Environmental Assessment of North Coogee Dredging

Sediment Analysis Report

City of Cockburn

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O2 MARINE

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Version Register

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B	Draft	E. Riboni	J. Abbott	Minor Edits	
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Transmission Register

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Abbreviations and Acronyms

Abbreviation / Acronym	Expanded text
AASS	Actual Acid Sulfate Soils
ASS	Acid Sulfate Soil
ANZG	Australia and New Zealand Guidelines
BTEXN	benzene, toluene, ethylbenzene, xylenes and naphthalene
COC	Chain of Custody
DBT	dibutyl tin
LCS	Laboratory Control Samples
LoR	Limit of Reporting
MB	Method Blanks
MBT	monobutyl tin
MS	Matrix Spikes
QA/QC	Quality Assurance/Quality Control
PAH	polycyclic aromatic hydrocarbon
PASS	Potential Acid Sulfate Soils
PQL	Practical Quantitative Limit
PSD	Particle size distribution
RPD	Relative Percent Difference
RSD	Relative Standard Difference
SAP	Sampling and Analysis Plan
SPLIT	Split sample
TBT	tributyl tin
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbon
TRIP	Triplicate sample
UCL	Upper Confidence Limit

Executive Summary

The City of Cockburn (the City) has engaged O2 Marine (O2M) to undertake the environmental impact assessment (EIA) of dredge works immediately north of the Port Coogee development, and the subsequent sand nourishment at several locations both north and south of Port Coogee.

Sediment sampling and analysis of the proposed dredge material was undertaken in accordance with the Sediment Sampling and Analysis Plan (SAP) (O2 Marine 2021), approved by the City. Samples were collected using grab sample at five (5) locations randomly distributed over the dredge footprint. Samples were analysed for particle size distribution, total organic carbon, metals, total petroleum hydrocarbon, polyaromatic hydrocarbon, organotins and potential acid sulfate soils by two NATA accredited laboratories (ALS and ARL). The contaminant results were compared against recommended screening levels in the National Assessment Guidelines for Dredging (NAGD 2009) and ANZG (2018), while acid sulfate soils were compared against the action criteria in DER (2015).

The proposed dredge area was dominated by sand fractions (250 – 2000m). All samples reported analyte concentrations below the available ANZG (2018) guideline values and NAGD 2009 screening levels. Many hydrocarbons and organic compounds where below the laboratory Limit or Reporting (LoR).

The screening acid sulfate test did not detect the presence of Potential Acid Sulfate Soils (PASS).

No interlaboratory results exceeded the Relative Percent Difference (RPD) of 35%, and the Relative Standard Difference (RSD) or 35% indicating most of the results presented in this report are reliable and accurate. However, variability was found between the primary and secondary labs with many values exceeding the 35% RPD value, therefore these results must be used with caution.

Based on these results, sediments from the five sampling locations are likely acceptable for onshore disposal and do not pose a safety or environmental risk.

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1. Introduction

1.1. Proposal Description

The City of Cockburn propose to relocate sediments that have accumulated in a sand trap immediately north of the Coogee Marina, Western Australia, and nourish nearby beaches. Regular sand bypassing has been undertaken at Coogee Marina to maintain and manage beach accretion and erosion since the marina construction in 2006. The interruption of the southward longshore transport has potential to detrimentally impact beach size, dune integrity, coastal infrastructure, public safety and recreational enjoyment. This is the first time a dredge has been proposed to remove marine sediments within the sand trap. **Figure 1** identifies the excavation site and the two nourishment locations to the north and single nourishment location to the south of the marina. A short description of the proposal is included in **Table 1**.

Table 1 Short summary of the proposal

Project Title	Cockburn Dredging Impact Assessment 2021
Proponent Name	City of Cockburn
Short Description	The proponent proposes to undertake sand excavation via a floating cutter suction dredge, to reach accumulated material in the sand trap which has not been accessible to land-based excavation to date. Sand nourishment (bypassing and back-passing) activities to the north (C Y O'Connor Beach) will be undertaken via direct pumping and placement (as opposed to truck placement), while nourishment to the south of the marina will include pumping and discharge over the rock wall as per previous years.

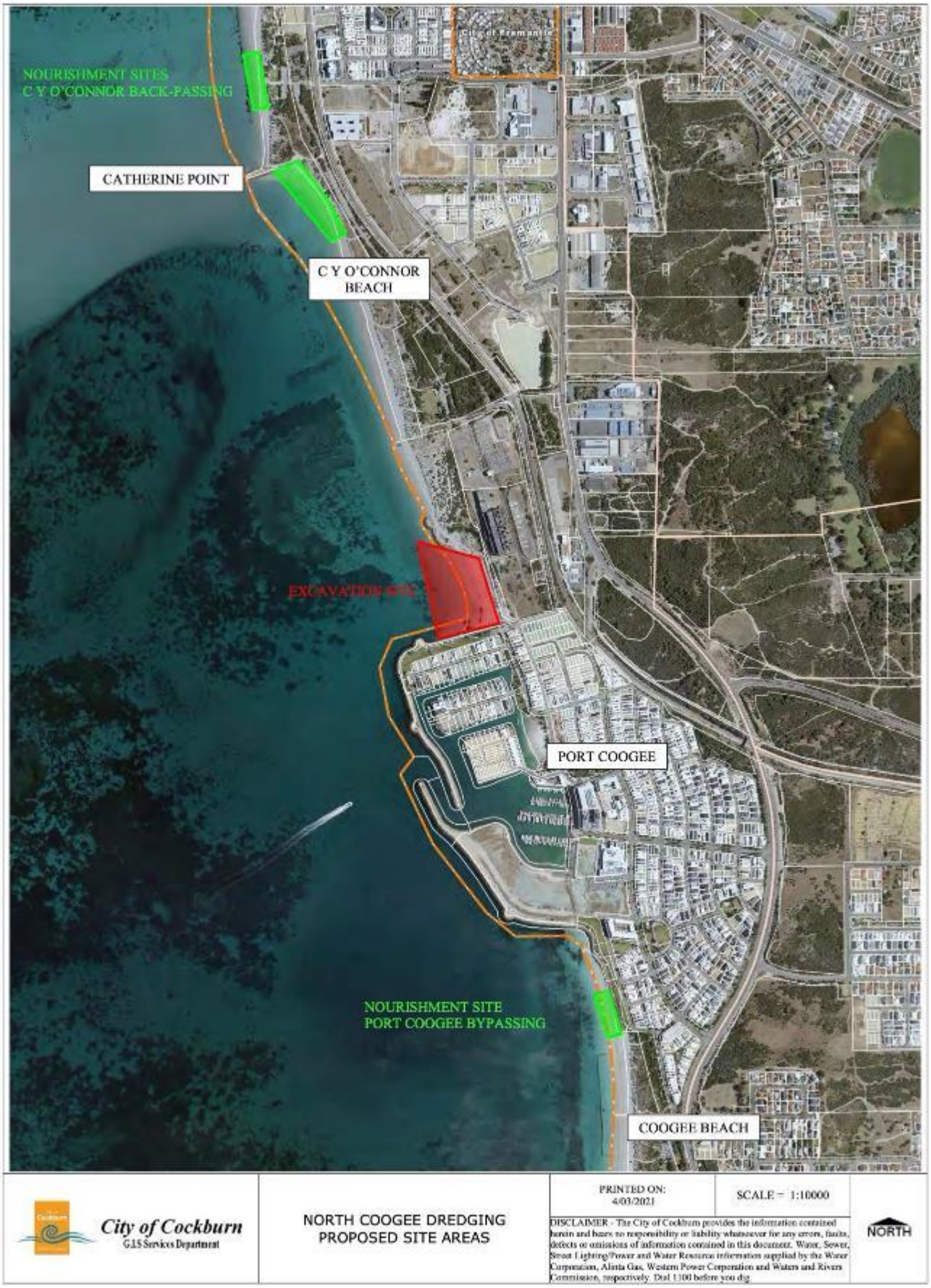

Figure 1 **Project Site with excavation and nourishment locations (City of Cockburn 2021)**

1.2. Purpose

To inform City of Cockburn of the sediment quality dredged from the Port Coogee Marina.

1.3. Objective

This document has been prepared by O2M on behalf of the City to guide the assessment of sediment quality characteristics in order to inform dredging and spoil disposal management.

This document has been prepared with consideration of relevant guidelines for this Project which apply to the management and assessment of dredging programs in Western Australia, including but not limited to:

- The Environmental Protection Authority: Environmental Quality Criteria Reference Document for Cockburn Sound (2015);
- The Environmental Protection Authority: Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (2016);
- The Environmental Protection Authority: Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (2016);
- The Department of Environment Regulation (DER): Assessment and Management of Contaminated Sites, Contaminated Sites Guidelines December 2014 (DER 2014);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2011, Volume 2, Schedule B1, Guideline on Investigation Levels for Soil and Groundwater (NEPM 2011);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013, Volume 3, Schedule B2, Guideline on Site Characterisation (NEPM 2013);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013, Volume 8, Schedule B5c, Guideline on Ecological Investigation Levels for Arsenic, Chromium (III), Copper, DDT, Lead, Naphthalene, Nickel and Zinc (NEPM 2013a);
- The Department of Environment Regulation (DER): Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes, June 2015 (DER 2015);
- The National Assessment Guidelines for Dredging (NAGD), 2009 (NAGD 2009); and
- CSIRO Land and Water Science (CSIRO), Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines, 2013 (Simpson *et al.* 2013).

2. Methods

2.1. Sampling and Analysis Plan

The sediment sampling field investigation was implemented in accordance with the SAP (O2M, 2021). Sediment samples were collected from five (5) randomly distributed sampling locations within the proposed dredge footprint, in accordance with the sampling design described in the SAP (**Figure** 2).

2.2. Field Sampling

The field sediment sampling was implemented on the 28th May from surveyed vessel Freedom II. Surficial sediment samples were collected using a Petite Ponar sediment grab at five locations within the nominated excavation area (**Figure 2**). Additional Particle Size Distribution (PSD) samples were collected by hand at the three nourishment locations on the 5th November 2021.

The Petite Ponar is constructed of two 316 stainless steel buckets with a volume of 2.4 litres and samples an area of 152mm x 152mm. The grab is lightweight (6.8 kg) which enabled deployment by hand using a pulley block hung over the side of the vessel (**Figure 3**). The impact of the grab on the bottom surface triggers a release mechanism to shut the buckets together and collect the sample.

On return of the sample to the surface the water was carefully removed, a photographic and observation record of the sample was taken before transferring the sediment into laboratory containers (**Appendix A)**. All sample containers were marked with a unique identifier with the date/time and sampler's name using a 'Wet Write' permanent marker. The grab was rinsed using appropriate decontamination solution (i.e. DECON) between each sampling location.

Equipment required for the sediment grab sampling includes the following:

- Petite Ponar grab sampler
- Sample collection tray
- Disposable nitrile gloves
- Laboratory supplied sample containers
- Esky and ice bricks, and
- Decon 90.

Figure 2 **Indicative Sediment and Drop Camera (BCH) sampling locations**

Figure 3 A Petite Ponar grab sampler in use.

Field Quality Control Samples

Field quality control samples included the following sampling design in accordance with NAGD (2009) and NEPM (2013):

- One trip blank filled with inert chromographic sand;
- Three field triplicates (that is, three separate samples taken at the same location) to determine site variability of the physical and chemical characteristics;
- Two field splits (that is, samples thoroughly mixed then split into three sub-samples with one of the three samples sent to a secondary laboratory) to assess laboratory variation.

Sample Storage and Freight

Sediment samples were stored in suitable (laboratory supplied) jars and plastic bottles/bags and kept at approximately 4 ºC in an esky during the field program. All samples were transported with an O2 Marine Chain of Custody (CoC) form (**Appendix C**), to be included with the samples when transported to the National Association of Testing Authorities (NATA) accredited laboratory(s) for analysis.

Laboratory Testing

All primary samples were analysed for the following parameters:

- Metals/Metalloids (Sb, As, Cd, Cr, Cu, Co, Pb, Mn, Ni, Ag, V and Zn);
- Acid sulphate soil potential (Laboratory Screen test)
- Organochlorine and organophosphate (OC/OP) pesticides
- Organotins (including TBT);
- Total Petroleum Hydrocarbons (TPH) / Total Recoverable Hydrocarbons (TRH);
- Polycyclic Aromatic Hydrocarbons (PAH)
- Particle Size Distribution (PSD);
- Total Organic Carbon;

2.2.1. Field Quality Assurance/Quality Control (QA/QC) Procedure

The list of analytes is based upon the following assumptions:

1. The proposed suite of analytes is based on general requirements for sediment quality assessment in Western Australia
2. PASS is included for compliance with the Contaminated Sites Act 2003 as this will be applicable to land-based reclamation impact assessments;
3. Elutriate and/or Bioavailability testing were only analysed if results exceed the relevant guidelines in accordance with NAGD (2009). However, O2M assume that sediments will were not contaminated and therefore no bioavailable or elutriate tests have been costed below.;
4. PSD has been included as it will assist in dredge impact assessment (plume dispersion and settling rates etc); and
5. TOC is required to normalise organic contaminants (i.e. TBT) for comparison against guidelines values in accordance with NAGD (2009). The TOC is also useful to assist with PASS interpretation.

2.2.2. Laboratory QA/QC

Both the primary and secondary laboratories are NATA accredited, and as such provide a comprehensive best practice QA/QC program, designed to provide highly defensible analytical data in accordance with NEPM (2013), ANZECC/ARMCANZ (2000) and NAGD (DEHWA (2009) guidelines. Both laboratories undertake Laboratory Control Samples (LCS), Method Blanks (MB), Matrix Spikes (MS), Laboratory Duplicates (Dups) and Surrogates (where applicable), at frequencies at or above the NEPM guidelines.

2.3. RPD and RSD

Relative percentage difference and relative standard deviation of QA/QC samples were calculated as followed. The relative percentage difference (RPD) between the primary and duplicate sample is calculated as:

$$RPD = \frac{Primary\ Sample - Duplicate\ Sample}{Average\ of\ Primary\ and\ Duplicate\ Samples}$$

If the RPDs are less than 35% then field and laboratory procedures are considered of acceptable quality and meaningful conclusions can be drawn from the data.

Three interlaboratory triplicates were collected for the 2021 program. This involves collecting three sub-samples from one sample replicate. The relative standard deviation (RSD) was calculated as:

$$RSD = \frac{Standard\ Deviation\ of\ Triplicate\ Samples}{Mean\ of\ Triplicate\ Samples}$$

If the RSDs are less than 35% then field and inter-laboratory procedures are considered of acceptable quality and meaningful conclusions can be made with the data.

3. Results

Samples were successfully collected at each of the five proposed locations. **Table 2Error! Reference source not found.** depicts the site name, location, method of collection, sample ID, depth and sampling outcome for all locations. Note, field splits and triplicates were collected at S4.

Table 2 Field sample summary

Site ID	Coordinates		Collection Method	Sample ID	Depth (m)	Sampling outcome (✓ indicates 'collected')
S1	115.75681	-32.09493	SG	S1	3.5	✓
S2	115.7567	-32.09552	SG	S2	4	✓
S3	115.75779	-32.0952	SG	S3	2.1	✓
S4	115.75795	-32.09605	SG	S4	3.1	✓
				T1	3.1	✓
				T2	3.1	✓
				SP1	3.1	✓
				SPT	3.1	✓
S5	115.759	-32.09692	SG	S5	2.3	✓
N1*	115.7516	-32.08237	HG	N1	0	✓
N2*	115.7531	-32.08478	HG	N2	0	✓
N3*	115.7627	-32.10783	HG	N3	0	✓

** Particle Size Distribution only*
SG – Sediment grab
HG – Hand grab

3.1. Particle size distribution

PSD results indicate that all marine samples (S1 – S5) recorded comparable grain size distributions. The large majority of sediments sampled comprised of medium sand (250-500µm) or coarse sand (500-2000µm). A small fraction of each sample contained fine sand (62-250µm). Site S5 was found to contain the highest proportion of fine sand when compared to the remaining four sites. Additional PSD samples collected at the at the high tide mark within nourishment sites (N1 – N3) recorded a higher proportion of fine and medium sand, and less coarse sand when compared to the marine sediments. PSD results are shown in **Table 3** and **Figure 4**.

Table 3 **Tabulated Particle Size Distribution results.**

	S1	S2	S3	S4	S5	N1	N2	N3
Clay % (<4µm)	0	0	0	0	0	1	1	1
Silt % (4-62µm)	0	0	0	0	0	0	0	1
Fine Sand % (62-250µm)	6.49	10.61	12.27	6.61	28.26	14.5	37.5	55
Medium Sand % (250-500µm)	47.09	46.12	48.25	42.31	48.89	81	59.5	36.5
Coarse Sand % (500-2000µm)	46.42	43.27	39.48	51.08	22.85	3.5	2	6.5
Gravel % (>2000µm)	0	0	0	0	0	0	0	0

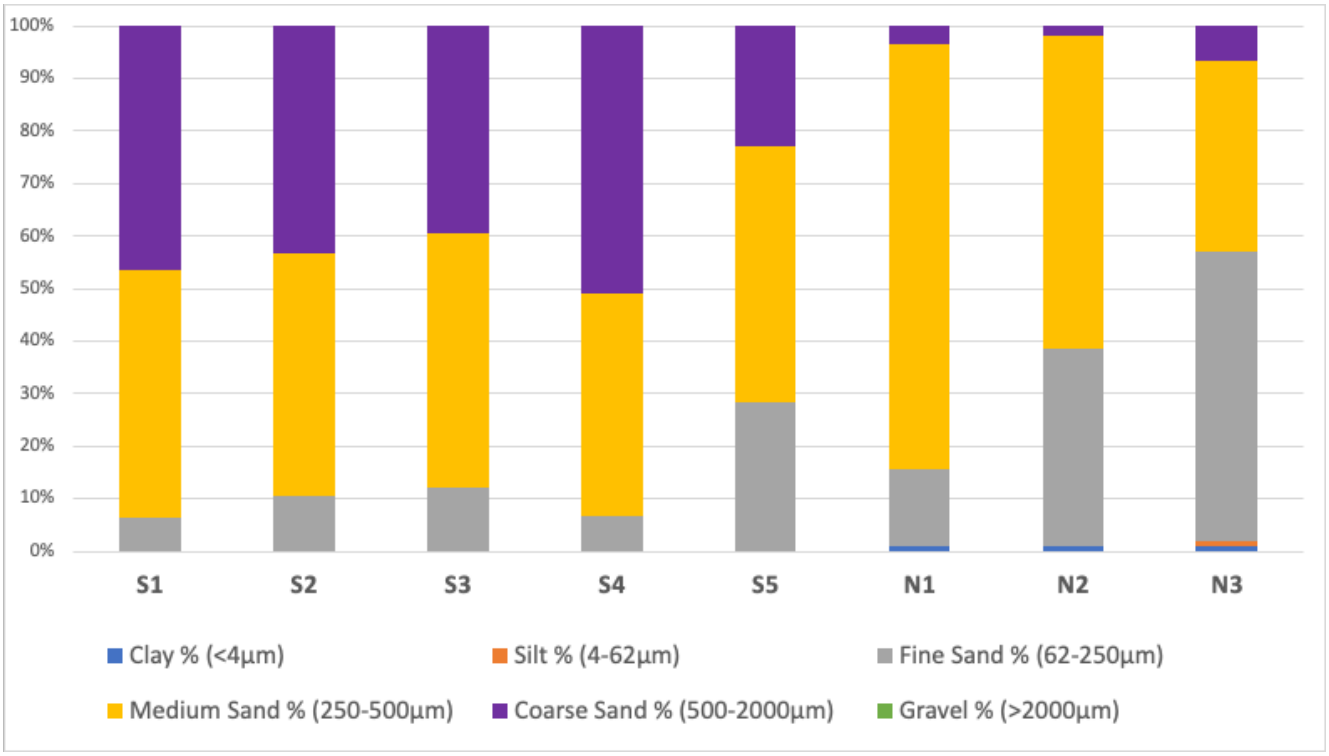

Figure 4 **Particle Size Distribution analysis results.**

3.2. Moisture Contended and Total Organic Carbon

The moisture content of the sediment samples ranged from 21.3% (S1 and S2) up to 31.2% (S5) (**Table 4**). The TOC ranged from 0.08 (S2) up to 0.17 (S1) (**Table 4**). No relevant historic studies were identified that included the analysis of TOC within or near Port Coogee Marina. However, they are considered low for inshore marine sediments.

Table 4 Moisture Content and TOC for marine locations

Sample ID	Moisture Content (%)	Total Organic Carbon (%)
S1	21.3	0.17
S2	21.3	0.08
S3	23.5	0.1
S4	23.7	0.08
S5	31.2	0.13
T1	21.4	0.1
T2	22.4	0.08
SP1	23.3	0.09
SPT	N/A	0.3
Mean	23.5125	0.125555556
95% UCL	28.575	0.248

3.3. Metals

All sediment samples recorded metal concentrations below the NAGD (2009) screening levels (**Table** 5). The 95% Upper Confidence Limit (UCL) for all metals were calculated for all sites and were below the ISQG. Results were uniform across all sites and no areas of contamination were identified.

A report for Port Coogee conducted by RPS (formally known as BBG) (BBG, 2001) also found that there were no metals exceeding the screening levels across all sites and displayed similar results.

The PQLs (Practical Quantitation Limits) are needed to accurately determine contaminant concentrations at, or near, natural levels. It also allows the detection of organic substances that can have impacts at low environmental concentrations (NAGD, 2009).

Table 5 Total metal concentrations in sediment samples

Samples	Metals													
	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Iron	Lead	Manganese	Nickel	Silver	Vanadium	Zinc
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ISQG-low	N/A	2	20	1.5	80	65	N/A	N/A	50	N/A	21	N/A	1	N/A
NAGD PQL	**200**	**0.5**	**1**	**0.1**	**1**	**1**	**0.5**	**100**	**1**	**10**	**1**	**0.1**	**0.1**	**2**
S1	210	<0.50	2.38	<0.1	12.8	<1.0	<0.5	580	2.5	19	<1.0	<0.1	2.6	2.7
S2	200	<0.50	2.26	<0.1	12.1	<1.0	<0.5	560	2.8	18	<1.0	<0.1	2.6	2.8
S3	200	<0.50	2.38	<0.1	13.6	<1.0	<0.5	580	3	20	<1.0	<0.1	2.4	3.2
S4	220	<0.50	2.19	<0.1	13.2	<1.0	<0.5	540	3.5	18	<1.0	<0.1	2.2	3.4
S5	160	<0.50	1.81	<0.1	12.8	<1.0	<0.5	500	4	14	<1.0	<0.1	2.2	4
T1	210	<0.50	2.22	<0.1	12.7	<1.0	<0.5	560	2.8	18	<1.0	<0.1	2.3	2.7
T2	230	<0.50	2.34	<0.1	13.4	<1.0	<0.5	580	2.9	18	<1.0	<0.1	2.5	3.2
SP1	230	<0.50	2.31	<0.1	13.5	<1.0	<0.5	590	3.4	18	<1.0	<0.1	2.5	3.9
SPT	200	N/A	2.5	<0.1	11	7	<1	620	2	14	<1	<1	2	0.5
Mean	206.666	0.25	2.26555	0.05	12.7888	1.22222	0.2778	567.78	2.99	17.4444	0.5	0.1	2.36666	2.93333
95% UCL	230	0.25	2.452	0.05	13.56	4.4	0.4	608	3.8	19.6	0.5	0.32	2.6	3.96

N/A=No guideline available in NAGD, 2009.

3.4. Hydrocarbons and TBT

All results for TPH, TRH and BTEXN were below the laboratories Practical Quantitative Limits (PQLs). thereby meeting the data quality objective. All results are tabulated in **Appendix F**.

All samples were analysed for Polynuclear Aromatic Hydrocarbons (PAH), with results below the NAGD screening levels and met the data quality objectives. The majority of results were below laboratory PQLs except for Benzo(a)pyrene TEQ (half LOR) and Benzo(a)pyrene TEQ (LOR) at all sites, and Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene and Benzo(b+j). at site S5. (**Appendix F**).

Monobutyltin, Dibutyltin and Tributyltin were analysed for all collected samples and concentrations were below the laboratories PQLs and below the NAGD screening levels (**Appendix F**).

3.5. Acid Sulfate Soil

3.5.1. Assessment Guideline

ASS in sediment was assessed assuming a disturbance greater than 1000 t of sediment, The representative action criteria adopted for the assessment is shown in Table 6

Table 6 Texture base action criteria for PASS (Ahern *et al.* 1998)

Material Type		Net Acidity Action Criteria			
		1-1000 t		>1000 t	
Texture range	Clay Content (%)	%S	Mole H+/t	%S	Mole H+/t
Coarse Texture (Sand to loamy sands)	<5%	0.03	18.7	0.03	18.7
Medium Texture (sandy loams to light clays)	5-40%	0.06	37.4	0.03	18.7
Fine Texture (medium to heavy clays and silty clays)	>40%	0.1	64.8	0.03	18.7

3.5.2. Field Screening Test (Laboratory)

The screening acidity (pHF) of the samples ranged from 8.1 to 8.5, which are typical of marine sediments and did not indicate the presence of any Actual Acid Sulfate Soils (AASS). The oxidised screening test (pHFOX) ranged from 6.8 to 6.9. The maximum change between pHF and pHFOX was 1.6 at the site SP1. No sites showed an 'Extreme' reaction to oxidation with 30% peroxide. As there was no ASS detected in the field screening test, therefore there was no need to undertake further investigation for ASS (Chromium suites or SPOCAS). A data summary is provided in (**Table 7**).

Table 7 Potential Acid sulfate soils field screening results

			PASS		
Samples	pH (F)	pH (Fox)	ΔpH	Reaction Rate	PASS
Unit	pH Unit	pH Unit	pH Unit	pH Unit	
Assessment	6.5-8.5	5	1	-	-
S1	8.1	6.8	1.3	Slight	U
S2	8.3	6.8	1.5	Slight	U
S3	8.2	6.9	1.3	Slight	U
S4	8.3	6.9	1.4	Slight	U
S5	8.2	6.9	1.3	Slight	U
T1	8.2	6.8	1.4	Slight	U
T2	8.3	6.8	1.5	Slight	U
SP1	8.5	6.9	1.6	Slight	U
SPT	7.9	6.6	1.3	Moderate	U
Mean	8.2	6.85	1.4	-	-
95% UCL	8.42	6.9	1.56	-	-

4. Quality Assurance/Quality Control

The field sampling methods, sediment variability and intra-laboratory quality assurance indicated no values exceeded the RPD or RSD (35%) across the primary lab, as recommended in NAGD (2009). Various metals, TRH, TPH, and organotins were above the 35% RSD when comparing results from primary to secondary labs. However, this discrepancy is related to slightly different levels of reporting/practical quantitative limits between labs, and not significant differences in actual results. When laboratory results were below the PQL the RSD was calculated by using half PQL value.

Metals including copper, cobalt, lead, silver and zinc exceeded the RPD of 35% between labs.

For TRH, the C6-C10, C10-C16, C16-C34 and C34-C40 fractions all exceeded an RPD value of 35% between labs.

TPH displayed similar QA/QC results with the C6-C9, C15-C28 and C29-C36 fractions exceeding the 35% RPD value.

No PAH values were returned by the secondary lab, ALS, therefore RPD calculations could not be completed on these analytes.

Monobutyltin and Dibutyltin were both above the 35% RPD value displaying variability between labs.

All QA/QC results are tabulated in **Appendix G**.

5. Discussion

A detailed site investigation of sediments within the proposed dredge footprint immediately north of the Port Coogee Marina was undertaken on the 28 May 2021. All sites returned adequate sample volumes a were observed as grey sand with little to no debris or organic matter. Sediments at all siters were medium to coarse grained sand and showed low moisture content and TOC.

All samples collected were assessed for PASS using the laboratory field screening test, however, as no reactions were recorded further chromium sulfur suite tests in the laboratory were not necessary. The pH values recorded during screening tests from all samples were within the expected values for marine waters (pH 8.2) except sites S2, T2 and SP1 with values of 8.3 and 8.5 respectively. There was no presence of ASS.

Results for TRH, TPH and PAH and metals were all below the NAGD (2009) screening levels and indicate no contamination was present. Metal results were consistent with findings from historic sampling in Cockburn Sound (BBG, 2001), however TRH and TPH, PAH, ASS, or Organotins were not tested for.

A review of the laboratory and field QA/QC outputs identified no values collected during the detailed site investigation were qualified as being unusable during the data review process. No values exceeded an RDS of 35% or an interlaboratory RPD of 35%, however, various values across metals, TPH, TRH and organotins exceeded the intra-laboratory RPD of 35%, indicating variability between laboratory methods.

Overall, results indicate the proposed dredge footprint comprises of sediments that are likely uncontaminated and are suitable for onshore disposal.

6. Reference List

Ahern CR, McElnea AE, Sullivan LA (2004) Acid Sulfate Soils Laboratory Methods Guidelines. Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland

ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory Governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

Bowman Bishaw Gorham, 2001. Port Catherine Environmental Review. Report G97062 prepared for the Western Australian Planning Commission. Perth, Western Australia.

NAGD (2009). National Assessment Guidelines for Dredging. Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia

O2 Marine (2021). Sediment Sampling and Analysis Plan for Port Coogee Marina; Report Number R210014

Appendix A Samples Photos

Site	Lat	Long	Date	Time	Depth	Comments	Image
S1	115.75681	-32.09493	28-May	7:25	3.5	Brown/grey coloured sand. Medium coarse grain size. No foreign material or organic matter. No odour.	
S2	115.7567	-32.09552	28-May	7:40	4	Brown/grey coloured sand. Medium coarse grain size. Contains shell grit. No organic matter. No odour.	

S3	115.75779	-32.0952	28-May	7:50	2.1	Brown/grey coloured sand. Medium coarse grain size. Contains shell grit. No organic matter. No odour.	
S4	115.75795	-32.09605	28-May	8:10	3.1	Brown/grey coloured sand. Medium coarse grain size. Contains shell grit. No organic matter. No odour.	

S5	115.759	-32.09692	28-May	8:32	2.3	Brown/grey coloured sand. Fine grain size. No foreign material or organic matter. No odour.	

Appendix B Field Log Sheet

Coogee Marina

Project Details		Sampling Requirements		Weather Observations	
Job Number:		Primary Lab	Secondary Lab	Sampling Dates:	28/5
Project Title:	Coogee Dredge EIA	ALS	ARL	Air Temp. (°C):	20°
Client:	City of Cockburn			Wind Speed (knts):	10 knots
Field Staff:	JA, ER, CH, GM			Wind Direction:	NE
				Sea State:	Calm

SITE	Long	Lat	Inter/Intralab Splits (Y/N)	DATE	TIME	ACTUAL DEPTH (m)	DIVER	Sample requirements	PHYSICAL APPEARANCE	COLOUR	PLASTICITY	GRAIN SIZE	FOREIGN MATERIAL	ORGANIC MATTER	ODOUR	COMMENTS
S1	115.7568	32.09493	–	28/5	725	3.5	Nil	4 jar / 3 bag	~~Bfou~~ Sand	Brown grey		Medium Coarse	–	–	Nil	Photos
S2	115.7567	32.09552	–	" "	740	4	Nil	" "	"	"		"	Shell grit	–	"	Photos
S3	115.7577	32.0957	–	" "	750	2.1	Nil	" "	"	"		"	Shell grit	–	"	Photos
S4	115.7574	32.09625	SP1 / SPT T1 / T2	"	810	3.1	Nil	" "	"	"		"	Shell grit	–	"	Photos
S5	115.757	32.09692	–		832	2.3	Nil	" "	"	"		fine	–	–	"	Photos

Appendix C Chain of Custody

O2 MARINE Chain of Custody (CoC) Record

Project:	North Coogee Dredge Sampling		
Client:	City of Cockburn	**Job No.:**	21WAU-0016
Lab Quote No.:		**Turnaround Time:**	
O2M Project Manager (Ph. Number):	Josh Abbott	**Email Address:**	josh.abbott@o2marine.com.au

Laboratory:	ALS
Address:	26 Rigali Way Wangara
Lab. Contact:	

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

Sediment

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil / SLSludge / W-Water / A-Air	Container: Type B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic	Container: Preservative Unpreserved / HCL / H_2SO^4 / HNO_3 / Other	No. of Samples	Total Volume (mL)	Analyses: Heavy Metals (Al, As III/V, Cd, Cr III/VI, Co, Cu, Fe, Pb, Mn, Hg, Ni, Ag, V, Zn)	Organotins (TBT, DBT and MBT)	PASS (field Test)	Organochlorine and organophosphate	TPH / TRH	PAHs	TOC	Particle size distribution (laser diffraction)		Bioavailability - Metals/Metaloids	Elutriate - Metals/Metaloids	Elutriate- Organotins (including TBT)	Elutriate - OC/Ops	Comments
S1	1	28/5/21		S	J/P	U			x	x	x	x	x	x	x	x						All Marine Sediments
S2	2			S	J/P	U			x	x	x	x	x	x	x	x						Please use Sediment methods
S3	3			S	J/P	U			x	x	x	x	x	x	x	x						TRH-SD, EP132B-SD, EG005,20,35-SD
S4	4			S	J/P	U			x	x	x	x	x	x	x	x						
S5	5			S	J/P	U			x	x	x	x	x	x	x	x						
T1	6			S	J/P	U			x	x	x	x	x	x	x	x						
T2	7			S	J/P	U			x	x	x	x	x	x	x	x						
SP1	8			S	J/P	U			x	x	x	x	x	x	x	x						
~~Elu~~				~~S~~		U			x	x	x	x	x	x	x							
TBS 112	9																					

Sampled By:	Josh. Abbott	**Date/Time:**	28/5/21	**Relinquished By:**	**Date/Time:**
Received By Lab:	MO-ALS	**Date/Time:**	28/5/21 1545	**Courier:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**			

Environmental Division
Perth
Work Order Reference
EP2106069

Telephone : -- 61-8-9406 1301

O2 MARINE **Chain of Custody (CoC) Record**

Project:	North Coogee Dredge Sampling		
Client:	City of Cockburn	**Job No.:**	21WAU-0016
Lab Quote No.:		**Turnaround Time:**	
O2M Project Manager (Ph. Number):	Josh Abbott	**Email Address:** josh.abbott@o2marine.com.au	

Laboratory:	ALS
Address:	26 Rigali Way Wangara
Lab. Contact:	

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

Sediment

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil / SL-Sludge / W-Water / A-Air	Container: Type B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic	Container: Preservative Unpreserved / HCL / H_2SO^4 / HNO_3 / Other	Container: No. of Samples	Container: Total Volume (mL)	Analyses: Particle size distribution - Wentworth Scale	Comments
1-A	1	5/11/21		S	P	U			x	
1-B	2	5/11/21		S	P	U			x	
2-A	3	5/11/21		S	P	U			x	
2-B	4	5/11/21		S	P	U			x	
3-A	5	5/11/21		S	P	U			x	
3-B	6	5/11/21		S	P	U			x	

Environmental Division
Perth
Work Order Reference
EP2113457

Telephone : – 61-8-9406 1301

Sampled By:	j. Abbott	**Date/Time:**	5/112021
Received By Lab:	NO	**Date/Time:**	5/11/21 15:10
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	
Relinquished By:		**Date/Time:**	
Courier:			

O2 MARINE Chain of Custody (CoC) Record

Project:	North Coogee Dredge Sampling		
Client:	City of Cockburn	**Job No.:**	21WAU-0016
Lab Quote No.:		**Turnaround Time:**	
O2M Project Manager (Ph. Number):	Josh Abbott	**Email Address:** josh.abbott@o2marine.com.au	

Laboratory:	ARL
Address:	
Lab. Contact:	

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

Sediment

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil / SL-Sludge / W-Water / A-Air	Container: Type B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic	Container: Preservative Unpreserved / HCL / H_2SO^4 / HNO_3 / Other	Container: No. of Samples	Container: Total Volume (mL)	Analyses: Heavy Metals (Al, As III/V, Cd, Cr III/VI, Co, Cu, Fe, Pb, Mn, Hg, Ni, Ag, V, Zn);	Analyses: Organotins (TBT, DBT and MBT)	Analyses: PASS (field Test)	Analyses: Organochlorine and organophosphate (Low (NAGD))	Analyses: TPH / TRH	Analyses: PAHs (Low → (NAGD))	Analyses: TOC							Comments
21-10433 SPT	-1	28/5/21		S	J / P	U			x	x	x	x	x	x	x							All Marine Sediments
																						Please use Sediment methods
																						TRH-SD, EP132B-SD, EG005,20,35-SD
																						or equivalent

Sampled By:	J. Abbott	**Date/Time:**	28/5/21
Received By Lab:	F. Senter	**Date/Time:**	0
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	
Relinquished By:		**Date/Time:**	
Courier:			

Appendix D Laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2106069**	Page	: 1 of 13
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: JOSH ABBOTT	Contact	: Nick Courts
Address	: SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH WA, AUSTRALIA 6281	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 21WAU-0016 North Coogee Dredge Sampling	Date Samples Received	: 28-May-2021 15:45
Order number	: ----	Date Analysis Commenced	: 05-Jun-2021
C-O-C number	: ----	Issue Date	: 15-Jun-2021 16:40
Sampler	: JOSH ABBOTT		
Site	: ----		
Quote number	: EP/413/21		
No. of samples received	: 9		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP003, EP090 conducted by ALS Brisbane, NATA Site No. 818.
- EA153 conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EA153: ALS does not hold NATA accreditation for Laser Particle Sizing.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP080-SD: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP090 Organotin: Particular sample shows poor matrix spike recovery for MBT due to matrix interference.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: **MARINE SEDIMENT** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	S1	S2	S3	S4	S5
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00
					EP2106069-001	EP2106069-002	EP2106069-003	EP2106069-004	EP2106069-005
					Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.1**	**8.3**	**8.2**	**8.3**	**8.2**
pH (Fox)	----	0.1	pH Unit		**6.8**	**6.8**	**6.9**	**6.9**	**6.9**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**21.3**	**21.3**	**23.5**	**23.7**	**31.2**
EA153: Laser Particle Size Analysis of Soils and Solids									
ø +1000µm	----	1	%		**See Attached**	**See Attached**	**See Attached**	**See Attached**	**See Attached**
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		**210**	**200**	**200**	**220**	**160**
Iron	7439-89-6	50	mg/kg		**580**	**560**	**580**	**540**	**500**
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg		**2.38**	**2.26**	**2.38**	**2.19**	**1.81**
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg		**12.8**	**12.1**	**13.6**	**13.2**	**12.8**
Copper	7440-50-8	1.0	mg/kg		<1.0	<1.0	<1.0	<1.0	<1.0
Cobalt	7440-48-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Lead	7439-92-1	1.0	mg/kg		**2.5**	**2.8**	**3.0**	**3.5**	**4.0**
Manganese	7439-96-5	10	mg/kg		**19**	**18**	**20**	**18**	**14**
Nickel	7440-02-0	1.0	mg/kg		<1.0	<1.0	<1.0	<1.0	<1.0
Silver	7440-22-4	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg		**2.6**	**2.6**	**2.4**	**2.2**	**2.2**
Zinc	7440-66-6	1.0	mg/kg		**2.7**	**2.8**	**3.2**	**3.4**	**4.0**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**11**	**11**	**12**	**11**	**11**
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		**0.17**	**0.08**	**0.10**	**0.08**	**0.13**
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: MARINE SEDIMENT (Matrix: SOIL)			Sample ID	S1	S2	S3	S4	S5
			Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00
Compound	CAS Number	LOR	Unit	EP2106069-001	EP2106069-002	EP2106069-003	EP2106069-004	EP2106069-005
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: MARINE SEDIMENT (Matrix: SOIL)				Sample ID	S1	S2	S3	S4	S5
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00
Compound	CAS Number	LOR	Unit		EP2106069-001	EP2106069-002	EP2106069-003	EP2106069-004	EP2106069-005
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
>C16 - C34 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
>C34 - C40 Fraction	----	5	mg/kg		<5	<5	<5	<5	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg		<3	<3	<3	<3	<3
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg		<3	<3	<3	<3	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
C10 - C14 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
C15 - C28 Fraction	----	3	mg/kg		<3	<3	<3	<3	<3
C29 - C36 Fraction	----	5	mg/kg		<5	<5	<5	<5	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg		<3	<3	<3	<3	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg		<3	<3	<3	<3	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg		<3.0	<3.0	<3.0	<3.0	<3.0
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

Analytical Results

Sub-Matrix: MARINE SEDIMENT (Matrix: SOIL)			Sample ID	S1	S2	S3	S4	S5
			Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00
Compound	CAS Number	LOR	Unit	EP2106069-001	EP2106069-002	EP2106069-003	EP2106069-004	EP2106069-005
				Result	Result	Result	Result	Result
EP080-SD: BTEXN - Continued								
Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	<5	<5	<5	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	<5	<5	<5
Acenaphthylene	208-96-8	4	µg/kg	<4	<4	<4	<4	<4
Acenaphthene	83-32-9	4	µg/kg	<4	<4	<4	<4	<4
Fluorene	86-73-7	4	µg/kg	<4	<4	<4	<4	<4
Phenanthrene	85-01-8	4	µg/kg	<4	<4	<4	<4	<4
Anthracene	120-12-7	4	µg/kg	<4	<4	<4	<4	<4
Fluoranthene	206-44-0	4	µg/kg	<4	<4	<4	<4	8
Pyrene	129-00-0	4	µg/kg	<4	<4	<4	<4	8
Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	<4	<4	6
Chrysene	218-01-9	4	µg/kg	<4	<4	<4	<4	4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	<4	<4	5
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	<4	<4	<4
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	<4	<4	<4
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	<4	<4	<4
Perylene	198-55-0	4	µg/kg	<4	<4	<4	<4	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	<4	<4	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	31
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	6
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	80.1	63.5	61.3	73.0	103
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	46.6	41.1	41.9	42.7	61.5

Analytical Results

Sub-Matrix: **MARINE SEDIMENT** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	S1	S2	S3	S4	S5
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00
					EP2106069-001	EP2106069-002	EP2106069-003	EP2106069-004	EP2106069-005
					Result	Result	Result	Result	Result
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**96.6**	**96.2**	**98.2**	**97.5**	**95.6**
Toluene-D8	2037-26-5	0.2	%		**93.0**	**93.3**	**97.6**	**93.4**	**96.9**
4-Bromofluorobenzene	460-00-4	0.2	%		**87.9**	**88.1**	**90.1**	**89.1**	**88.0**
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		**102**	**107**	**81.7**	**93.5**	**116**
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		**118**	**113**	**98.2**	**105**	**108**
Anthracene-d10	1719-06-8	10	%		**106**	**95.8**	**84.5**	**89.4**	**85.4**
4-Terphenyl-d14	1718-51-0	10	%		**88.0**	**87.2**	**76.2**	**80.7**	**87.3**

Analytical Results

Sub-Matrix: **MARINE SEDIMENT** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	T1	T2	SP1	----	----
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	----	----
					EP2106069-006	EP2106069-007	EP2106069-008	--------	--------
					Result	Result	Result	----	----
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.2**	**8.3**	**8.5**	**----**	**----**
pH (Fox)	----	0.1	pH Unit		**6.8**	**6.8**	**6.9**	**----**	**----**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**----**	**----**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**21.4**	**22.4**	**23.3**	**----**	**----**
EA153: Laser Particle Size Analysis of Soils and Solids									
ø +1000µm	----	1	%		**See Attached**	**See Attached**	**See Attached**	**----**	**----**
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		**210**	**230**	**230**	**----**	**----**
Iron	7439-89-6	50	mg/kg		**560**	**580**	**590**	**----**	**----**
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	**----**	**----**
Arsenic	7440-38-2	1.00	mg/kg		**2.22**	**2.34**	**2.31**	**----**	**----**
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	**----**	**----**
Chromium	7440-47-3	1.0	mg/kg		**12.7**	**13.4**	**13.5**	**----**	**----**
Copper	7440-50-8	1.0	mg/kg		<1.0	<1.0	<1.0	**----**	**----**
Cobalt	7440-48-4	0.5	mg/kg		<0.5	<0.5	<0.5	**----**	**----**
Lead	7439-92-1	1.0	mg/kg		**2.8**	**2.9**	**3.4**	**----**	**----**
Manganese	7439-96-5	10	mg/kg		**18**	**18**	**18**	**----**	**----**
Nickel	7440-02-0	1.0	mg/kg		<1.0	<1.0	<1.0	**----**	**----**
Silver	7440-22-4	0.1	mg/kg		<0.1	<0.1	<0.1	**----**	**----**
Vanadium	7440-62-2	2.0	mg/kg		**2.3**	**2.5**	**2.5**	**----**	**----**
Zinc	7440-66-6	1.0	mg/kg		**2.7**	**3.2**	**3.9**	**----**	**----**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		<0.01	<0.01	<0.01	**----**	**----**
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	**----**	**----**
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**11**	**12**	**12**	**----**	**----**
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		**0.10**	**0.08**	**0.09**	**----**	**----**
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	<0.05	**----**	**----**
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	<0.05	**----**	**----**

Analytical Results

Sub-Matrix: MARINE SEDIMENT (Matrix: SOIL)				Sample ID	T1	T2	SP1	----	----
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EP2106069-006	EP2106069-007	EP2106069-008	--------	--------
					Result	Result	Result	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----

Analytical Results

Sub-Matrix: MARINE SEDIMENT (Matrix: SOIL)			Sample ID	T1	T2	SP1	----	----
			Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	EP2106069-006	EP2106069-007	EP2106069-008	--------	--------
				Result	Result	Result	----	----
EP068B: Organophosphorus Pesticides (OP) - Continued								
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	----	----
>C16 - C34 Fraction	----	3	mg/kg	<3	<3	<3	----	----
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	<5	----	----
>C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	<3	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	----	----
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	----	----
C15 - C28 Fraction	----	3	mg/kg	<3	<3	<3	----	----
C29 - C36 Fraction	----	5	mg/kg	<5	<5	<5	----	----
^ C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	<3	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	<3	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	<3.0	----	----
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	----	----

Analytical Results

Sub-Matrix: **MARINE SEDIMENT** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	T1	T2	SP1	----	----
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	----	----
					EP2106069-006	EP2106069-007	EP2106069-008	--------	--------
					Result	Result	Result	----	----
EP080-SD: BTEXN - Continued									
Naphthalene	91-20-3	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		<1	<1	<1	----	----
Dibutyltin	1002-53-5	1	µgSn/kg		<1	<1	<1	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg		<0.5	<0.5	<0.5	----	----
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	<5	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	<5	----	----
Acenaphthylene	208-96-8	4	µg/kg		<4	<4	<4	----	----
Acenaphthene	83-32-9	4	µg/kg		<4	<4	<4	----	----
Fluorene	86-73-7	4	µg/kg		<4	<4	<4	----	----
Phenanthrene	85-01-8	4	µg/kg		<4	<4	<4	----	----
Anthracene	120-12-7	4	µg/kg		<4	<4	<4	----	----
Fluoranthene	206-44-0	4	µg/kg		<4	<4	<4	----	----
Pyrene	129-00-0	4	µg/kg		<4	<4	<4	----	----
Benz(a)anthracene	56-55-3	4	µg/kg		<4	<4	<4	----	----
Chrysene	218-01-9	4	µg/kg		<4	<4	<4	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg		<4	<4	<4	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		<4	<4	<4	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg		<4	<4	<4	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg		<4	<4	<4	----	----
Perylene	198-55-0	4	µg/kg		<4	<4	<4	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		<4	<4	<4	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<4	<4	<4	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		<4	<4	<4	----	----
Coronene	191-07-1	5	µg/kg		<5	<5	<5	----	----
^ Sum of PAHs	----	4	µg/kg		<4	<4	<4	----	----
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg		<4	<4	<4	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg		**5**	**5**	**5**	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg		**10**	**10**	**10**	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**94.4**	**74.1**	**75.2**	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**58.8**	**39.8**	**55.4**	----	----

Analytical Results

Sub-Matrix: **MARINE SEDIMENT** (Matrix: **SOIL**)				Sample ID	T1	T2	SP1	----	----
				Sampling date / time	28-May-2021 00:00	28-May-2021 00:00	28-May-2021 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EP2106069-006**	**EP2106069-007**	**EP2106069-008**	--------	--------
					Result	Result	Result	----	----
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**97.4**	**97.4**	**103**	**----**	**----**
Toluene-D8	2037-26-5	0.2	%		**96.2**	**94.7**	**101**	**----**	**----**
4-Bromofluorobenzene	460-00-4	0.2	%		**89.1**	**87.6**	**93.3**	**----**	**----**
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		**50.2**	**87.2**	**37.8**	**----**	**----**
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		**112**	**89.4**	**101**	**----**	**----**
Anthracene-d10	1719-06-8	10	%		**95.6**	**79.7**	**81.2**	**----**	**----**
4-Terphenyl-d14	1718-51-0	10	%		**89.8**	**74.0**	**76.7**	**----**	**----**

Surrogate Control Limits

Sub-Matrix: **MARINE SEDIMENT**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	53	152
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	28	152
EP080-SD: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	70	130
Toluene-D8	2037-26-5	70	130
4-Bromofluorobenzene	460-00-4	70	130
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	70	130
Anthracene-d10	1719-06-8	70	130
4-Terphenyl-d14	1718-51-0	70	130

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EP003: Total Organic Carbon (TOC) in Soil

(SOIL) EP090: Organotin Compounds

(SOIL) EP090S: Organotin Surrogate

Analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(SOIL) EA153: Laser Particle Size Analysis of Soils and Solids

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2113457**	Page	: 1 of 4
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: JOSH ABBOTT	Contact	: Nick Courts
Address	: SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH WA, AUSTRALIA 6281	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 21WAU-0016 North Coogee Dredge Sampling	Date Samples Received	: 05-Nov-2021 15:10
Order number	: ----	Date Analysis Commenced	: 15-Nov-2021
C-O-C number	: ----	Issue Date	: 15-Nov-2021 11:05
Sampler	: JOSH ABBOTT		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Vincent Emerton-Bell	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- PSD conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	1 - A	1 - B	2 - A	2 - B	3 - A
			Sampling date / time	05-Nov-2021 00:00	05-Nov-2021 00:00	05-Nov-2021 00:00	05-Nov-2021 00:00	05-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EP2113457-001	EP2113457-002	EP2113457-003	EP2113457-004	EP2113457-005
				Result	Result	Result	Result	Result
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	**1**	**1**	**1**	**1**	**1**
Silt (4-62 µm)	----	1	%	<1	<1	<1	<1	**1**
Fine Sand (62-250 µm)	----	1	%	**15**	**14**	**39**	**36**	**55**
Medium Sand (250-500 µm)	----	1	%	**80**	**82**	**58**	**61**	**36**
Coarse Sand (500-2000 µm)	----	1	%	**4**	**3**	**2**	**2**	**7**
Gravel (2000-10000 µm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.66**	**2.68**	**2.63**	**2.59**	**2.47**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	3 - B	----	----	----	----
			Sampling date / time	05-Nov-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EP2113457-006	--------	--------	--------	--------
				Result	----	----	----	----
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	**1**	----	----	----	----
Silt (4-62 µm)	----	1	%	**1**	----	----	----	----
Fine Sand (62-250 µm)	----	1	%	**55**	----	----	----	----
Medium Sand (250-500 µm)	----	1	%	**37**	----	----	----	----
Coarse Sand (500-2000 µm)	----	1	%	**6**	----	----	----	----
Gravel (2000-10000 µm)	----	1	%	<1	----	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.52**	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(SOIL) EA152: Soil Particle Density

(SOIL) EA150: Particle Sizing

eurofins | ARL

Job Number: 21-10433
Revision: 00
Date: 1 July 2021

LABORATORY REPORT

ADDRESS: **O2 Marine**
Suite 2, 4B Mews Rd
Fremantle WA 6160

ATTENTION: Josh Abbott

DATE RECEIVED: 3/06/2021

YOUR REFERENCE: 21WAU-0016 - North Coogee Dredge Sampling

PURCHASE ORDER:

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

APPROVALS:

Paul Nottle	Sean Sangster	DouglasTodd
Organics Manager	Inorganics Supervisor	Laboratory Manager

REPORT COMMENTS:

This report is issued by Eurofins ARL Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

Metals and TOC in soils analysis was conducted on a dry weight basis.

Organotins analysis subcontracted to MPL, NATA Accred No. 2901, Report Number 263204

Rates of Reaction are determined by visual observation and are based on
Acid Sulphate Soils Laboratory Methods Guidelines: Section H - Table H1.1

RATES OF REACTION
Slight Reaction = X
Moderate Reaction = XX
Vigorous Reaction = XXX
Very Vigorous Reaction = XXXX

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" and "EDP" are covered under NATA Accreditation Number: 2561

Method ID	Method Description
ARL No. 010	Total Petroleum Hydrocarbons (TPH) in Soil
ARL No. 208	"Field" pH measurements
23A and 23B	QASSIT et al Method Code
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 030	Metals in Soil and Sediment by AAS
ARL No. 051	Hexavalent Chromium in Soil
ARL No. 064	Total Organic Carbon in Sediment
Subcontracting	See Report Comments section for more information.

LABORATORY REPORT

TRH in Soil/Sediment		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
TRH C_{6-9}	0.2	mg/kg	<0.2
TRH C_{10-14}	0.2	mg/kg	<0.2
TRH C_{15-28}	0.4	mg/kg	<0.4
TRH C_{29-36}	0.4	mg/kg	<0.4
TRH $C_{>36}$	0.4	mg/kg	<0.4

TPH in Soil/Sediment		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
TPH C_{6-9}	0.2	mg/kg	<0.2
TPH C_{10-14}	0.2	mg/kg	<0.2
TPH C_{15-28}	0.4	mg/kg	<0.4
TPH C_{29-36}	0.4	mg/kg	<0.4
TPH $C_{>36}$	0.4	mg/kg	<0.4

Acid Sulfate Soils		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
pH_f (23Af)	0.1	pH units	7.9
pH_{fox} (23Bf)	0.1	pH units	6.6
Rate of Reaction			XX

Metals in Soil and Sediment		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
Aluminium	1	mg/kg	200
Arsenic	5	mg/kg	<5
Cadmium	0.1	mg/kg	<0.1
Chromium	1	mg/kg	11
Chromium (III)*	1	mg/kg	11
Cobalt	1	mg/kg	<1
Copper	1	mg/kg	7
Iron	1	mg/kg	620
Lead	1	mg/kg	2
Manganese	1	mg/kg	14
Mercury	0.02	mg/kg	<0.02
Nickel	1	mg/kg	<1
Silver	1	mg/kg	<1
Vanadium	2	mg/kg	2
Zinc	1	mg/kg	<1
Chromium (VI)	1	mg/kg	<1

LABORATORY REPORT

Misc. Inorganics in Soil		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
TOC	0.1	%	0.3

Subcontracting		Sample No	21-10433-1
		Sample Description	SPT
		Sample Date	28/05/2021
ANALYTE	**LOR**	**Units**	**Result**
Monobutyl tin	0.5	µg Sn/kg	<0.5
Dibutyl tin	0.5	µg Sn/kg	<0.5
Tributyl tin	0.5	µg Sn/kg	<0.5

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

Appendix E Quality Control Reports

Appendix F Hydrocarbon and TBT

Table 8 TRH and BTEXN laboratory results

	TRH & BTEXN											
Analytes	TRH C6 - C10 Fraction	TRH C6 - C10 Fraction minus BTEX (F1)	TRH >C10 - C16 Fraction	TRH >C16 - C34 Fraction	TRH >C34 - C40 Fraction	TRH >C10 - C16 Fraction minus Naphthalene (F2)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PQL	**3**	**3**	**3**	**3**	**5**	**3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.5**
ANZG (2018)	550	550	550	550	550	550	-	-	-	-	-	-
S1	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
S2	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
S3	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
S4	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
S5	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
T1	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
T2	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
SP1	<3	<3.0	<3	<3	<5	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.5
SPT	<2	N/A	<2	<4	<4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mean	1.34	1.5	1.34	1.36	2.24	1.5	0.1	0.1	0.1	0.1	0.1	0.25
95% UCL	1.5	1.5	1.5	1.5	2.5	1.5	0.1	0.1	0.1	0.1	0.1	0.25

Table 9 TPH laboratory results

	TPH				
Samples	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	^C10-C36 Fraction (sum)
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ISQG-low	550	550	550	550	550
S1	<3	<3	<3	<5	<3
S2	<3	<3	<3	<5	<3
S3	<3	<3	<3	<5	<3
S4	<3	<3	<3	<5	<3
S5	<3	<3	<3	<5	<3
T1	<3	<3	<3	<5	<3
T2	<3	<3	<3	<5	<3
SP1	<3	<3	<3	<5	<3
SPT	<0.2	N/A	<0.4	<0.4	N/A
Mean	1.344444444	1.5	1.355555556	2.244444444	1.5
95% UCL	1.5	1.5	1.5	2.5	1.5

Table 10 PAH laboratory results

	PAH																							
Samples	Naphthalene 91-20-3	2-Methylnaphthalene 91-57-6	Acenaphthylene 208-96-8	Acenaphthene 83-32-9	Fluorene 86-73-7	Phenanthrene 85-01-8	Anthracene 120-12-7	Fluoranthene 206-44-0	Pyrene 129-00-0	Benz(a)anthracene 56-55-3	Chrysene 218-01-9	Benzo(b+j)fluoranthene 205-99-2 205-82-3	Benzo(k)fluoranthene 207-08-9	Benzo(e)pyrene 192-97-2	Benzo(a)pyrene 50-32-8	Perylene 198-55-0	Benzo(g.h.i)perylene 191-24-2	Dibenz(a.h)anthracene 53-70-3	Indeno(1.2.3.cd)pyrene 193-39-5	Coronene 191-07-1	Sum of PAHs	Benzo(a)pyrene TEQ (zero LOR)	Benzo(a)pyrene TEQ (half LOR)	Benzo(a)pyrene TEQ (LOR)
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PQL	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4
S1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
S2	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
S3	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
S4	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
S5	<5	<5	<4	<4	<4	<4	<4	8	8	6	4	5	<4	<4	<4	<4	<4	<4	<4	<5	31	<4	6	10
T1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
T2	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
SP1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4	<4	5	10
SPT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mean	2.5	2.5	2	2	2	2	2	2.75	2.75	2.5	2.25	2.38	2	2	2	2	2	2	2	2.5	5.63	2	5.13	10
95% UCL	2.5	2.5	2	2	2	2	2	5.9	5.9	4.6	3.3	3.95	2	2	2	2	2	2	2	2.5	20.9	2	5.65	10

Table 11 Organotin compounds laboratory results

Analytes	Organotin Compounds		
	Monobutyltin	Dibutyltin	Tributyltin
Units	µg Sn/kg	µg Sn/kg	µg Sn/kg
ISQG-low			9
S1	<1	<1	<0.5
S2	<1	<1	<0.5
S3	<1	<1	<0.5
S4	<1	<1	<0.5
S5	<1	<1	<0.5
T1	<1	<1	<0.5
T2	<1	<1	<0.5
SP1	<1	<1	<0.5
SPT	<0.5	<0.5	<0.5
Mean	0.47	0.47	0.25
95% UCL	0.5	0.5	0.25

Appendix G QA/QC Results

Table 12 Metals QA/QC Results

Samples	Antimony	Arsenic	Cadmium	Chromium	Copper	Cobalt	Lead	Manganese	Nickel	Silver	Vanadium	Zinc
S4	0.25	2.19	0.05	13.2	0.5	0.25	3.5	18	0.5	0.5	2.2	3.4
T1	0.25	2.22	0.05	12.7	0.5	0.25	2.8	18	0.5	0.5	2.3	2.7
T2	0.25	2.34	0.05	13.4	0.5	0.25	2.9	18	0.5	0.5	2.5	3.2
RSD (%)	**0%**	**4%**	**0%**	**3%**	**0%**	**0%**	**12%**	**0%**	**0%**	**0%**	**7%**	**12%**
S4	0.25	2.19	0.05	13.2	0.5	0.25	3.5	18	0.5	0.5	2.2	3.4
SP1	0.25	2.31	0.05	13.5	0.5	0.25	3.4	18	0.5	0.5	2.5	3.9
RPD (%)	**0%**	**5%**	**0%**	**2%**	**0%**	**0%**	**3%**	**0%**	**0%**	**0%**	**13%**	**14%**
S4	0.25	2.19	0.05	13.2	0.5	0.25	3.5	18	0.5	0.5	2.2	3.4
SPT	200	N/A	2.5	0.05	11	7	0.5	620	2	14	0.5	0.5
RPD (%)	**10%**	**N/A**	**13%**	**0%**	**18%**	**173%**	**67%**	**14%**	**55%**	**25%**	**0%**	**164%**

Table 13 TRH and BETEX QA/QC Results

Analytes	TRH C6 - C10 Fraction	TRH C6 - C10 Fraction minus BTEX (F1)	TRH >C10 - C16 Fraction	TRH >C16 - C34 Fraction	TRH >C34 - C40 Fraction	TRH >C10 - C16 Fraction minus Naphthalene (F2)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes
S4	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
T1	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
T2	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
RSD (%)	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
SP1	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
RPD (%)	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5	1.5	2.5	1.5	1.5	0.1	0.1	0.1	0.1	0.25
SPT	0.1	N/A	0.1	0.2	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RPD	**175%**	**N/A**	**175%**	**153%**	**170%**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 14 TPH QA/QC results

Analytes	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	^C10-C36 Fraction (sum)
S4	1.5	1.5	1.5	2.5	1.5
T1	1.5	1.5	1.5	2.5	1.5
T2	1.5	1.5	1.5	2.5	1.5
RSD (%)	**0%**	**0%**	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5	2.5	1.5
SP1	1.5	1.5	1.5	2.5	1.5
RPD (%)	**0%**	**0%**	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5	2.5	1.5
SPT	0.1	N/A	0.2	0.2	N/A
RPD (%)	**175%**	**N/A**	**153%**	**170%**	**N/A**

Table 15 PAH QA/QC results

Samples	Naphthalene 91-20-3	2-Methylnaphthalene 91-57-6	Acenaphthylene 208-96-8	Acenaphthene 83-32-9	Fluorene 86-73-7	Phenanthrene 85-01-8	Anthracene 120-12-7	Fluoranthene 206-44-0	Pyrene 129-00-0	Benz(a)anthracene 56-55-3	Chrysene 218-01-9	Benzo(b+j)fluoranthene 205-99-2 205-82-3	Benzo(k)fluoranthene 207-08-9	Benzo(e)pyrene 192-97-2	Benzo(a)pyrene 50-32-8	Perylene 198-55-0	Benzo(g.h.i)perylene 191-24-2	Dibenz(a.h)anthracene 53-70-3	Indeno(1.2.3.cd)pyrene 193-39-5	Coronene 191-07-1	Sum of PAHs	Benzo(a)pyrene TEQ (zero)	Benzo(a)pyrene TEQ (half LOR)	Benzo(a)pyrene TEQ (LOR)
S4	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
T1	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
T2	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
RSD	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
S4	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
SP1	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
RPD	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
S4	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2	5	10
SPT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RPD	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 16 Organic compounds QA/QC results

Analytes	Monobutyltin	Dibutyltin	Tributyltin
Units	µg Sn/kg	µg Sn/kg	µg Sn/kg
S4	1.5	1.5	1.5
T1	1.5	1.5	1.5
T2	1.5	1.5	1.5
RSD (%)	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5
SP1	1.5	1.5	1.5
RPD (%)	**0%**	**0%**	**0%**
S4	1.5	1.5	1.5
SPT	0.25	0.25	0.25
RPD (%)	**67%**	**67%**	**0%**