Sediment Quality Sampling Summary Report – March 2022

MWPA Tourist Jetty

CLIENT: Mid West Ports Authority

STATUS: Rev 0

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WA Marine Pty Ltd t/as O2 Marine
ACN 168 014 819
Originating Office – Western Australia
11 Mews Road FREMANTLE WA 6160
T 1300 219 801 | info@o2marine.com.au

Version Register

Version	Status	Author	Reviewer	Change from Previous Version	Authorized for Release (signed and dated)
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Rev B	Draft	C Holder	K Reynolds	Internal review comments addressed in revised version	R Stevens 24/10/2022
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Name	Email Address
Kylie Reynolds	kylie.reynolds@midwestports.com.au

Executive Summary

Mid West Ports Authority (MWPA) is currently responsible for the development and management of a new Tourist Jetty proposed to be constructed to the east of the current Esplanade (Eastern Breakwater). The proposed Tourist Jetty is to be used by the commercial vessel fleet running tourism operations around the local area and to the Abrolhos Islands.

As part of this project a sediment quality investigation was implemented to assess the area around the current proposed Tourist Jetty. Sediment samples were collected within the study area at three sites, two using a surface grab sampler and one using diver push corer. Sediment samples were analysed by the laboratory for physical properties and toxicants.

Samples were typical of a nearshore coastal environment comprising of fine grey sands with the presence of shells/biota, slight odour, and low levels of foreign material. Sediments were dominated by sand-sized particles with most sediments having a slightly higher proportion of fine-grained sand. All contaminants in sediments were below ANZG (2018) guideline levels where they exist or detected at very low levels considered natural. Chemical parameters within sediments were also reported at low levels, typically representative of natural levels.

Sediments analysed in this report appear to be of natural origins and contaminant free, as expected for the natural environment setting of the proposed Project.

Acronyms, Abbreviations and Definitions

Acronyms and Abbreviations	Definitions
ANZG	Australia and New Zealand Guidelines
DGV	Default guideline value
EBW	Eastern Breakwater
EPA	Environmental Protection Authority
FRP	Filterable Reactive Hydrocarbons
MGA	Map Grid of Australia
MWPA	Mid-West Ports Authority
NATA	National Association of Testing Authorities
QAQC	Quality assurance and Quality control
RPD	Relative Percentage Difference
TBT	Tributyl Tin
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TOC	Total Organic Carbon
TRH	Total Reactive Hydrocarbons
WA	Western Australia

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1. Introduction

1.1. Project Background

Geraldton and the Eastern Breakwater (EBW) Project site are located approximately 430 km north of the Western Australian capital city of Perth on the Mid West coastline. Locally the EBW is situated on the eastern side of the Geraldton Port commercial harbour in the southern end of Champion Bay (Figure 1). The Midwest Ports Authority (MWPA) are responsible for the ongoing management and environmental performance of the Port and Port Waters.

MWPA have been instructed by the Minister for Transport to design and construct a new maritime facility to facilitate commercial vessels servicing the tourism industry. The tourism jetty will facilitate embarkation and disembarkation of tourists from the EBW via the gangway and jetty infrastructure onto vessels greater than 25 m in length. Vessels up to 2.8 m draft will be able to access the jetty under all tidal conditions, however larger vessels greater than 2.8 m draft will be restricted to specific tidal heights based on the navigational channel depth. Only one vessel at a time will be able to utilise the facility.

MWPA, in consultation with the City of Greater Geraldton, Department of Transport, and the Midwest Development Commission were appointed the lead agency, responsible for the final design, construction and ongoing operational management, navigational access requirements and environmental performance of the Tourism Jetty, access channel and surrounding waters.

1.2. Survey Purpose and Scope

The purpose of this survey was to investigate and assess sediment quality within the defined study area. This document provides a summary of the sediment quality within the survey area from a site-specific investigation. This report aims to:

- Collect, assess and characterise baseline sediment quality within the immediate and adjacent area.
- Document the field activities and methodologies.
- Present an assessment of analytical results against guideline values.

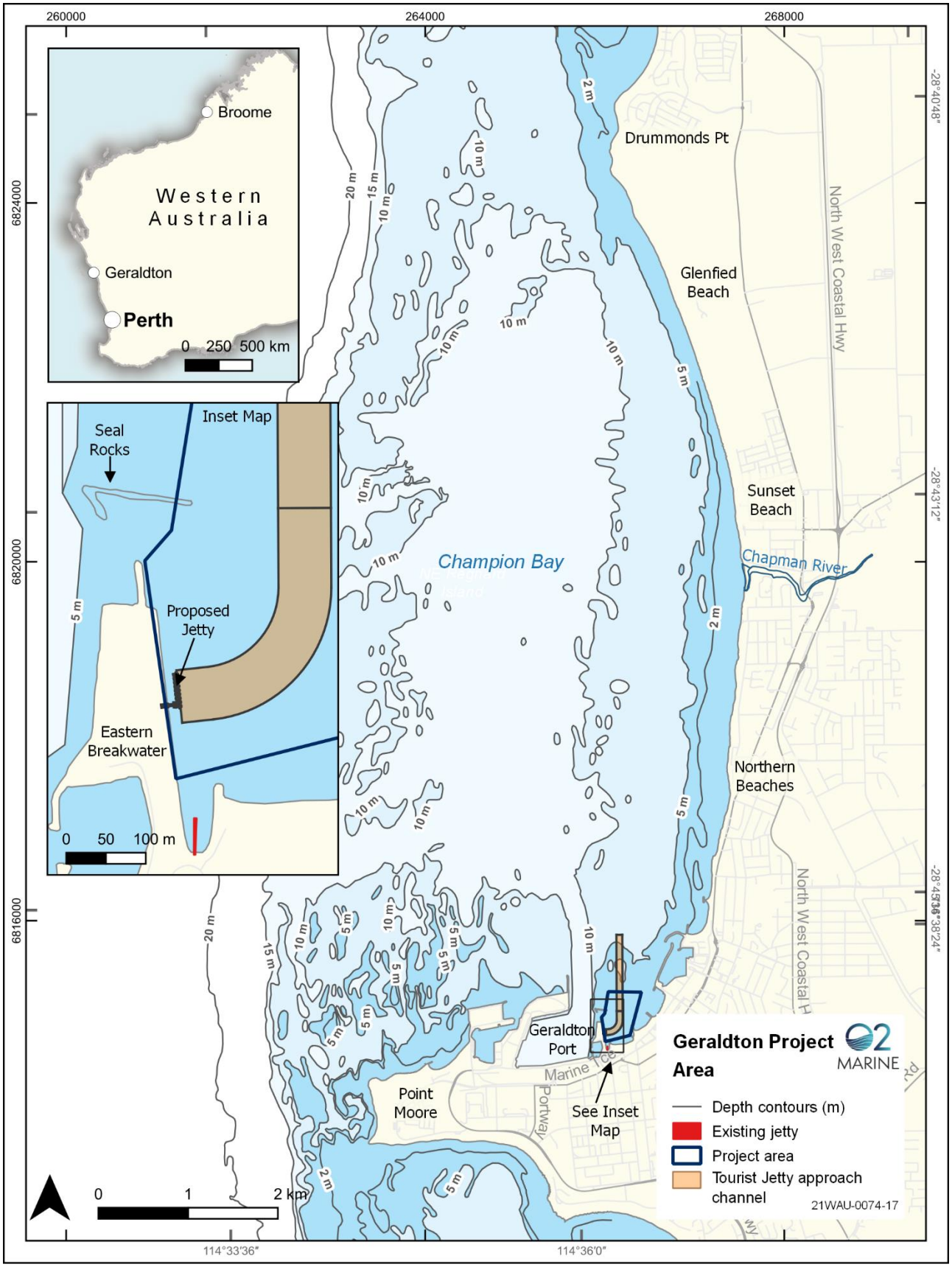

Figure 1: Site location

2. Methodology

Sediment quality sampling was conducted on 30th and 31st of March 2022 by suitably qualified marine scientists from the survey vessel "Freedom II". An overview of the methods is presented below.

2.1. Sampling Locations

The sampling program included the collection of sediment samples at three sites as presented in Table 1 and displayed in Figure 2.

Table 1: Sampling locations for the 2022 MWPA tourist jetty sampling

Site	Easting	Northing	Depth	Duplicate	Triplicate
TJ1	266004	6814813	4.5	X	-
TJ2	266008	6814721	4.2	-	-
TB1	266094	6814790	3.6	-	X

Note: Site TB1 is a previously established sediment sampling site, having been sampled annually since 1999 as part of MWPA Environmental License requirements.

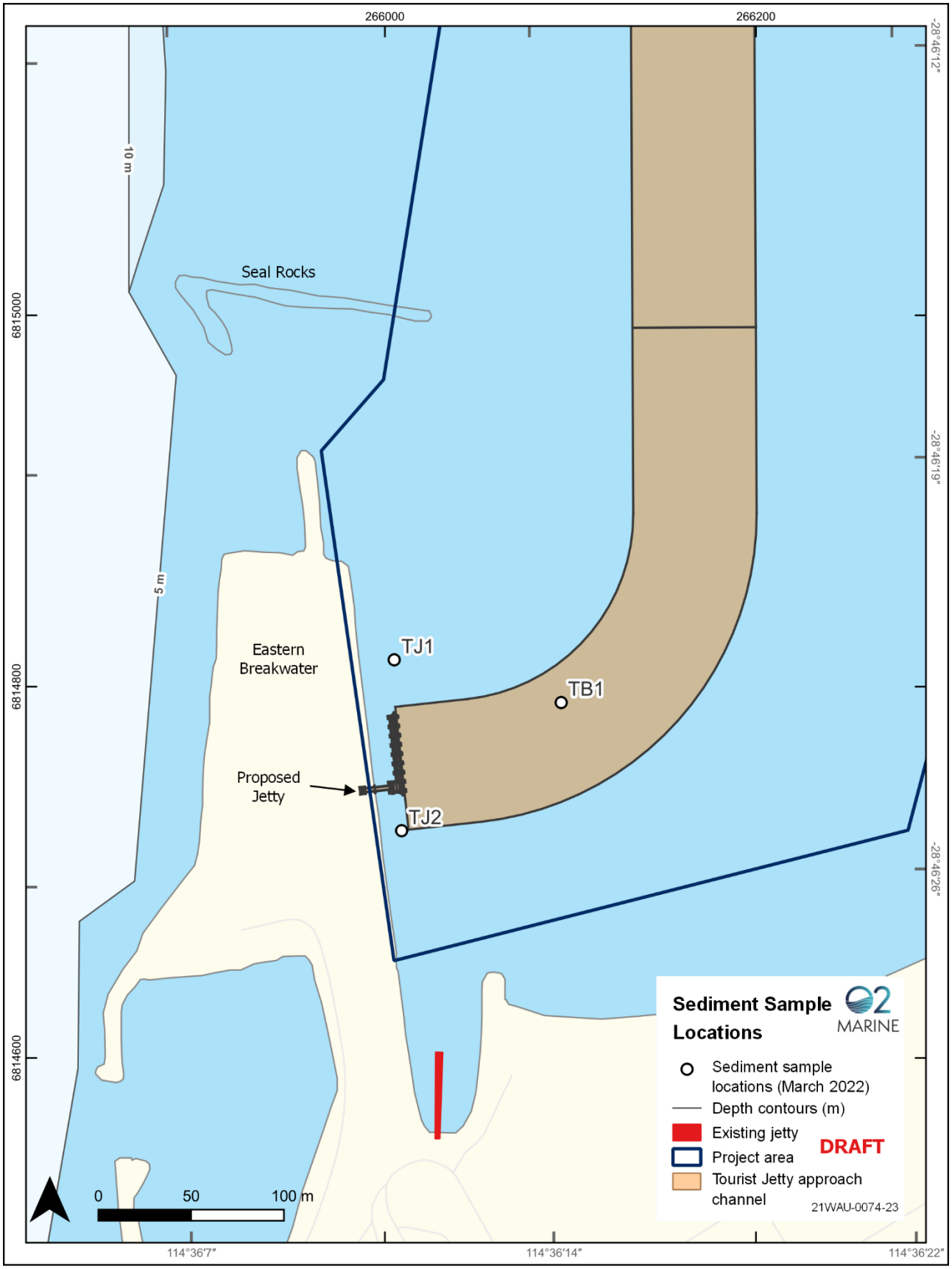

Figure 2: Sediment sampling locations

2.2. Sampling Procedures

Sediment samples were collected at sites TJ1 and TJ2 using a 'Van Veen' grab. The grab, plastic tray, and other equipment in contact with the sediment was rinsed with Decon solution and seawater prior to sampling each site to reduce potential for contamination. Where insufficient sediment was collected (i.e. less than 1/3rd of grab volume), the grab was redeployed. Upon sample recovery the Van Veen grab was emptied into a Pyrex mixing bowl, photographed, and described (including any organic material captured in the grab). Sediments were then homogenised and subsampled into pre-labelled sample jars/containers provided by a laboratory. Samples were placed into an esky with ice bricks and frozen overnight and delivered to a NATA approved laboratory.

For sediment samples collected at TB1 polyethylene sediment corers of 5 cm diameter were immersed by hand by divers to a depth of ~10 cm. Each sample comprised of five sediment cores collected as accurately as possible within each corner and in the centre of a 1m^2 quadrat. This sampling methodology is consistent with EPA (2005). The five cores were bought to the surface in a vertical position to maintain sediment profiles. Sediment characteristics (colour, particle size, foreign particles, organic matter, organisms, and odour) were recorded (Appendix A), a digital photograph was taken, and all five cores homogenised to represent a single sample. Subsamples of the homogenised sample were packed into the laboratory supplied sample containers and labelled with a unique sampling code.

2.3. Laboratory Analysis

All samples were submitted along with Chain of Custody (CoC) documentation (Appendix B) to Eurofins laboratory (NATA Accreditation #2377) for sediment analysis (Table 2).

Table 2: Sediment sampling analytical suite

Analyte	TJ1 and TJ2	TB1
Aluminium	X	X
Arsenic	X	X
Cadmium	X	X
Copper	X	X
Iron	X	X
Lead	X	X
Lithium	X	X
Mercury	X	X
Nickel	X	X
Vanadium	X	X
Silver	X	X
Zinc	X	X
Organotins (TBT)	-	X
Particle Size Distribution (PSD)	X	X

Analyte	TJ1 and TJ2	TB1
Total Organic Carbon (TOC)	X	X
Total Phosphorus (TP)	X	X
Total Nitrogen (TN)	X	-
Total Kjeldahl Nitrogen (TKN)	X	-
Filterable reactive phosphorus (FRP)	-	X
Poly Aromatic Hydrocarbons (PAH)	-	X
Total Reactive Hydrocarbons (TRH)	X	-
NO_X	X	-
Porewater NO_2, NO_3, NH_4, FRP	X	-

2.4. Data Analysis

Median values were reported from triplicate samples from site TB1. Data from TJ1, TJ2 and median values calculated from TB1 were pooled for comparison undertaken against the DGV and GV-High values (Table 3) where typically comparison of the 95% Upper Confidence Limit (UCL) to these values is used to determine the contamination status. Due to the sampling program incorporating only three sites, the assessment against the DGV and GV-High was undertaken without comparison to the 95% UCL, using raw laboratory reported concentrations for each parameter.

Table 3: DGVs and GV-high values from the sediment quality guidelines (ANZG 2018).

Constituents	DGV (mg/kg)	GV-high (mg/kg)
Aluminum (Al)	-	-
Arsenic (As);	20	70
Cadmium (Cd);	1.5	10
Copper (Cu);	65	270
Lead (Pb);	50	220
Lithium (Li)	-	-
Iron (Fe)	-	-
Mercury (Hg);	0.15	1.0
Nickel (Ni);	21	52
Silver (Ag);	1.0	4.0
Vanadium (V)	-	-
Zinc (Zn)	200	410
TBTs	9	70
Total phosphorous (TP)	-	-
Filterable reactive phosphorous (FRP)	-	-
Tributyltin (TBT) (µgSn/kg)	9.0	70
Total PAHs (µg/kg)	10,000	50,000

2.5. Sample QA/QC

In accordance with the SAP, the following QA/QC samples were collected:

- A duplicate sediment sample was collected at site TJ1; and
- Triplicate samples collected at TB1.

Laboratory QA/QC testing was conducted in accordance with NATA accreditation and include testing of laboratory control samples, method blanks, matrix spikes, certified reference materials, and laboratory duplicates.

3. Results

3.1. General Observations

General observations from field sampling are presented in Appendix A. During sampling, the wind was moderate at ~15 knots with low swell and calm sea surface conditions. The air temperature was approximately 20°C.

3.2. Sediment Sample Analysis

Laboratory certificates of analysis are presented in Appendix C and a sample results summary and assessment against the DGVs presented below. Where a group of analytes have not been detected at any sites above the laboratory limit of reporting (LoR), they have not been presented within tables or assessed against DGVs.

Sediments were generally dark grey in colour with slight odour and low foreign material and shell grit/biota content (Appendix A). The sediments from all sites were dominated by the silt and fine sand-sized fraction with most sediments comprising a high proportion of fine-grained sand (Table 4and Figure 3).

The concentration of TBT, PAHs (TB1 only), and TRH in sediment were all below the LoR and the DGVs. Several metals (arsenic, cadmium, mercury, nickel, and silver) reported one or more values below laboratory LoR. Remaining metals had detections at all sites, however no metals were detected at concentrations above DGVs (Table 5). Concentrations of metals reported between 2018-2022 for site TB1 and reference sites CS1 and CS2 were included in Appendix D. A very low level of organic matter was observed where maximum Total Organic Carbon (TOC) concentration reported was 1.3% at site TJ2 (Table 5).

Nitrate and nitrite in porewater samples were reported below the LoR for site TJ2, and at low concentrations slightly above the LoR at site TJ1. Ammonium ranged from 63 mg/L to 47 mg/L at TJ1 and TJ2 respectively. FRP was reported at similar concentrations at both sites ranging from 1.3-1.5 mg/L (Table 6). Porewater nutrients analysis was not conducted for site TB1. Inter-site variability reported for nutrient concentrations in sediment at tourist jetty sites was low, where minor differences were reported between tourist jetty sites and TB1 for all analytes (Table 6).

Table 4: Particle size distribution by laser diffraction (%)

Sites	Clay (0–4 µm)	Silt (4–62 µm)	Fine Sand (62–250 µm)	Medium Sand (250–500 µm)	Coarse Sand (500–2000 µm)	Gravel (>2000 µm)
TJ1	6.38	51.25	36.85	2.61	1.97	0.94
TJ2	5.76	47.32	40.58	3.13	2.74	0.47
TB1	2.25	17.18	59.06	0.69	13.87	6.95

Note: Yellow highlighted cells represent the highest size fraction for each sample

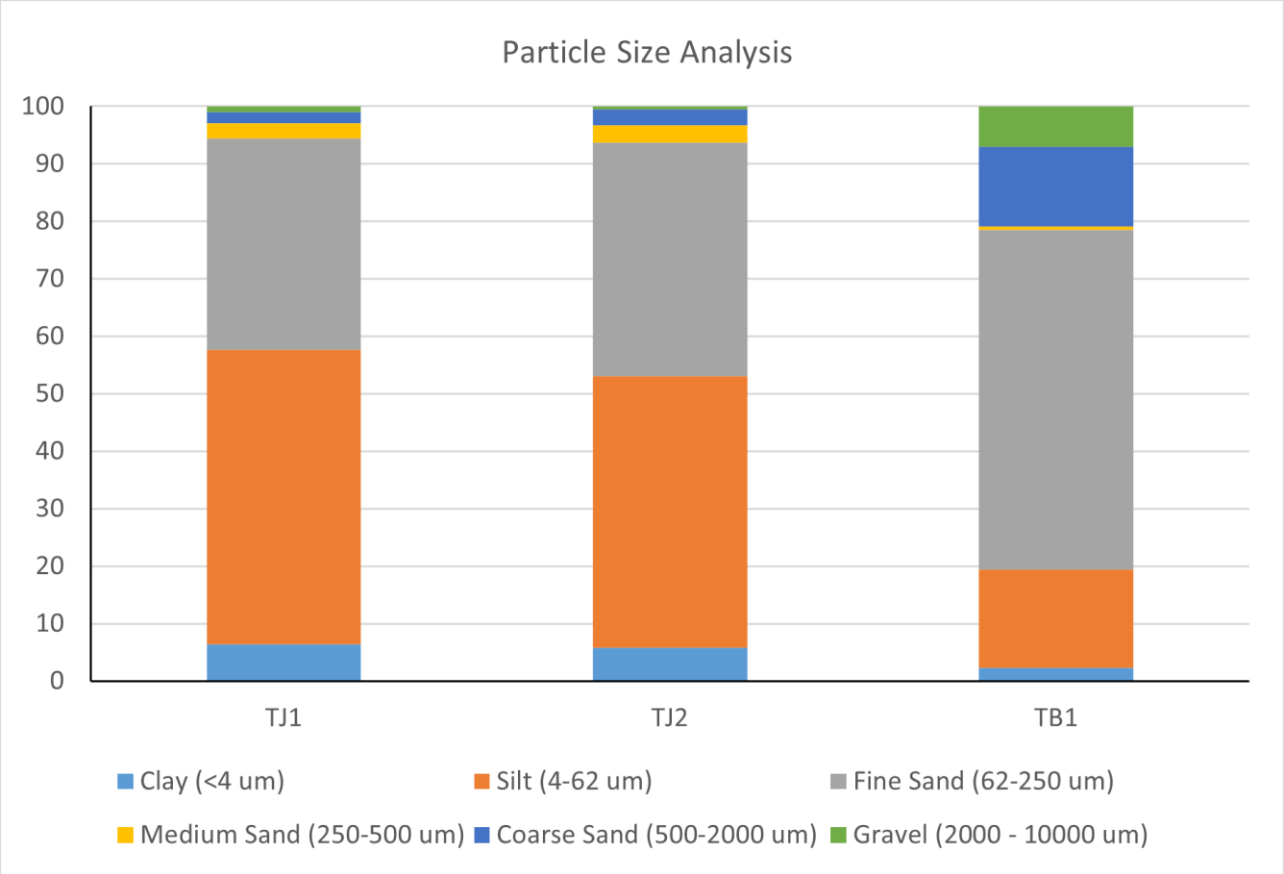

Figure 3 Sediment particle size distribution

Table 5: Sediment quality results for TOC, TBT, and metals for 2022

Site	TOC	TBT	Al	As	Cd	Cu	Fe	Pb	Li	Hg	Ni	Ag	V	Zn
Units	%		mg/kg											
DGV	-	9	-	20	1.5	65	-	50	-	0.15	21	1	-	200
GV-High	-	70	-	70	10	270	-	220	-	1	52	4	-	410
TJ1	1.1	-	2300	5.4	0.2	51	3800	10	4.7	0.1	2.3	< 1	11	69
TJ2	1.3	-	2300	5.7	0.2	46	3800	9.7	4.6	0.1	2.3	< 1	11	69
TB1	0.4	<0.5	490	<5	<0.1	13	820	1.4	2.1	<0.02	<1	<1	2.2	11

Table 6: Porewater and sediment nutrient quality results for 2022

Site	NH_4	Nitrate-N	Nitrite-N	FRP	TP	TKN	TN	NOx-N	FRP
Units	mg/L				mg/kg				
LoR	0.02	0.01	0.01	0.01	1	10	10	1	1
TB1	-	-	-	-	390	-	-	-	<1
TJ1	63	0.02	0.02	1.5	540	1200	1200	2.3	-
TJ2	47	0.01	0.01	1.3	540	1300	1300	1.1	-

3.3. QA/QC Assessment

3.3.1. Field Sampling QA/QC

Results of the QA/QC assessment for sample duplicates collected at TJ1 and sample triplicates sampled at TB1 are presented in Appendix E. All RPDs for metals and TOC were within acceptable limits (<35%). QA/QC assessment for porewater samples concluded two analytes with a higher than acceptable RPD which were FRP and Nitrite in porewater, being 105% and 67% respectively. However as recorded concentrations for FRP and nitrite were very low, small changes in concentration for these analytes likely yielded the larger RPD value.

Triplicate QA/QC analysis of samples at TB1 were all within acceptable limits (<50%) for all analytes.

It is considered that the data reported herein is suitable for the purposes of this assessment.

3.3.2. Laboratory QA/QC

Laboratory QA/QC reports are presented in in Appendix C. The QA/QC results reported from the laboratory are within acceptable criteria. The following results are recorded for the primary laboratory:

- All method blanks are below the LoR;
- All laboratory control spikes for all analytes are within acceptable reported recovery levels;
- All laboratory duplicates were reported within acceptable RPD limits;
- Matrix spike samples for all analytes are within acceptable reported surrogate recovery levels; and
- Certified Reference Material (CRM) was reported within acceptable recovery levels.

These results provide a high level of assurance that the laboratory analytical methods and processes are robust, and a high level of confidence can be placed in the interpretation of reported results.

4. Discussion and Conclusions

The sediment quality results reported herein generally indicate clean, contaminant free substrates, as expected for the natural environmental setting of the proposed Project. Samples were typical of a nearshore coastal environment comprising fine grey sands with the presence of shells/biota, slight odour, and low levels of foreign material. Sediments were dominated by sand-sized particles with most sediments having a slightly higher proportion of fine-grained sand. Total organic carbon levels were very low indicating sediments comprise low levels of organic matter, which was also evident in visual observation of samples. All metal concentrations were below the available guideline values, whilst hydrocarbon concentrations were all below the laboratory limits of reporting.

Total metal concentrations can be strongly influenced by particle size, with increased metal-binding in sediments comprising greater portions of fine clay or silt sized particles (e.g., <63 µm) (Zhang *et. al.* 2014). Variability in particle size and metals concentration was observed between tourist jetty sites TJ1 and TJ2 and site TB1, where a higher proportion of fines (<63 µm), and slightly higher concentrations of metals were observed at tourist jetty sample sites. This trend is consistent with O2 Marine (2022), where elevated concentrations of metals and greater metal enrichment was observed within fringing areas of the commercial harbour where generally a high proportion of fines (<63 um) were reported. In the context of historical sampling at TB1, results remain consistent with generally lower metals concentrations being reported, and at levels similar to established reference sites albeit with slightly higher historical copper, lead, and zinc concentrations generally attributable to differences within particle size distribution.

Nutrient porewater samples generally had low variability between sites, with several analytes reporting concentrations close to or below laboratory LoRs. Similar trends were observed in sediment nutrient concentrations which exhibited low inter-site variability. Sediment nutrients are generally of organic nature indicated by similar TKN and TN concentrations. No evidence of toxic ammonification and nitrification is apparent within nutrients and porewater, though NOx-N levels are very low in porewaters, indicating low nitrification, or high levels of dilution occurring with the water column. As all analytes were reported below guideline values where applicable, existing sediment quality is commensurate with a high level of ecological protection, as afforded to a natural environmental setting (ANZG 2018).

5. References

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.

Chang Zhang, Zhi-gang Yu, Guang-ming Zeng, Min Jiang, Zhong-zhu Yang, Fang Cui, Meng-ying Zhu, Liu-qing Shen, Liang Hu (2014). Effects of sediment geochemical properties on heavy metal bioavailability. Environment International, Volume 73, pp 270-281.

Environmental Protection Authority (EPA) (2005). Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria: A supporting document to the Draft State Environmental (Cockburn Sound) Policy.

O2M (2022). Geraldton Port Annual Sediment Compliance Survey 2022. Report prepared by O2 Marine for Mid West Ports Authority.

Appendix A. Field Log

Sediment Sampling Record

Project Details		Weather Observations	
Job Number:	21WAU-0074	**Sampling Dates:**	31 3
Project Title:	Geraldton Tourist Jetty Sediment Sampling 2022	**Air Temp. (°C):**	20
Client:	Midwest Ports Authority	**Wind Speed (knts):**	15
Field Staff:	Russell Stevens, Paul Day and Mike Rule	**Wind Direction:**	NE
		Sea State:	Calm

SITE	EASTING	NORTHING	DEPTH (m)	TRIPLICATE	~~FIELD SPLIT~~ DUP	DATE	TIME	DEPTH (m)	DIVER	TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
TJ1	GPS		0.5	N	DUP1	31.3	10.00	4.5	✓	F Sand	Dk Gr	L	L	Slight	4 Jars
TJ2	GPS		0.5	N	X	31.3	10:15	4.2	✓	"	"	"	"	"	4 Jars
DUP1			0.5	N											3 Jars

Appendix B. Chain of Custody

Chain of Custody (CoC) Record

Project:	Geraldton Tourist Jetty Sediment Sampling 2022			**Laboratory:**	ARL/Eurofins													**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.	
Client:	Midwest Ports Authority	**Job No.:**	21WAU-0074	**Address:**	46-48 Banksia Road, WELSHPOOL, WA, 6106														
Lab Quote No.:	O2M 240222	**Turnaround Time:**	Standard	**Lab. Contact:**	Kim Rogers														
O2M Project Manager	Russell Stevens (0447 465 009)	**Email Address:**	russell.stevens@o2marine.com.au		**Containers**				**Analyses**										
O2M Sample ID	**Laboratory Sample ID**	**Date**	**Time**	**Sample Matrix** S-Soil / SL-Sludge / W-Water / A-Air	**Type** B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic / B-Bag	**No. of Samples**	**Total Volume (mL)**	Total Metals (Ag, Al, As, Cd, Cu, Fe, Pb, Li, Hg, Ni, V, Zn)	Particle Size Distribution	TRH	TOC	TN, TKN, Nox, TP	Porewater NO2, NO3, NH4, FRP				**Comments**	
TJ1		31/03/2022	10:00	S	4J	4	1000	X	X	X	X	X	X				All soil samples are marine sediment	
TJ2		31/03/2022	10:15	S	4J	4	1000	X	X	X	X	X	X					
DUP-1		31/03/2022		S	3J	3	750	X		X	X	X	X					
																	LORs as per Quote No. O2M 240222	

Sampled By:	R Stevens	**Date/Time:**	30/03/2022 - 1/04/2022	**Relinquished By:**	P Day
Received By Lab:	MS	**Date/Time:**	1/04 1500	**Date/Time**	01/04/22 ~1300
Sample Cold (Yes/No):	Y	**Sample Container Sealed (Yes/No):**			

876872

#1 Esk: 3.1°C
#2 Esk: 4.7°C
#3 Esk: 6.4°C /3 = 4.73°C

Appendix C. Laboratory Analytical Reports

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

Attention: **Russel Stevens**

Report **876822-S**
Project name Geraldton Tourist Jetty Sediment Sampling
Project ID 21WAU-0074
Received Date Apr 01, 2022

Client Sample ID			**TJ1**	**TJ2**	**DUP-1**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**L22-Ap0004055**	**L22-Ap0004057**	**L22-Ap0004059**
Date Sampled			**Mar 31, 2022**	**Mar 31, 2022**	**Mar 31, 2022**
Test/Reference	LOR	Unit			
TRH in Soil/Sediment					
TRH C6-9	0.2	mg/kg	< 0.2	< 0.2	< 0.2
TRH C10-14	0.2	mg/kg	< 0.2	< 0.2	< 0.2
TRH C15-28	0.4	mg/kg	< 0.4	< 0.4	< 0.4
TRH C29-36	0.4	mg/kg	< 0.4	< 0.4	< 0.4
TRH C>36	0.4	mg/kg	< 0.4	< 0.4	< 0.4
NOx-N	1	mg/kg	2.3	1.1	3.0
TOC	0.1	%	1.1	1.3	1.0
Total Kjeldahl Nitrogen	10	mg/kg	1200	1300	1200
Total Nitrogen	10	mg/kg	1200	1300	1200
Aluminium	1	mg/kg	2300	2300	2700
Arsenic	5	mg/kg	5.4	5.7	5.5
Cadmium	0.1	mg/kg	0.2	0.2	0.2
Copper	1	mg/kg	51	46	55
Iron	1	mg/kg	3800	3800	4100
Lead	1	mg/kg	10	9.7	10
Lithium	1	mg/kg	4.7	4.6	4.8
Mercury	0.02	mg/kg	0.10	0.10	0.08
Nickel	1	mg/kg	2.3	2.3	2.6
Phosphorus	1	mg/kg	540	540	580
Silver	1	mg/kg	< 1	< 1	< 1
Vanadium	2	mg/kg	11	11	12
Zinc	1	mg/kg	69	69	73
% Moisture	1	%	45	45	45

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
TRH in Soil/Sediment	Welshpool	Apr 04, 2022	14 Days
- Method: ARL010 - Total Petroleum Hydrocarbons (TPH) in Soil			
TOC	Welshpool	Apr 04, 2022	28 Days
- Method: ARL No. 064 - Total Organic Carbon in Sediment			
Aluminium	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Arsenic	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Cadmium	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Copper	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Iron	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Lead	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Lithium	Welshpool	Apr 04, 2022	180 Day
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Mercury	Welshpool	Apr 04, 2022	28 Days
- Method: ARL No. 406 - Mercury by Cold Vapour Atomic Absorption Spectrophotometry			
Nickel	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Phosphorus	Welshpool	Apr 04, 2022	7 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Silver	Welshpool	Apr 04, 2022	180 Days
- Method: ARL030 - Metals in Soil and Sediment by AAS			
Vanadium	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Zinc	Welshpool	Apr 04, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
NOx-N	Welshpool	Apr 04, 2022	7 Days
- Method: ARL314 - NOx in Soil and Sediment by Discrete Analyser			
Total Kjeldahl Nitrogen	Welshpool	Apr 04, 2022	7 Days
- Method: ARL118 - Total Phosphorus and TKN in Soil and Biosolids			
Total Nitrogen	Welshpool	Apr 04, 2022	7 Days
- Method: ARL No. 330 - Persulfate Method for Simultaneous Determination of TN & TP			
% Moisture	Welshpool	Apr 04, 2022	14 Days
- Method: ARL135 Moisture in Solids			

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
TRH in Soil/Sediment							
TRH C6-9	mg/kg	< 0.2			0.2	Pass	
TRH C10-14	mg/kg	< 0.2			0.2	Pass	
TRH C15-28	mg/kg	< 0.4			0.4	Pass	
TRH C29-36	mg/kg	< 0.4			0.4	Pass	
TRH C>36	mg/kg	< 0.4			0.4	Pass	
Method Blank							
NOx-N	mg/kg	< 1			1	Pass	
TOC	%	< 0.1			0.1	Pass	
Total Kjeldahl Nitrogen	mg/kg	< 10			10	Pass	
Aluminium	mg/kg	< 1			1	Pass	
Copper	mg/kg	< 1			1	Pass	
Iron	mg/kg	< 1			1	Pass	
Lead	mg/kg	< 1			1	Pass	
Mercury	mg/kg	< 0.02			0.02	Pass	
Nickel	mg/kg	< 1			1	Pass	
Phosphorus	mg/kg	< 1			1	Pass	
Vanadium	mg/kg	< 2			2	Pass	
Zinc	mg/kg	< 1			1	Pass	
LCS - % Recovery							
Aluminium	%	102			80-120	Pass	
Arsenic	%	118			80-120	Pass	
Cadmium	%	95			80-120	Pass	
Copper	%	104			80-120	Pass	
Iron	%	106			80-120	Pass	
Lead	%	106			80-120	Pass	
Lithium	%	104			80-120	Pass	
Mercury	%	108			60-120	Pass	
Nickel	%	104			80-120	Pass	
Phosphorus	%	101			80-120	Pass	
Silver	%	98			80-120	Pass	
Vanadium	%	97			80-120	Pass	
Zinc	%	98			80-120	Pass	
CRM - % Recovery							
Total Kjeldahl Nitrogen	%	117			80-120	Pass	
Aluminium	%	112			80-120	Pass	
Arsenic	%	108			80-120	Pass	
Cadmium	%	105			80-120	Pass	
Copper	%	100			80-120	Pass	
Iron	%	98			80-120	Pass	
Lead	%	97			80-120	Pass	
Nickel	%	99			80-120	Pass	
Silver	%	111			80-120	Pass	
Vanadium	%	95			80-120	Pass	
Zinc	%	94			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
TOC	L22-Ap0003427	NCP	%	110			80-120	Pass	
Lead	L22-Ap0003425	NCP	%	91			80-120	Pass	
Mercury	L22-Ap0003425	NCP	%	115			80-120	Pass	
Nickel	L22-Ap0003425	NCP	%	88			80-120	Pass	
Vanadium	L22-Ap0003425	NCP	%	106			80-120	Pass	
Zinc	L22-Ap0003372	NCP	%	106			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
TRH in Soil/Sediment				Result 1	Result 2	RPD			
TRH C6-9	L22-Ma56525	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
TRH C10-14	L22-Ma56525	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
TRH C15-28	L22-Ma56525	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
TRH C29-36	L22-Ma56525	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
TRH C>36	L22-Ma56525	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
NOx-N	L22-Ap0004055	CP	mg/kg	2.3	2.2	4.0	20%	Pass	
TOC	L22-Ap0003426	NCP	%	0.8	0.8	10	20%	Pass	
Total Kjeldahl Nitrogen	L22-Ap0004055	CP	mg/kg	1200	1200	<1	20%	Pass	
Aluminium	L22-Ap0003390	NCP	mg/kg	4800	4300	9.0	20%	Pass	
Iron	L22-Ap0003370	NCP	mg/kg	410	450	11	20%	Pass	
% Moisture	L22-Ap0027364	NCP	%	4.2	4.2	1.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Arsenic	L22-Ap0004059	CP	mg/kg	5.5	5.5	1.0	20%	Pass	
Cadmium	L22-Ap0004059	CP	mg/kg	0.2	0.2	5.0	20%	Pass	
Copper	L22-Ap0004059	CP	mg/kg	55	47	<1	20%	Pass	
Lead	L22-Ap0004059	CP	mg/kg	10	9.5	<1	20%	Pass	
Lithium	L22-Ap0004059	CP	mg/kg	4.8	4.7	1.0	30%	Pass	
Mercury	L22-Ap0004059	CP	mg/kg	0.08	0.07	13	30%	Pass	
Nickel	L22-Ap0004059	CP	mg/kg	2.6	2.5	8.0	20%	Pass	
Phosphorus	L22-Ap0004059	CP	mg/kg	580	500	3.0	30%	Pass	
Silver	L22-Ap0004059	CP	mg/kg	< 1	< 1	<1	20%	Pass	
Vanadium	L22-Ap0004059	CP	mg/kg	12	10	2.0	20%	Pass	
Zinc	L22-Ap0004059	CP	mg/kg	73	68	7.0	20%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Douglas Todd	Analytical Services Manager
Maxine Saw	Senior Analyst-Inorganic
Paul Nottle	Senior Analyst-Organic
Sam Becker	Senior Analyst-Inorganic
Sean Sangster	Senior Analyst-Metal
Sean Sangster	Senior Analyst-Sample Properties

Kim Rodgers
Business Unit Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request

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

NATA Accredited
Accreditation Number 2377
Site Number 2370

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Russel Stevens**

Report **876822-W**
Project name Geraldton Tourist Jetty Sediment Sampling
Project ID 21WAU-0074
Received Date Apr 01, 2022

Client Sample ID			**TJ1**	**TJ2**	**DUP-1**
Sample Matrix			**Water**	**Water**	**Water**
Eurofins Sample No.			**L22-Ap0004056**	**L22-Ap0004058**	**L22-Ap0004060**
Date Sampled			**Mar 31, 2022**	**Mar 31, 2022**	**Mar 31, 2022**
Test/Reference	LOR	Unit			
Ammonia-N	0.02	mg/L	63	47	49
Filterable Reactive Phosphorus	0.01	mg/L	1.5	1.3	0.47
Nitrate-N	0.01	mg/L	0.02	0.01	0.01
Nitrite-N	0.01	mg/L	0.02	0.01	0.02

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Ammonia-N	Welshpool	Apr 04, 2022	28 Days
- Method: ARL303 - Ammonia in Water by Discrete Analyser			
Filterable Reactive Phosphorus	Welshpool	Apr 04, 2022	28 Days
- Method: ARL309 - Filterable Reactive Phosphorus in Water by Discrete Analyser			
Nitrate-N	Welshpool	Apr 04, 2022	28 Days
- Method: ARL313/319 - NOx in Water by Discrete Analyser			
Nitrite-N	Welshpool	Apr 04, 2022	2 Days
- Method: ARL311 - Nitrite in Water by Discrete Analyser			

Internal Quality Control Review and Glossary

General

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3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
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6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
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NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

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COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
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LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
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RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Ammonia-N			mg/L	< 0.02			0.02	Pass	
Filterable Reactive Phosphorus			mg/L	< 0.01			0.01	Pass	
Nitrate-N			mg/L	< 0.01			0.01	Pass	
Nitrite-N			mg/L	< 0.01			0.01	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Ammonia-N	L22-Ap0044760	NCP	%	101			80-120	Pass	
Filterable Reactive Phosphorus	L22-Ap0056972	NCP	%	110			80-120	Pass	
Nitrite-N	L22-Ap0055945	NCP	%	105			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Ammonia-N	L22-Ap0044759	NCP	mg/L	1.9	1.9	1.0	20%	Pass	
Filterable Reactive Phosphorus	L22-Ap0056971	NCP	mg/L	0.30	0.30	1.0	20%	Pass	
Nitrite-N	L22-Ap0038126	NCP	mg/L	< 0.01	< 0.01	<1	20%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Douglas Todd	Analytical Services Manager
Sam Becker	Senior Analyst-Inorganic

Kim Rodgers
Business Unit Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request

Appendix D. Historical metals data

Site		TB1	CS1	CS2
Metals	Year			
Aluminium	2018	750	890	550
	2019	540	440	320
	2020	560	420	440
	2021	710	510	440
	2022	490	440	410
Arsenic	2018	2.0	3.2	3.0
	2019	2.5	2.7	2.4
	2020	2.1	2.5	4.2
	2021	2.5	2.5	2.5
	2022	2.5	2.5	2.5
Cadmium	2018	0.1	0.2	0.2
	2019	0.1	0.1	0.1
	2020	0.1	0.2	0.1
	2021	0.1	0.1	0.1
	2022	0.1	0.1	0.1
Copper	2018	3.1	0.9	0.5
	2019	15.0	8.0	8.0
	2020	7.4	0.5	0.5
	2021	15.0	7.0	7.0
	2022	13	8	9
Lead	2018	1.9	1.5	1.5
	2019	8.0	1.0	2.0
	2020	5.5	1.7	1.6
	2021	3.0	1.0	1.0
	2022	1.4	0.5	0.5
Nickel	2018	0.7	0.9	0.7
	2019	0.5	0.5	0.5

	2020	0.5	0.5	0.5
	2021	0.5	0.5	0.5
	2022	0.5	0.5	0.5
Zinc	2018	6.1	3.3	2.0
	2019	16.0	3.0	2.0
	2020	20.4	3.7	2.1
	2021	18.0	3.0	2.0
	2022	11.0	2.6	2.4
Vanadium	2018	2.4	4.7	3.8
	2019	4.0	5.0	4.0
	2020	3.0	4.0	5.0
	2021	4.0	5.0	4.0
	2022	2.2	5.3	5.1
Iron	2018	930	1400	960
	2019	1200.0	900.0	730.0
	2020	930	800	990
	2021	1100	980	800
	2022	820	1100	1000
Silver	2018	0.1	0.1	0.1
	2019	0.5	0.5	0.5
	2020	0.1	0.1	0.1
	2021	0.5	0.5	0.5
	2022	0.5	0.5	0.5
Mercury	2018	0.01	0.01	0.01
	2019	0.20	0.05	0.03
	2020	0.03	0.01	0.01
	2021	0.03	0.01	0.01
	2022	0.01	0.01	0.01

Appendix E. Field QAQC

Table 7 Metals and TOC RPD calculation results

Sample ID	TOC	Al	As	Cd	Cu	Fe	Pb	Li	Hg	Ni	Ag	V	Zn
Units	%	mg/kg											
LoR	1	1	5	0.1	1	1	1	0.1	1	1	1	1	1
TJ1	1.1	2300	5.4	0.2	51	3800	10	4.7	0.1	2.3	< 1	11	69
DUP-1	1	2700	5.5	0.2	55	4100	10	4.8	0.08	2.6	< 1	12	73
RPD (%)	*10%*	*16%*	*2%*	*0%*	*8%*	*8%*	*0%*	*2%*	*22%*	*12%*	-	*9%*	*6%*

Table 8 Nutrient RPD calculation results in porewater and sediment

Sample ID	NH4	Nitrate-N	Nitrite-N	TP	TKN	TN	NOx-N	FRP
Units	mg/L			mg/kg				
LoR	0.02	0.01	0.01	1	10	10	1	0.01
TJ1	63	0.02	0.02	540	1200	1200	2.3	1.5
DUP-1	49	0.01	0.02	580	1200	1200	3	0.47
RPD (%)	*25%*	*67%*	*0%*	*7%*	*0%*	*0%*	*26%*	*105%*

Table 9 TOC, TBT, Nutrients and Metals RSD calculation results in sediment

Sample ID	TOC	TBT	TP	FRP	Al	As	Cd	Cu	Pb	Li	Ni	Zn	Ag	Fe	V	Hg
Units	%	µgSn/kg								mg/kg						
LoR	1	0.5	1	1	1	5	0.1	1	1	0.1	1	1	1	1	2	0.02
TB1-1	0.4	<0.5	490	<1	490	<5	<0.1	18	1.7	2	<1	17	<1	1000	2.9	<0.02
TB1-2	0.4	<0.5	380	<1	450	<5	<0.1	13	1.4	2.1	<1	11	<1	810	2.1	<0.02
TB1-3	0.4	<0.5	390	<1	570	<5	<0.1	13	1.1	3	<1	9.3	<1	820	2.2	<0.02
RSD (%)	*0%*	-	*14%*	-	*12%*	-	*0%*	*20%*	*21%*	*23%*	-	*33%*	-	*12%*	*18%*	-

WA Marine Pty Ltd trading as O2Marine
ACN 168 014 819
11 Mews Road Fremantle 6160
T: 1300 739 449
E: info@o2marine.com.au