.4	90	80
Inorganics Section				**W12/019755**				**W12/019755**
Carbon - Total	NW_S15	100	<100	14000	NA	NA	83	91

Filename = K:\RESIDUES\A_TPH_BX\ESDAT\

Legend
Acceptable recovery is 80-120%.
Acceptable RPDs on duplicates is 40% at >5 times LOR. Greater RPD may be expected at <5 LOR.
LOR = Limit Of Reporting
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
ND = Not Determined
NA = Not Applicable

Comments
This report shall not be reproduced except in full.
Results greater than ten times LOR have been rounded to two significant figures.

Signed:

Dr Michael Wu
Inorganics Manager, NMI-Pymble

Date: **21/12/2012**

Australian Government

National Measurement Institute

ORGANIC QUALITY ASSURANCE REPORT

NMI Job No: OCEA26_W/121207

Sample Matrix: **Solid**

			Sample Duplicates			LCS	Matrix	Extracted *
Analyte	**LOR**	**Blank**	**Sample**	**Duplicate**	**RPD**	**Recovery**	**Spike**	**within**
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**%**	**%**	**%**	**holding time**
BTEX			**W12/019740**				**W12/019744**	
Benzene	0.20	<0.20	-	-	-	109%	110%	✓
Toluene	0.20	<0.20	-	-	-	103%	105%	✓
Ethylbenzene	0.20	<0.20	-	-	-	105%	109%	✓
Xylene	0.40	<0.40	-	-	-	103%	107%	✓
TPH								
TPH C6-C9	25	<25	<25	<25	-	104%	102%	✓
TPH C10-C14	50	<50	<50	<50	-	103%	108%	✓
TPH C15-C28	100	<100	<100	<100	-	100%	109%	✓
TPH C29-C36	100	<100	<100	<100	-	103%	108%	✓

	Sample Duplicates			Sample Duplicates		
Analyte	**Sample**	**Duplicate**	**RPD**	**Sample**	**Duplicate**	**RPD**
	mg/kg	**mg/kg**	**%**	**mg/kg**	**mg/kg**	**%**
BTEX	**W12/019750**			**W12/019760**		
Benzene	-	-	-	<0.20	<0.20	-
Toluene	-	-	-	<0.20	<0.20	-
Ethylbenzene	-	-	-	<0.20	<0.20	-
Xylene	-	-	-	<0.40	<0.40	-
TPH						
TPH C6-C9	<25	<25	-	<25	<25	-
TPH C10-C14	<50	<50	-	<50	<50	-
TPH C15-C28	<100	<100	-	<100	<100	-
TPH C29-C36	<100	<100	-	<100	<100	-

	BTEX	TPH C6-C9	TPH C10 - C36
Spike criteria	70 - 130%	70 - 130%	50 - 150%
Acceptable duplicate RPD	60%	60%	60%
Method used	WL 230	WL 230	WL 230
Holding time	14 days	14 days	14 days

Results expressed in percentage (%) or mg/kg wherever appropriate on dry weight basis.
RPD = Relative Percentage Difference.
' - ' = Not Applicable.
* Applies to all samples in the job.

Signed: KBHo

Koon-Bay Ho
Organic Chemistry

Date: **14/12/2012**

Australian Government
National Measurement Institute

ORGANIC QUALITY ASSURANCE REPORT

NMI Job No: OCEA26_W/121207

Sample Matrix **Solid**

			Sample Duplicates			LCS	Matrix	Acceptable	Extracted *
Analyte	**LOR**	**Blank**	**Sample**	**Duplicate**	**RPD**	**Recovery**	**Spike**	**Spike**	**within**
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**%**	**%**	**%**	**Recovery %**	**holding time**
PAHs		**W12/019740**				**W12/019744**			
Naphthalene	0.01	<0.01	<0.01	<0.01	-	101%	98%	21 - 133	✓
Acenaphthylene	0.01	<0.01	<0.01	<0.01	-	-	-	47 - 145	✓
Acenaphthene	0.01	<0.01	<0.01	<0.01	-	-	-	33 - 145	✓
Fluorene	0.01	<0.01	<0.01	<0.01	-	97%	97%	59 - 121	✓
Phenanthrene	0.01	<0.01	<0.01	<0.01	-	95%	95%	54 - 120	✓
Anthracene	0.01	<0.01	<0.01	<0.01	-	82%	85%	27 - 133	✓
Fluoranthene	0.01	<0.01	<0.01	<0.01	-	-	-	26 - 137	✓
Pyrene	0.01	<0.01	<0.01	<0.01	-	-	-	52 - 115	✓
Benz[a]anthracene	0.01	<0.01	<0.01	<0.01	-	85%	85%	33 - 143	✓
Chrysene	0.01	<0.01	<0.01	<0.01	-	92%	89%	17 - 168	✓
Benzo[b+k]fluoranthene	0.02	<0.02	<0.02	<0.02	-	-	-	11 - 162	✓
Benzo[a]pyrene	0.01	<0.01	<0.01	<0.01	-	96%	87%	17 - 163	✓
Indeno[1,2,3-c,d]pyrene	0.01	<0.01	<0.01	<0.01	-	-	-	1 - 171	✓
Dibenz[a,h]anthracene	0.01	<0.01	<0.01	<0.01	-	102%	93%	1 - 227	✓
Benzo[g,h,i]perylene	0.01	<0.01	<0.01	<0.01	-	-	-	1 - 219	✓

	Sample Duplicates			Sample Duplicates		
Analyte	**Sample**	**Duplicate**	**RPD**	**Sample**	**Duplicate**	**RPD**
	mg/kg	**mg/kg**	**%**	**mg/kg**	**mg/kg**	**%**
PAHs	**W12/019750**			**W12/019760**		
Naphthalene	<0.01	<0.01	-	<0.01	<0.01	-
Acenaphthylene	<0.01	<0.01	-	<0.01	<0.01	-
Acenaphthene	**0.02**	**0.03**	34	<0.01	<0.01	-
Fluorene	**0.02**	**0.03**	19	<0.01	<0.01	-
Phenanthrene	**0.42**	**0.45**	7	<0.01	<0.01	-
Anthracene	**0.09**	**0.09**	0	<0.01	<0.01	-
Fluoranthene	**0.77**	**0.81**	5	<0.01	<0.01	-
Pyrene	**0.61**	**0.66**	8	<0.01	<0.01	-
Benz[a]anthracene	**0.25**	**0.22**	13	<0.01	<0.01	-
Chrysene	**0.21**	**0.21**	0	<0.01	<0.01	-
Benzo[b+k]fluoranthene	**0.35**	**0.34**	3	<0.02	<0.02	-
Benzo[a]pyrene	**0.22**	**0.21**	5	<0.01	<0.01	-
Indeno[1,2,3-c,d]pyrene	**0.10**	**0.10**	0	<0.01	<0.01	-
Dibenz[a,h]anthracene	**0.02**	**0.03**	15	<0.01	<0.01	-
Benzo[g,h,i]perylene	**0.10**	**0.11**	10	<0.01	<0.01	-

Spike criteria as per USEPA method 8270B (noted above).
Acceptable duplicate RPD 60%
Method used WL 206
Holding time 14 days

Results expressed in percentage (%) or mg/kg wherever appropriate on dry weight basis.
RPD = Relative Percentage Difference.
' - ' = Not Applicable.
* Applies to all samples in the job.

Signed: KBHo
Koon-Bay Ho
Organic Chemistry
Date: **14/12/2012**

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: OCEANICA CONSULTING PTY LTD

NMI QA Report No: OCEA26_W/121207 **Sample Matrix:** Solid

Analyte	Method	LOR	Blank	Sample Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ng/g	ng/g	ng/g	ng/g	%	%	%
Organics Section								
Organotin				**W12/019747**				**W12/019747**
Monobutyltin	NR_35	0.5	<0.5	<0.5	<0.5	-	74	80
Dibutyltin	NR_35	0.5	<0.5	5.1	4.0	24	77	53
Tributyltin	NR_35	0.5	<0.5	84	100	17	95	100
Organotin Surrogate								
Tripropyltin (%Rec)	NR_35	-	-	133	122	8.6	99	70

Results expressed in percentage (%) or ng/g wherever appropriate.
Acceptable Spike recovery is 30-150% (monobutyltin and Tripropyltin); 40-160% (dibutyltin and tributyltin)
Maximum acceptable RPDs on spikes and duplicates is 60%.
'NA ' = Not Applicable.
RPD= Relative Percentage Difference, LCS = Laboratory Control Spike, LOR = Limit of Reporting.
This report shall not be reproduced except in full.

Signed:

Danny Slee
Organics Manager, NMI-North Ryde

Date: **21/12/2012**

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: OCEANICA CONSULTING PTY LTD

NMI QA Report No: OCEA26_W/121207 **Sample Matrix:** Solid

Analyte	Method	LOR	Blank	Sample Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ng/g	ng/g	ng/g	ng/g	%	%	%
Organics Section								
Organotin				**W12/019757**				**W12/019757**
Monobutyltin	NR_35	0.5	<0.5	<0.5	<0.5	-	90	120
Dibutyltin	NR_35	0.5	<0.5	0.54	0.5	5.7	100	127
Tributyltin	NR_35	0.5	<0.5	0.73	0.72	1.4	100	95
Organotin Surrogate								
Tripropyltin (%Rec)	NR_35	-	-	124	118	8.6	95	122

Results expressed in percentage (%) or ng/g wherever appropriate.
Acceptable Spike recovery is 30-150% (monobutyltin and Tripropyltin); 40-160% (dibutyltin and tributyltin)
Maximum acceptable RPDs on spikes and duplicates is 60%.
'NA ' = Not Applicable.
RPD= Relative Percentage Difference, LCS = Laboratory Control Spike, LOR = Limit of Reporting.
This report shall not be reproduced except in full.

Signed:

Danny Slee
Organics Manager, NMI-North Ryde

Date: **21/12/2012**

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: OCEANICA CONSULTING PTY LTD

NMI QA Report No: OCEA26_W/121207-1 **Sample Matrix:** Liquid

Analyte	Method	LOR	Blank	Sample Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ng/L	ng/L	ng/L	ng/L	%	%	%
Organics Section								
Organotin								
Monobutyltin	NR_35	2	<2	NA	NA	NA	107	NA
Dibutyltin	NR_35	2	<2	NA	NA	NA	109	NA
Tributyltin	NR_35	2	<2	NA	NA	NA	101	NA
Organotin Surrogate								
Tripropyltin (%Rec)	NR_35	-	-	NA	NA	NA	108	NA

Results expressed in percentage (%) or ng/L wherever appropriate.
Acceptable Spike recovery is 30-150% (monobutyltin and Tripropyltin); 40-160% (dibutyltin and tributyltin).
Maximum acceptable RPDs on spikes and duplicates is 60%.
'NA ' = Not Applicable.
RPD= Relative Percentage Difference, LCS = Laboratory Control Spike, LOR = Limit of Reporting.
This report shall not be reproduced except in full.

Signed:

Danny Slee
Organics Manager, NMI-North Ryde

Date: **21/12/2012**

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: OCEANICA CONSULTING PTY LTD

NMI QA Report No: OCEA26_W/121207-1 **Sample Matrix:** Liquid

Analyte	Method	LOR	Blank	Sample Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ng/L	ng/L	ng/L	ng/L	%	%	%
Organics Section								
Organotin								
Monobutyltin	NR_35	2	<2	NA	NA	NA	79	NA
Dibutyltin	NR_35	2	<2	NA	NA	NA	96	NA
Tributyltin	NR_35	2	<2	NA	NA	NA	89	NA
Organotin Surrogate								
Tripropyltin (%Rec)	NR_35	-	-	NA	NA	NA	89	NA

Results expressed in percentage (%) or ng/L wherever appropriate.
Acceptable Spike recovery is 30-150% (monobutyltin and Tripropyltin); 40-160% (dibutyltin and tributyltin).
Maximum acceptable RPDs on spikes and duplicates is 60%.
'NA ' = Not Applicable.
RPD= Relative Percentage Difference, LCS = Laboratory Control Spike, LOR = Limit of Reporting.
This report shall not be reproduced except in full.

Signed:

Danny Slee
Organics Manager, NMI-North Ryde

Date: **21/12/2012**

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

OCEANICA CONSULTING

Level 1
353 Cambridge Street
WEMBLEY 6014

Attention: Katharine Cox

NMI Job No: OCEA26_W/121207
Sample Matrix: Soil
Sample LRN Range: W12/019740 - 019761

Analyte	LOR	Blank	Units	LRN	Duplicate	LRN	Duplicate	LRN	Duplicate	Recovery	Acceptability
				W12/019740	D	W12/019750	D	W12/019760	D	%	Limits
ANC bt as CaCO3	0.05	N/A	%	-	-	-	-	9	8.5	95 %	95 - 105
pH kcl	-	-	-	9.6	9.6	9.5	9.5	9.3	9.3	100 %	-
Scr	0.01	N/A	%	0.03	0.02	0.02	0.02	0.13	0.13	100 %	80 - 120

Signed: **David Lynch**
Senior Environmental Chemist
NMI WA, Inorganic Section

Date: **17/12/2012**

Appendix F

Memorandum: TBT contamination in Beadon Creek, Onslow

oceanica
marine & coastal specialists

353 Cambridge Street, Wembley PO Box 462, Wembley, Western Australia 6913
Tel: +61 8 6272 0000 Fax: +61 8 6272 0099 oceanica@oceanica.com.au ABN: 89 093 752 811

Arvid Hogstrom
Regional Manager
Exmouth District
20 Nimitz Street Exmouth
PO Box 201 Exmouth 6707

11/06/2013
Project No.: 365_004

To Mr Hogstrom,

SEDIMENT SAMPLING AT BEADON CREEK, ONSLOW

The Department of Transport (DoT) is proposing to upgrade the facilities in Beadon Creek, Onslow, to support the growing demand for land at the facility. The upgrade works include capital dredging of a berth pocket and turning basin immediately west of the existing channel. The dredged material will be used to create an additional land-backed wharf immediately north of the existing lots. This proposal will be referred to the Office of Environmental Protection Authority (OEPA) and to support this referral a Dredging Environmental Impact Assessment (DEIA) has been prepared.

During the sediment sampling and analysis that was undertaken as part of the DEIA, sediments containing high concentrations of tributyltin (TBT) were found in a small proportion of the samples collected. On behalf of DoT, Oceanica Consulting Pty Ltd has prepared a memorandum which details the nature of this TBT contamination that is being provided to the Department of Environment and Conservation for their information. Also detailed in the attached memorandum are the environmental management measures undertaken by the DoT in response to the TBT contamination, and the proposed management measures to be undertaken during the capital dredging to minimise the risk of releasing TBT into the marine environment.

If you have any queries regarding this matter, please do not hesitate to contact the undersigned on (08) 6272 0000.

Regards,

Katharine Cox
Oceanographer
Oceanica Consulting Pty Ltd

oceanica
marine & coastal specialists

353 Cambridge Street, Wembley PO Box 462, Wembley, Western Australia 6913
Tel: +61 8 6272 0000 Fax: +61 8 6272 0099 oceanica@oceanica.com.au ABN: 89 093 752 811

MEMORANDUM

ATTN:	Arvid Hogstrom	**CC:**	Joel Bailey, Peter Wilkins
ORGANISATION:	DEC Exmouth	**FROM:**	Katharine Cox/Sarah Marshman
PROJECT NO:	365_01_004	**DATE:**	11 June 2013
SUBJECT:	Summary of environmental management measures undertaken at Beadon Creek, Onslow in relation to tributyltin contamination		

Introduction

Sediment sampling in Beadon Creek, Onslow, was undertaken on 4–5 December 2012 in anticipation of proposed capital dredging of berth pockets and a turning basin immediately west of the existing navigation channel. The dredged material is proposed to be used to create an additional land-backed wharf immediately north of the existing lots. Sample collection and analysis was undertaken in accordance with the National Assessment Guidelines for Dredging—NAGD (CA 2009) and the Department of Transport (DoT) Environmental Management Framework—EMF (Oceanica 2012a). These documents contain guidelines for dredging and detail the sediment screening levels and trigger values for contaminants based on the ANZECC/ARMCANZ (2000) Interim Sediment Quality Guideline (ISQG) and the ANZECC/ARMCANZ (2000) water quality guidelines. The proposed capital dredging works will be referred to the Office of the Environmental Protection Authority (OEPA) for assessment.

The tributyltin (TBT) results from the December 2012 sediment sampling program are presented in this document. This document also includes an interpretation of the observed TBT exceedances and outlines environmental management measures to mitigate the potential release of TBT into the marine environment.

Tributyltin (TBT)

TBT is the most common group of organotin compounds which have had widespread usage in marine antifoulant paints (ANZECC/ARMCANZ 2000). TBT compounds are generally not very soluble in seawater but TBT tends to bind strongly to particulate matter and therefore accumulates in sediments. TBT biodegrades rapidly in seawater (within hours) but this degradation is much slower (years) in sediments. The degradation products of TBT (dibutyltin and monobutyltin) have a much lower toxicity than TBT (ANZECC/ARMCANZ 2000).

TBT compounds have been used in antifoulant paints since the early 1960s. In 2008 the International Maritime Organisation introduced a complete worldwide ban on the use of organotin antifoulant paints.

Toxic effects of TBT

TBT is the most toxic of all organotin compounds to aquatic organisms (Daly & Fabris 1993). At extremely low concentrations (0.4–0.8 ng.Sn/L) TBT can cause acute (short-term) and chronic (long-term) poisoning of non-target species. Gastropod molluscs are amongst the most sensitive marine organisms to TBT; however elevated TBT concentrations can also affect a wide range of organisms including algae, zooplankton, molluscs, fish larvae (Hoch 2001) and even marine mammals.

Sediment sampling

To characterise the proposed dredge material, sediment cores were taken from 15 randomly-distributed sites (Oceanica 2012b) (Figure 1). Further details on sample collection methods and laboratory results are documented in the sediment sampling and analysis plan (Oceanica 2012b) and the dredging environmental impact assessment (DEIA) (Oceanica DRAFT 2013).

Laboratory results

The total TBT[1] concentrations from one sample of the sediment surface (at Site B4—Figure 1) exceeded the NAGD Screening Level of 9 µg/kg. Two samples of the surface sediments (at Sites B7 and B9—Figure 1) had very high TBT concentrations (420 and 140 µg/kg, respectively) which exceeded both the Screening Level (9 µg/kg) and the ISQG-High Value (70 µg/kg) (refer to the Appendix for all results).

To examine the potential for release of contaminants from the sediment during dredging and disposal, elutriate[2] analysis was also undertaken. The elutriate TBT concentration from surface sample at Site B4 (12 ng/L) was below the ANZECC/ARMCANZ (2000) 90% species protection trigger value for toxicants (20 ng/L) and therefore does not contain bioavailable TBT at levels of concern. However, the elutriate TBT concentration in the surface samples at Sites B7 and B9 were both high (1600 and 24 ng/L, respectively) and exceeded the ANZECC/ARMCANZ (2000) 90% species protection trigger values for toxicants.

Following the analysis of these results and in accordance with the Department of Transport's maintenance dredging Environmental Management Framework (Oceanica 2012a), the deeper samples from these three sites (B4, B7, B9) were analysed for total and elutriate TBT. In addition, a second split of the surface sample with the highest TBT concentration (at Site B7) was also analysed. The analysis of the deeper samples indicated that at Site B7, TBT concentrations exceeding the NAGD Screening Levels were found to extend to 1 m depth below the seabed, but the sediments below this had TBT concentrations below the laboratory limit of reporting (0.05 µg/kg). At Sites B4 and B9, TBT concentrations of the deeper sediments were all below the Screening Level. The reanalysed TBT concentration of the surface sample at Site B7 still exceeded the NAGD Screening Levels although the concentration (115 µg/kg) was much less than that found in the initial analysis (refer to the Appendix for all results).

Elutriate TBT of the deeper samples showed that only the 1–1.5 m depth interval at Site B9 exceeded the ANZECC/ARMCANZ (2000) 90% species protection trigger values. The total TBT concentration for this depth interval was, however, below the NAGD Screening Level, indicating that elevated the TBT concentration was not widespread throughout this sample.

---

1 *Total TBT refers to the TBT contained (and bound) in the sediment.*

2 *Elutriate analysis is required where the dredge material data exceeds the NAGD Screening Level. The elutriate test is designed to simulate the release of contaminants from a sediment during dredge material disposal. The elutriate test is carried out by shaking the sediment samples with four times the volume of seawater from the disposal site. The water is then tested for the contaminant in question (CA 2009).*

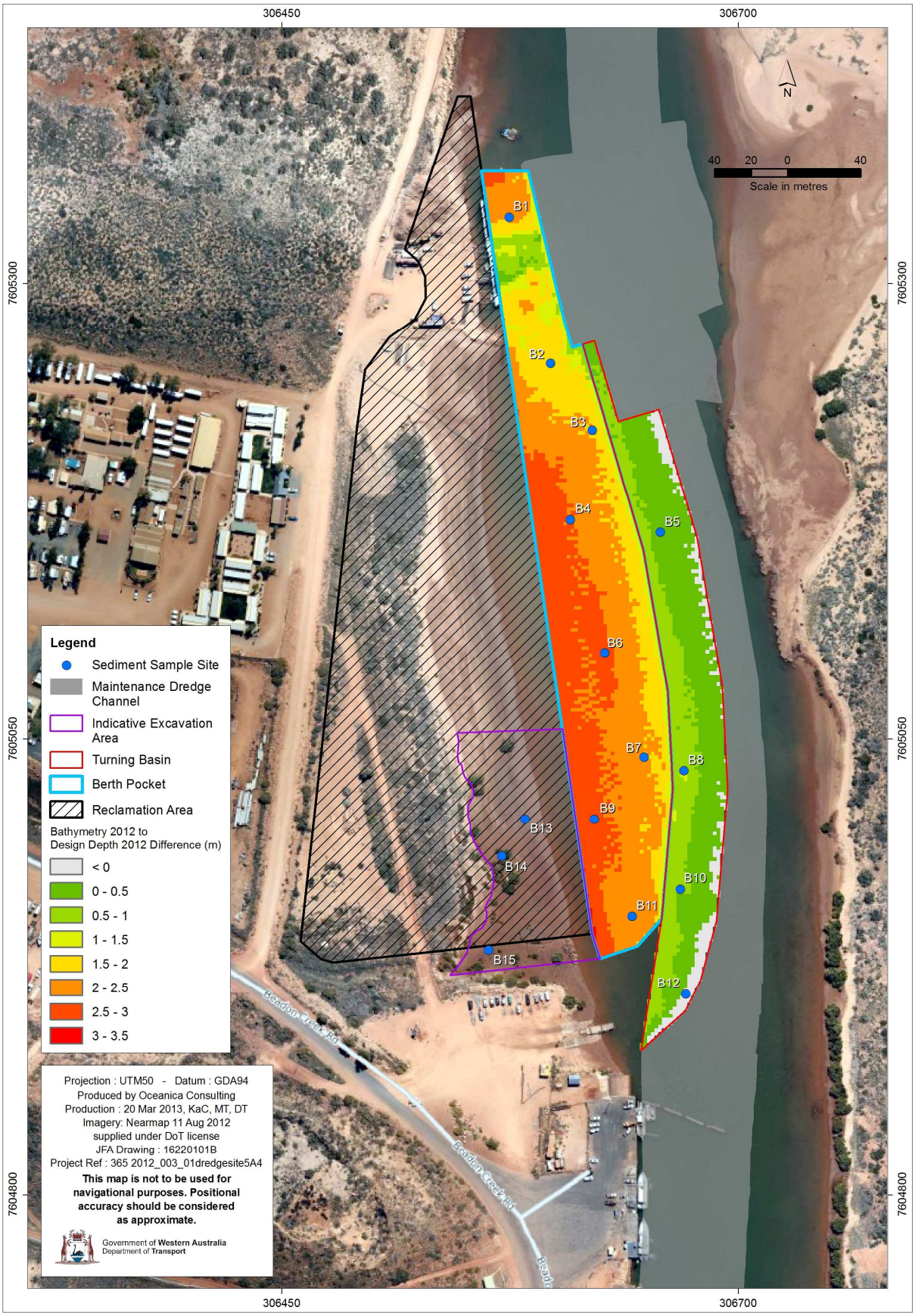

Figure 1 Sediment sampling sites at Beadon Creek on 4-5 December 2012

Interpretation of results

The majority (26) of the sediment samples analysed (30) showed total TBT values below the NAGD screening level. However, there was an isolated area, around Sites B4, B7 and B9, where elevated total TBT levels were observed in Beadon Creek; this contamination was limited to the surface 1 m of sediments at Site B7 and the surface 0.5 m of sediments at Sites B4 and B9.

Only the elutriate TBT concentrations in the surface 0.5 m of sediment at Sites B7 and B9 exceeded the 90% species protection level, and therefore contain bioavailable TBT at levels of potential concern. These surface sediments (at Sites B7 and B9) represent approximately 3.5% of the total volume of sediments to be dredged (Figure 2) and it is appropriate that the removal of these sediments is carefully managed.

The isolated extent of contamination, and the high variability in the total TBT between the initial and follow-up analysis, are typical of TBT contamination caused by antifoulant paint flakes (CA 2009). The area of elevated TBT concentration is not connected to the shore which suggests the contamination is unlikely to have arisen from a terrestrial source (e.g. discharge from the stormwater drain). It is more likely that this contamination is associated with either a boat breaching by accident or in-water hull cleaning in the vicinity of Sites B7 and B9.

In this area of elevated TBT the concentration of monobutyltin was below detection and the concentrations of dibutyltin were relatively low. These low concentrations of the TBT breakdown products suggest that the contamination is relatively recent (within ca. two years). This is supported by previous sampling and analysis undertake in March 2009 (Oceanica 2010) which indicated low TBT concentrations in the sediments within the maintenance dredge channel sediments.

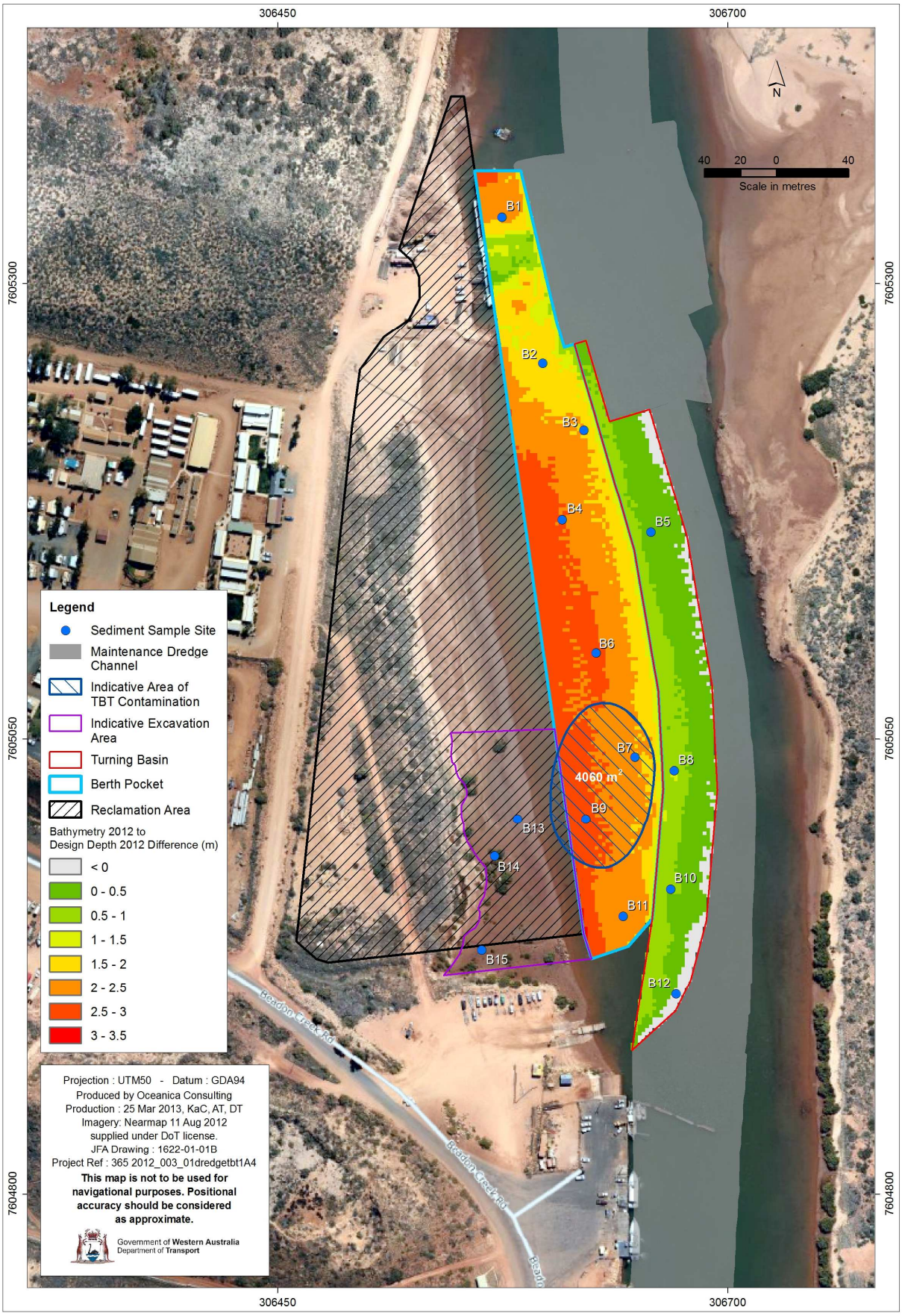

Figure 2 Indicative area of elevated TBT in Beadon Creek

Environmental management measures

The DoT is concerned about these elevated TBT concentrations and as a result has undertaken the following environmental management:

- DoT consulted with the main leasee, Chevron Australia, and advised them of the potential TBT contamination. As a result, Chevron has now included TBT considerations into their relevant environmental management plans.
- DoT has asked all of the long-term leasees at Beadon Creek, Onslow, if they have ever seen a vessel stranded on the intertidal area (where TBT contamination was found) in the last two years. All of the leasees have said that they are not aware of any such event occurring.
- DoT has deduced that the TBT contamination was probably from a vessel striking the intertidal area, this event going unnoticed by the leasees. This vessel is not thought to belong to an existing long-term leasee and the vessel has since left Beadon Creek.
- DoT has written into their procedures that anti-fouling certificates are required to be presented for each vessel that applies for a berth permit at Beadon Creek, Onslow.
- DoT has undertaken additional sediment sampling and analysis for TBT in the maintenance dredging area in front of the existing land-backed wharf prior to the final dredging phase in that area. The TBT concentrations for these sediment samples were all below the laboratory limit of reporting.

The DoT plans to request that the long-term leasees at Beadon Creek provide their historic and current certificates of anti-fouling application for their vessels. This will be an ongoing requirement, and certificates must be provided upon the application of new anti-fouling paint.

Further, it is proposed that the dredge material be disposed of to a reclamation area adjacent to the dredge area. TBT, when exposed to oxygen and ultraviolet light, degrades rapidly hence this disposal will act to effectively remediate these sediments (Fletcher & Lewis 1999, Hoch 2001). It is proposed that the surface sediments from the TBT contaminated area will be dredged first and disposed to a separately bunded and sealed area within the reclamation area. The return water from this sealed area will flow into the broader reclamation area which will also be bunded to prevent this water being discharged to the marine environment. This return water will be tested for TBT and total suspended solids three times over the period of dredging of this contaminated area (anticipated to be approximately eight days). It is hoped that this data will inform management of future dredge programs where high TBT concentrations are observed.

Once dredging of the contaminated area is complete, the remaining dredge material will be disposed of to reclamation area to cap the contaminated sediment and fill the remaining reclamation area. These environmental management and monitoring measures are detailed in the DEIA that will soon be referred to the OEPA (Oceanica DRAFT 2013).

In the event that the proposed capital dredging works do not go ahead in 2013, follow-up environmental monitoring of the TBT contamination will be undertaken by DoT. This monitoring is likely to include sediment sampling in the contaminated area and in the surrounding sediments in 1-2 years. It is not considered appropriate to undertake significant remedial action due to the expected increased boat traffic in Beadon Creek in the coming years and the understanding that the most effective way to manage contaminated marine sediment is to leave them undisturbed. The DoT will continue to liaise with existing and new leasees in Beadon Creek to ensure that no further TBT contamination occurs.

References

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Oceanica (2012a) Department of Transport Maintenance Dredging Environmental Management Framework. Prepared for the Department of Transport, Report No 179_004/2, Perth, Western Australia, September 2012

Oceanica (2012b) Beadon Creek Boat Harbour - Capital Dredging Sediment Sampling and Analysis Plan. Prepared for BMT JFA Consultants Pty Ltd by Oceanica Consulting Pty Ltd, Report No 365_003/1, Perth, Western Australia, November 2012

Oceanica (DRAFT) Beadon Creek Capital Dredging - Dredging Environmental Impact Assessment. Prepared for BMT JFA Consultants Pty Ltd by Oceanica Consulting Pty Ltd, Report No 365_01_004/1, Perth, Western Australia, March 2013

Appendix

Table 1 Total organotin concentrations in the sediment samples from Beadon Creek (initial analysis)

	Analytes			
	Raw MBT µg/kg	**Raw DBT µg/kg**	**Raw TBT µg/kg**	**Normalised TBT µg/kg[4]**
NAGD[1]	**-**	**-**	**-**	**9**
ANZECC/ARMCANZ ISQG-High[2]				**70**
Samples				
B1 0–0.5 a	<0.05	<0.05	<0.05	<0.05
B2 0–0.5	<0.05	<0.05	<0.05	<0.05
B3 0–0.5	<0.05	<0.05	<0.05	<0.05
B4 0–0.5	<0.05	1.2	2	**10**
B5 0–0.5	<0.05	<0.05	<0.05	<0.05
B6 0–0.5	<0.05	<0.05	<0.05	<0.05
B7 0–0.5	<0.05	5.1	84	**420**
B8 0–0.5	<0.05	<0.05	<0.05	<0.05
B9 0–0.5_1	<0.05	0.57	0.73	3.7
B9 0–0.5_2[3]	<0.05	0.71	1.7	8.5
B9 0–0.5_3[3]	<0.05	4.9	28	**140**
B10 0–0.5	<0.05	<0.05	0.66	3.3
B11 0–0.5	<0.05	0.64	0.64	3.2
B11 0.5–1	<0.05	<0.05	<0.05	<0.05
B11 1–1.5	<0.05	<0.05	0.6	3.0
B11 1.5–2	<0.05	<0.05	<0.05	<0.05
B12 0–0.5	<0.05	0.54	0.73	3.7
B13 0–0.5	<0.05	<0.05	<0.05	<0.05
B14 0–0.5	<0.05	<0.05	<0.05	<0.05
B14 0.5–1	<0.05	<0.05	<0.05	<0.05
B15 0–0.5	<0.05	<0.05	<0.05	<0.05

Notes:
1. NAGD screening level (CA 2009).
2. ARMCANZ/ANZECC (2000) Interim Sediment Quality Guideline-High.
3. The field triplicate samples have been included here as they were found to have TBT concentrations exceeding the NAGD screening level (CA 2009).
4. TBT results are normalised to 1% total organic carbon in accordance with the NAGD (CA 2009).
5. Exceedances of the guidelines are indicated in red.

Table 2 Elutriate organotin concentrations in the sediment samples from Beadon Creek (initial analysis)

Analytes	**Elutriate MBT ng/L**	**Elutriate DBT ng/L**	**Elutriate TBT ng/L**
ANZECC/ARMCANZ[1] - high level of protection	**-**	**-**	**4**
ANZECC/ARMCANZ[1] - moderate level of protection	**-**	**-**	**20**
B4 0–0.5	2.1	2.5	**12**
B7 0–0.5	7.3	140	**1600**
B9 0–0.5_3[3]	2.7	20	**24**

Notes:
1. ANZECC/ARMCANZ (2000) guidelines for toxicants in marine waters: 99% species protection applicable to areas of a high level of ecosystem protection applicable to Western Australian marine waters, and 90% species protection guidelines for a moderate level of ecosystem protection applicable to waters adjacent to marine facilities.
2. Exceedances of the 90% species protection guidelines are indicated in red, and exceedances of the 99% species protection guidelines are indicated in blue.

Table 3 Follow-up analysis of total organotin concentrations in the sediment samples from Beadon Creek

Analytes	Raw MBT µg/kg	Raw DBT µg/kg	Raw TBT µg/kg	Normalised TBT µg/kg[3]
NAGD[1]	**-**	**-**	**-**	**9**
ANZECC/ARMCANZ ISQG-High[2]				**70**
Site B4				
B4 0.5–1	<0.5	<0.5	<0.5	<0.5
B4 1–1.5	<0.5	<0.5	<0.5	<0.5
B4 1.5–2	<0.5	<0.5	<0.5	<0.5
Site B7				
B7 0–0.5_reanalysis	<0.5	0.87	23	**115**
B7 0.5–1	<0.5	<0.5	3.7	**18.5**
B7 1–1.5	<0.5	<0.5	<0.5	<0.5
B7 1.5–2	<0.5	<0.5	<0.5	<0.5
B7 2–2.5	<0.5	<0.5	<0.5	<0.5
B7 2.5–3	<0.5	<0.5	<0.5	<0.5
Site B9				
B9 0.5–1	<0.5	0.56	1.6	8.0
B9 1–1.5	<0.5	<0.5	0.82	4.1
B9 1.5–2	<0.5	<0.5	<0.5	<0.5

Notes:
1. NAGD Screening Level (CA 2009).
2. ARMCANZ/ANZECC (2000) Interim Sediment Quality Guideline-High.
3. TBT results are normalised to 1% total organic carbon in accordance with the NAGD (CA 2009).
4. Exceedances of the guidelines are indicated in red.

Table 4 Follow-up analysis of elutriate organotin concentrations in the sediment samples from Beadon Creek

Analytes	Elutriate MBT ng/L	Elutriate DBT ng/L	Elutriate TBT ng/L
ANZECC/ARMCANZ[1] - high protection level	**-**	**-**	**4**
ANZECC/ARMCANZ[1] - moderate protection level			**20**
Site B4			
B4 0.5–1	<2	<2	3
B4 1–1.5	<2	<2	<2
B4 1.5–2	<2	<2	<2
Site B7			
B7 0–0.5_reanalysis	3.9	22	**210**
B7 0.5–1	<2	<2	<2
B7 1–1.5	<2	<2	<2
B7 1.5–2	<2	<2	<2
B7 2–2.5	<2	<2	<2
B7 2.5–3	2.2	<2	<2
Site B9			
B9 0.5–1	2.5	2.4	2.4
B9 1–1.5	2.4	17	**26**
B9 1.5–2	3.5	<2	<2

Notes:
1. ANZECC/ARMCANZ (2000) guidelines for toxicants in marine waters: 99% species protection applicable to areas of a high level of ecosystem protection applicable to Western Australian marine waters, and 90% species protection guidelines for a moderate level of ecosystem protection applicable to waters adjacent to marine facilities.
2. Exceedances of the 90% species protection guidelines are indicated in red, and exceedances of the 99% species protection guidelines are indicated in blue.

Appendix G

Application for Amendment to the Vegetation Clearing Permit

Government of **Western Australia**
Department of **Transport**

Your ref: CPS 4495/1
Our ref: DT/11/03585/1
Enquiries: Katharine Cox
Phone: 6272 0000
Email: katharine.cox@oceanica.com.au

Manager
Native Vegetation Conservation Branch
Locked Bag 104
Bentley Delivery Centre
BENTLEY WA 6983

17 June 2013

Attention: Abbie Crawford

ONSLOW (BEADON CREEK) MARITIME FACILITY – LETTER OF AUTHORITY TO APPLY FOR AMENDMENT TO THE VEGETATION CLEARING PERMIT 4495/1

The Department of Transport (DoT) is proposing to upgrade the facilities at Beadon Creek to support the growing demand for land at the facility. The works will occur within the harbour lease boundaries and include the clearance and preparation of land on the western side of the creek (within Lot 561) for the construction of a land-backed wharf and the clearance and preparation of a site to the north of this (within Lot 3054) for car parking facilities (see figure in attached Application Form C4). In order to complete these works, the DoT require an amendment to the existing Vegetation Clearing Permit to include these sites and to extend the duration of the permit.

This letter gives authority to Oceanica Consulting Pty Ltd (Oceanica) to apply for the amendment to Vegetation Clearing Permit 4495/1 on behalf of DoT as per the attached Application Form C4.

This letter also gives authority for Oceanica, CGC Dredging Pty Ltd and other contractors of DoT to access the aforementioned land and undertake vegetation clearing pending the approval to clear vegetation. The DoT recognises that this vegetation clearing work will involve manual labour and machinery that will be coordinated by DoT's contractors.

Please do not hesitate to contact Katharine Cox from Oceanica on (08) 6272 0000 should you have any queries.

Yours sincerely,

Jason Bradford
Senior Planning Project Officer

Marine House, 1 Essex Street, Fremantle WA 6160
PO Box 402, Fremantle WA 6959
Tel: (08) 9435 7520 Fax: (08) 9435 7808 www.transport.wa.gov.au
ABN 27 285 643 255

Department of Environment and Conservation - Department of Mines and Petroleum

Application for an amendment to a clearing permit

Environmental Protection Act 1986 s 51M

FORM C4

Clearing of native vegetation is prohibited in Western Australia except where a clearing permit has been granted or an exemption applies. A person who causes or allows unauthorised clearing commits an offence.

Date stamp

Part 1 Clearing permit details

FILE REFERENCE

Permit number: CPS 4495/1

Permit holder's name as it appears on the permit: Minister for Transport

Part 2 Proposed changes

Additional information to support the assessment of your application to amend may be attached.

If you are applying on behalf of the Permit Holder, please attach your agent's authority expressly authorising you to act on behalf of the Permit Holder.

Please ensure you have included the following as part of your application:

- A completed application form that is signed and dated by the permit holder,
- A photocopy of the granted Clearing Permit, with proposed changes highlighted; and
- Payment

Please tick below the proposed change(s) to your Clearing Permit:

- [x] extend the duration of the permit;
- [ ] vary a due date of complying with a permit condition;
- [x] amend the size of the area permitted to be cleared, or remove a land parcel listed on the permit;
- [ ] correct a clerical error or make an administrative change; or
- [ ] other.

Details of proposed changes:

The Department of Transport (DoT) is proposing to prepare a site in Lot 561 (footprint: 5.15ha) and a site in Lot 3054 (footprint: 0.34ha) for building harbour service facilities (attached figure). The proposed footprints include areas of native vegetation. Permission to clear the majority of native vegetation within the site in Lot 561 has been granted under Permit number CPS 4495/1 (attached) and the DoT is seeking an amendment to the existing permit to clear the additional 0.43ha in Lot 561 adjacent to the already permitted area and the additional 0.34ha in Lot 3054 for construction. The DoT is also seeking an extension to the duration of the permit to October 2015 to allow adequate time for construction.

Part 3 Contact/Applicant details

Person with whom Department of Environment and Conservation or Department of Mines and Petroleum should liaise concerning the clearing application.

*If applying as a company or incorporated body, please also supply the registered business office address.

Given name, family name and title (Mr, Mrs, Ms, etc) **(Please print)**: Dr Katharine Cox

Position (Director, Secretary, Consultant etc): Environmental Consultant

Postal / Business address*

Postal: Oceanica
PO Box 462
Wembley WA 6913

Business: Oceanica
Level 1, 353 Cambridge Street
Wembley WA 6014

Fixed Telephone number: 08 6272 0000

Mobile telephone number:

Fax number: 08 6272 0099

Email: katharine.cox@oceanica.com.au

Part 4 Declaration & Signature

For your application to be accepted, it must be signed either on behalf of the company or as an individual.

By signing this form you are declaring that the statements on this form are true and correct. Providing false or misleading information is an offence under s112 of the *Environmental Protection Act 1986*.

Please indicate if you are signing as an individual or a company:

☐ **An individual**. For individual permit holder(s), **all landowners** must sign this form.

or

☐ **A company**. A person duly authorised to sign for an on behalf of the incorporated body or company must sign this form. If your company is required to use a common seal, you must affix this seal and have this application signed by an authorised director(s) in accordance with the Corporations Law.

Signature(s)
(1)
(2)

Date
17/6/13

Print name(s)
(1) Dr Katharine Cox
(2) Dr Bruce Hegge

Common Seal (if used)

Position
(1) Environmental Consultant
(2) Co-managing Director

Company Name and Australian Company Number (ACN)
Oceanica Consulting ABN - 89 093 752 811

Part 5 Application checklist

Additional information to assist in the assessment of your proposal may be attached to this application – e.g. reports on salinity, fauna or flora studies or other environmental reports conducted for the site could be included in electronic format and submitted on CDROM.

Please ensure you have included the following as part of your application:

REQUIRED

- ☐ A completed application form that is signed and dated by all landowners, or the applicant acting on behalf of or likely to become the landowner.
- ☐ An aerial photograph or map with a north arrow clearly identifying the areas of vegetation propose to be cleared.
- ☐ Payment

IF APPLICABLE

- ☐ If you are applying on behalf of the Permit Holder, please attach your agent's authority expressly authorising you to act on behalf of the Permit Holder.

Part 6 Lodgement

Send original applications to amend permits granted by the Department of Environment and Conservation to:

Department of Environment and Conservation
Native Vegetation Conservation Branch
Locked Bag 104, Bentley Delivery Centre, BENTLEY WA 6983

Telephone: 9219 8744

For further information: www.dec.wa.gov.au/nvc, or Email: nvp@dec.wa.gov.au

Send original applications to amend permits granted by the Department of Mines and Petroleum to:

Department of Mines and Petroleum
Native Vegetation Assessment Branch
Mineral House
100 Plain St EAST PERTH WA 6004

Telephone: 9222 3333.

For further information: www.dmp.wa.gov.au/nvabinfo

Electronic versions or facsimiles of this application form are not acceptable.
Please retain a copy of this form for your records. Incomplete applications will be returned.

CONFIDENTIAL OR COMMERCIALLY SENSITIVE INFORMATION

Information submitted as part of this application may be made publicly available. If you wish to submit information that you believe to be commercially sensitive or otherwise confidential, then you should submit that information in an appendix to this application, with a written statement of reasons why you request that each item of information be kept confidential. The Department will take reasonable steps to protect confidential or commercially sensitive information. Please note in particular that all submitted information may be the subject of an application for release under the *Freedom of Information Act 1992*. If you have any enquiries regarding the provision of relevant information as part of this application contact either the Department of Environment and Conservation or the Department of Mines and Petroleum.

If there is insufficient room on any part of this form, please continue on a separate sheet of paper and attach to this form.

Part 7 Fees

Make cheques or money orders payable to:

Department of Environment and Conservation for all clearing purposes granted by this agency.

or

Department of Mines and Petroleum for all permits granted by this agency.

Do not send cash in the mail.

Please indicate the Clearing Permit application fee that is being paid:

OFFICE USE ONLY

AREA PERMIT

- [■] $50 to alter the requirements of, or increase the area covered by an Area Permit by less than 1ha; or
- [ ] $100 to increase the area covered by an Area Permit by between 1ha and 10ha; or
- [ ] $200 to increase the area covered by an Area Permit by more than 10ha.

PURPOSE PERMIT

- [ ] $200 to alter any requirement of a Purpose Permit.

Payment method (tick applicable box):

[ ] Cheque [ ] Money Order [■] Credit Card (complete details below)

Credit Card Number

4	5	5	7	0	4	5	5	3	6	5	8	2	5	0	3

Card Holder Name

Dr Bruce Hegge

Card Type:

- [ ] Bank Card
- [ ] Master Card
- [■] Visa

Expiry Date

11/14

Signature

Contact Phone Number

08 6272 0000


306200
306700
7605700
7605200
7604700
Projection : UTM50 - Datum : GDA94
Produced by Oceanica Consulting
Production : 13 Jun 2013, KaC, WA, DT
Imagery : Nearmap 11 Aug 2012
supplied under DoT license.
Project Ref : 365 2012_004_01vegc2A4
This map is not to be used for navigational purposes. Positional accuracy should be considered as approximate.
Government of Western Australia
Department of Transport
Lot 3054
Lot 561
Lot 460
Beadon Creek Road
N
100 50 0 100
Scale in metres
Legend
Cadastre Boundary
Proposed Footprint
Existing Vegetation Clearing Permit Area
Road

GOVERNMENT OF
WESTERN AUSTRALIA

CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

PERMIT DETAILS
Area Permit Number: 4495/1
File Number: 2011/006380-1
Duration of Permit: From 3 October 2011 to 3 October 2013

PERMIT HOLDER
Minister for Transport

LAND ON WHICH CLEARING IS TO BE DONE
Lot 561 on Deposited Plan 174170 (Onslow 6710 – Reserve 30711)
Lot 460 on Deposited Plan 210532 (Onslow 6710 – Reserve 30711)

AUTHORISED ACTIVITY
The Permit Holder shall not clear more than 6 hectares of native vegetation within the area hatched yellow on attached Plan 4495/1.

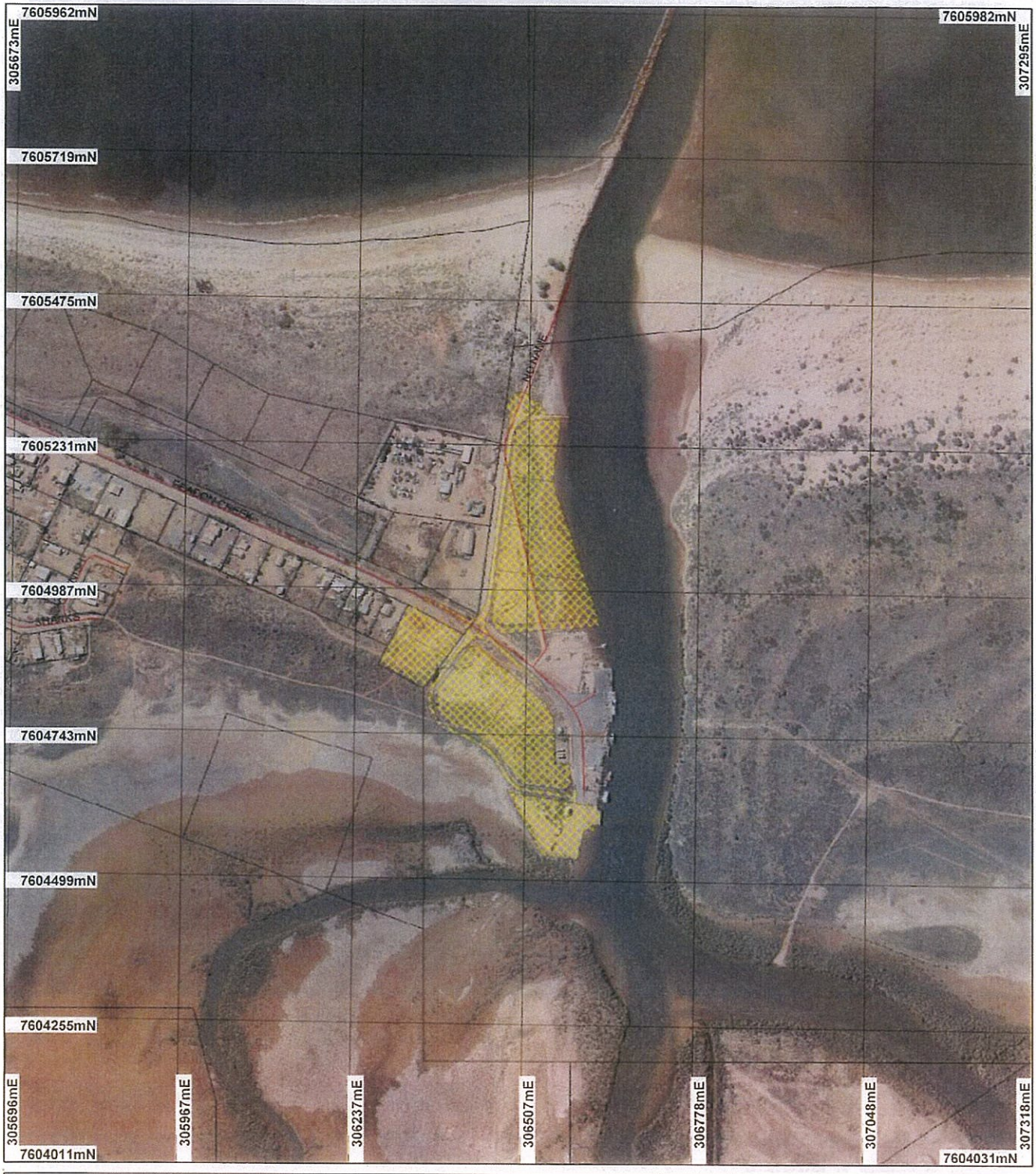
CONDITIONS
Nil.

Kelly Faulkner
MANAGER
NATIVE VEGETATION CONSERVATION BRANCH

Officer delegated under Section 20
of the Environmental Protection Act 1986

8 September 2011

Plan 4495/1



LEGEND

Clearing Instruments

- Areas Approved to Clear
- Road Centrelines
- Cadastre

Pilbara Coastline Exmouth
Cape Preston 50cm
Orthomosaic - Landgate

N

0 ~250 m

Scale 1:8968
(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies

K Faulkner Date 8/9/04

Officer with delegated authority under Section 20 of the Environmental Protection Act 1986

Information derived from this map should be confirmed with the data custodian acknowleged by the agency acronym in the legend.

Department of Environment and Conservation

Our environment, our future

Department of Environment and Conservation

Clearing Permit Decision Report

1. Application details

1.1. Permit application details

Permit application No.: 4495/1
Permit type: Area Permit

1.2. Proponent details

Proponent's name: Minister for Transport

1.3. Property details

Property: LOT 561 ON PLAN 174170 (Lot No. 561 BEADON CREEK ONSLOW 6710)
LOT 460 ON PLAN 210532 (Lot No. 460 BEADON CREEK ONSLOW 6710)
Local Government Area: Shire of Ashburton
Colloquial name: Onslow (Beadon Creek) Maritime Facility

1.4. Application

Clearing Area (ha)	No. Trees	Method of Clearing	For the purpose of:
6		Mechanical Removal	Building or Structure

1.5. Decision on application

Decision on Permit Application: Grant
Decision Date: 8 September 2011

2. Site Information

2.1. Existing environment and information

2.1.1. Description of the native vegetation under application

Vegetation Description	Clearing Description	Vegetation Condition	Comment
The area under application is mapped as Beard Vegetation Association 676 which is described as 'Succulent steppe; samphire' (Shepherd, 2009).	This application proposes to clear 6 hectares of native vegetation for the purpose of constructing marine and harbour facilities and an access road. The area under application has historically been subjected to numerous disturbances and is consequently in a degraded (Keighery, 1994) condition.	Degraded: Structure severely disturbed; regeneration to good condition requires intensive management (Keighery 1994)	The condition of the vegetation was determined via digital imagery (Pilbara Coastline Exmouth Cape Preston 50cm Orthomosaic - Landgate 2004).

3. Assessment of application against clearing principles

Comments

Proposal is not likely to be at variance to this Principle

This application proposes to clear six hectares of native vegetation within Lot 561 on Plan 174170 and Lot 460 on Plan 210532 (Reserve 30711), Onslow, for the purpose of constructing marine and harbour facilities and an access road.

The proposed marine and harbour facilities are located on Beadon Creek in Onslow. This area at Beadon Creek has traditionally been used for recreational, fishing and charter operations. Due to the previous/ongoing land use the area has been subjected to numerous disturbances and is consequently in a degraded (Keighery, 1994) condition.

No rare or priority flora has been recorded within a 10km radius of the area under application.

The area under application is located within the Pilbara Interim Biogeographic Regionalisation of Australia (IBRA) bioregion. This IBRA bioregion has approximately 100 per cent of its Pre European vegetation extent remaining (Shepherd, 2009).

The vegetation under application is mapped as Beard Vegetation Association 676 which has approximately 100 per cent of its Pre European extent remaining in the Pilbara bioregion (Shepherd, 2009).

Given the large proportion of native vegetation remaining in the local and regional context the six hectares of vegetation under application is not considered to be a significant remnant.

The area proposed to be cleared is located on Beadon Creek and consequently vegetation associated with a watercourse is likely to be removed. The disturbance caused by the clearing may increase sedimentation levels in Beadon Creek, however this impact will be short term and is not predicted to cause any significant deterioration in the quality of surface water.

Therefore this application may be at variance to principle (f) and is not likely to be at variance to any of the remaining clearing principles.

Methodology

References:
Keighery (1994)
Shepherd (2009)

GIS Database:
- Hydrography linear
- Pre European Vegetation
- SAC Biodatasets - accessed 2 August 2011

Planning instrument, Native Title, Previous EPA decision or other matter.

Comments

The care, control and management of Reserve 30711 is under a Management Order to the Minister for Transport for the designated purpose of 'Harbour Purposes'.

Under Section 9 of the Marine and Harbours Act 1981 the Minister for Transport has the power to lease the land. Under this power the Minister for Transport is leasing land at Beadon Creek and in currently seeking approval to clear the lease areas. Once the land is leased it will be the responsibility of the Lessees to obtain development approval from the Shire. The Department of Transport requires all non government lessees of its land to seek and obtain normal statutory planning and building approvals with respect to areas under lease and development can not proceed prior to these approvals being received.

The area under application falls within the Pilbara Groundwater Area which is an area proclaimed under the Right in Water and Irrigation Act 1914.

The area under application is zoned as 'industry'.

Methodology

GIS databases:
- RIWI Act, Groundwater Areas
- Town Planning Scheme Zones

4. References

Keighery, B.J. (1994) Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc). Nedlands, Western Australia.

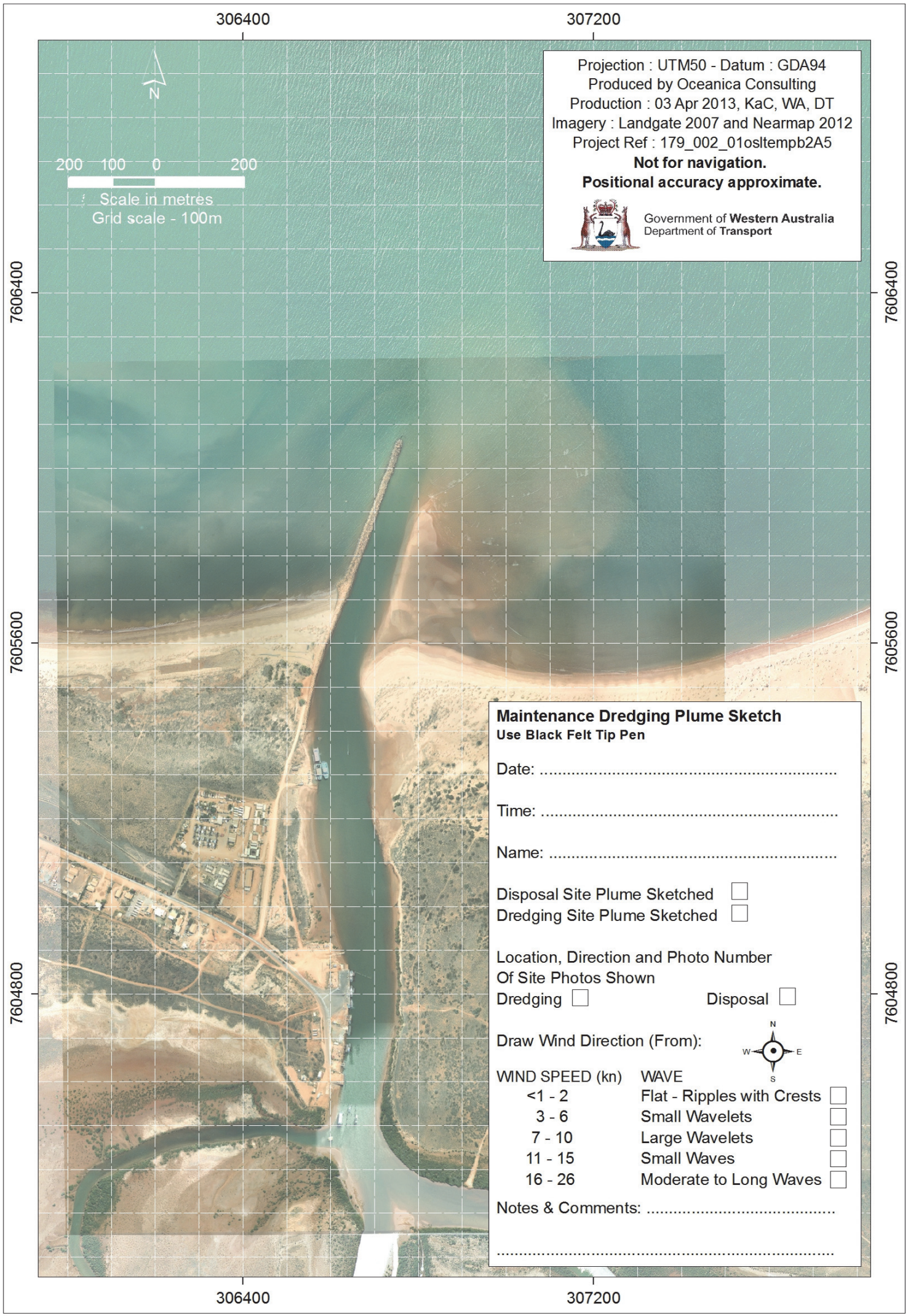
Shepherd, D.P. (2009) Adapted from: Shepherd, D.P., Beeston, G.R., and Hopkins, A.J.M. (2001), Native Vegetation in Western Australia. Technical Report 249. Department of Agriculture Western Australia, South Perth.

5. Glossary

Term	Meaning
BCS	Biodiversity Coordination Section of DEC
CALM	Department of Conservation and Land Management (now BCS)
DAFWA	Department of Agriculture and Food
DEC	Department of Environment and Conservation
DEP	Department of Environmental Protection (now DEC)
DoE	Department of Environment
DoIR	Department of Industry and Resources
DRF	Declared Rare Flora
EPP	Environmental Protection Policy
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
TEC	Threatened Ecological Community
WRC	Water and Rivers Commission (now DEC)

Appendix H

Plume Sketch Template


306400
307200
N
200 100 0 200
Scale in metres
Grid scale - 100m
Projection : UTM50 - Datum : GDA94
Produced by Oceanica Consulting
Production : 03 Apr 2013, KaC, WA, DT
Imagery : Landgate 2007 and Nearmap 2012
Project Ref : 179_002_01osltempb2A5
Not for navigation.
Positional accuracy approximate.
Government of Western Australia
Department of Transport
7606400
7605600
7604800
Maintenance Dredging Plume Sketch
Use Black Felt Tip Pen
Date: .....
Time: .....
Name: .....
Disposal Site Plume Sketched
Dredging Site Plume Sketched
Location, Direction and Photo Number
Of Site Photos Shown
Dredging
Disposal
Draw Wind Direction (From):
N
W
E
S
WIND SPEED (kn) WAVE
<1 - 2 Flat - Ripples with Crests
3 - 6 Small Wavelets
7 - 10 Large Wavelets
11 - 15 Small Waves
16 - 26 Moderate to Long Waves
Notes & Comments: .....
.....

Appendix I

Beadon Creek Wharf Dredging and Reclamation – Indicative Staging

STAGE 1

- BUND CONSTRUCTED TO CREATE TWO SEPERATE COMPARTMENTS
- DISCHARGE DREDGED SEDIMENTS FROM POTENTIAL TBT AREAS INTO AREA A
- DREDGE WATER OVERFLOWS INTO AREA B, WHERE IT IS CONTAINED (NO OUTFLOW)

STAGE 2

- MATERIAL FROM NON-CONTAMINATED AREAS DISCHARGED TO AREA B
- MATERIAL CONCURRENTLY EXCAVATED FROM AREA B TO AREA A. THIS CAPS CONTAMINATED MATERIAL AND CREATES A STOCKPILE, MAXIMISING THE AREA B SETTLING POND VOLUME
- RETURN WATER FLOWS FROM AREA B BACK TO CREEK

STAGE 3

- DREDGING COMPLETE
- MATERIAL STOCKPILED IN AREA A ARE SHIFTED BACK TO AREA B, BRINGING LEVEL OF ENTIRE RECLAMATION TO +4.0mCD

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
A	15/02/2013	INITIAL ISSUE FOR CLIENT REVIEW	JASK	

ORIG SIZE A3 | ARCHIVE 1622002f A dgn, OnsBC - I2012-05-int-lidarI-I2012-10 PD Mean clipped.dtm | PROJECT No

NOTES

SCALE 1 : 2000

10 0 100 METRES

DATUM

VERTICAL LAT WHICH IS 3.505m BELOW PWD BM B934 AND 1.492m BELOW A.H.D.

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
ENGINEER	J. McKay		15/02/2013
DRAWN	J. Kay		15/02/2013
ENGINEERING CHECK			
CARTOGRAPHY CHECK	G. Bebbington		
APPROVED PROJECT MGR			

BMT JFA Consultants

BebbCart Marine, Cadastral & Topographic Mapping Civil Drafting.

Government of Western Australia
Department of Transport
Spatial Information

ONSLOW - BEADON CREEK
BEADON CREEK WHARF
DREDGING AND RECLAMATION
INDICATIVE STAGING

DRAWING NUMBER 1622-02-01 | REVN A

oceanica

353 Cambridge Street, Wembley PO Box 462, Wembley, Western Australia 6913
Switch: (08) 6272 0000 Fax: (08) 6272 0099 oceanica@oceanica.com.au ABN: 89 093 752 811