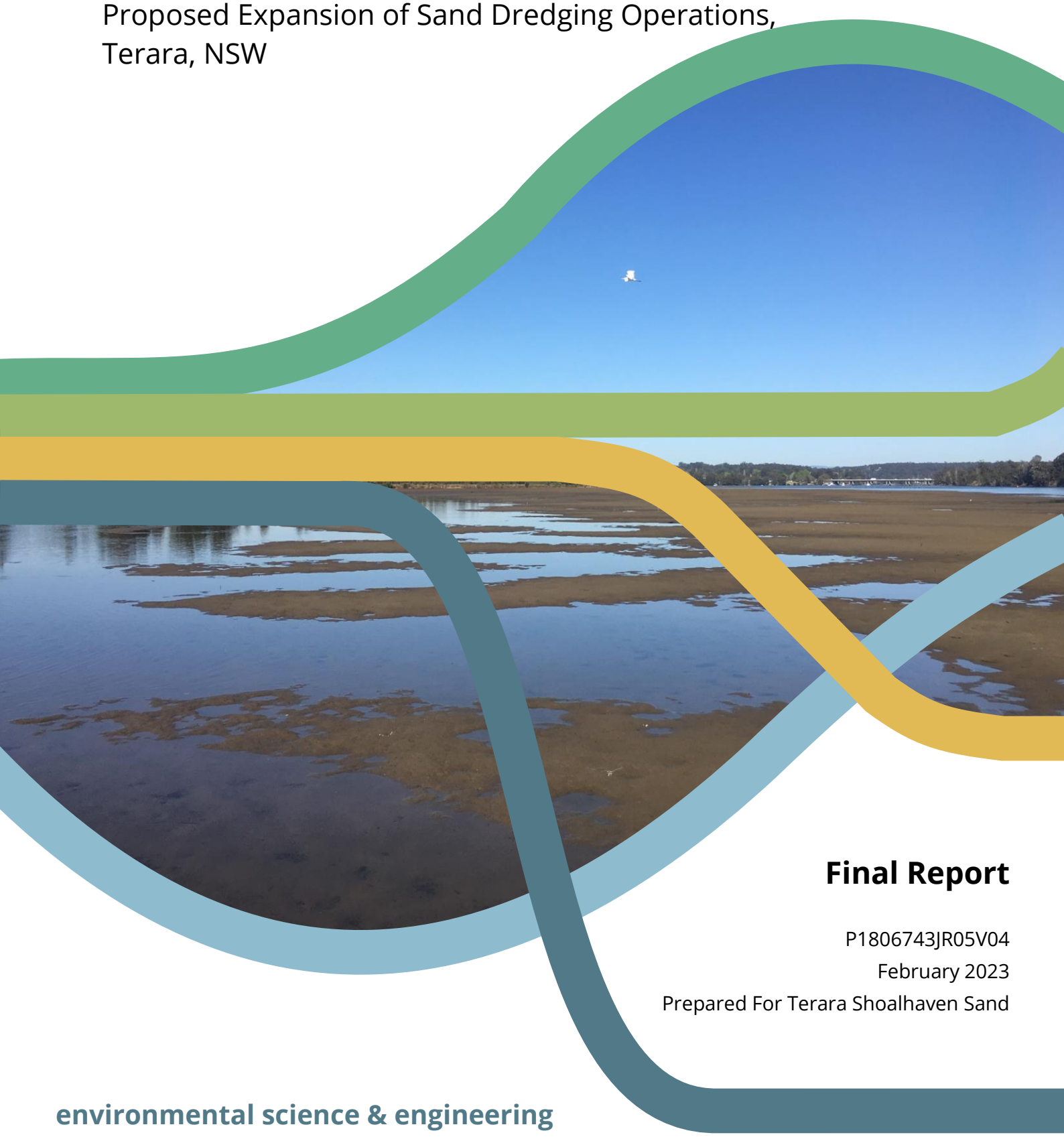
Estuarine and Surface Water Monitoring Plan

Proposed Expansion of Sand Dredging Operations, Terara, NSW



Final Report

P1806743JR05V04

February 2023

Prepared For Terara Shoalhaven Sand

environmental science & engineering

Project Details

Report Title	Estuarine and Surface Water Monitoring Plan: Proposed Expansion of Sand Dredging Operations, Terara, NSW
Client	Terara Shoalhaven Sand
Document	P1806743JR05V03
Director	Daniel Martens
Manager	Jeff Fulton
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Document History

Issue	Issue Date	Status	Description / Comment	Author	Reviewer	Approved
1	21/03/2018	Draft	Client Review	MV	BM, JF	JF
2	01/05/2018	Final	DA	MV	BM, JF	JF
3	26/09/2022	Final	Council RFI	MD	JF, DM	JF
4	24/02/2023	Final	Amended trigger values from DPE RFI	MD	JF, DM	JF

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1 Introduction

1.1 Overview

This estuarine and surface water monitoring plan (**ESWMP**) has been prepared in satisfaction of the Secretary's Environmental Assessment Requirements (**SEARs**) issued by the NSW Department of Planning and Environment (**NSW DPE**) (22 June 2018) for the proposed expansion of the existing sand extraction area in the vicinity of Burraga Island (Pig Island), Terara, NSW (the **Site**).

This ESWMP updates the version released on 1 May 2018 in response to Shoalhaven City Council's (**SCC**) request for information (the **RFI**) (19 April 2022, ref RA21/1000).

1.2 Scope

This ESWMP provides:

1. A summary of existing baseline water quality data.
2. An interim water quality monitoring plan for validating water quality modelling.
3. An operational water quality monitoring plan to be applied during extraction.

1.3 Controls and Guidelines

Relevant controls and guidelines considered in this ESWMP include:

1. SCC (2012) *Draft Shoalhaven Coastal Zone Management Plan*.
2. SCC (2008) *Shoalhaven River Estuary Management Plan*.
3. SCC (2014) *Development Control Plan*.
4. SCC (2014) *Local Environment Plan*.
5. NSW DPI Office of Water (2018) *Guidelines for riparian corridors on waterfront land*.
6. State Environmental Planning Policy (Resilience and Hazards) 2021.
7. Australian and New Zealand Environment and Conservation Council (2018) *National Water Quality Management Strategy – Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (**ANZECC 2018 guidelines**).

1.4 Background Documents

Background documents relevant to this ESWMP include:

1. *River Impact Assessment – Proposed expansion of Sand Extraction Area, Pig Island, Lower Shoalhaven* (P1103077JR01V03) (MA, 2012a)

2. *Supplementary Environmental Details – Proposed Expansion of Sand Extraction Area, Pig Island, Lower Shoalhaven* (P1103077JR01V03) (MA, 2012b)

3. *Estuarine Water Quality Impact Assessment: Proposed Expansion of Sand Dredging Operations, Terara, NSW* (P1806743JR06V01) MA, 2019).

1.5 Existing Environment

A summary description of the existing local environment is provided in Table 1.

Table 1: Summary description of existing local environment.

Site feature	Description
Address	Proposed extraction area includes river bed and sand flats to the west and north west of Burraga Island, Terara (Shoalhaven River), NSW.
Local Government Area (LGA)	Shoalhaven City Council
Proposed Extraction Area	Approximately 26.8 ha
Current zoning	W2 – Recreational Waterways
Site description and proposed use	The existing sand extraction area is located in the Shoalhaven River, to the south west of Burraga Island. The proposed development includes the extension of the existing dredging footprint to the west and north west of Burraga Island to allow extraction of sand via dredging.
Surrounding land uses	The northern bank of the Shoalhaven River is occupied with commercial / industrial properties, rural residential properties and agricultural land as well as the Bomaderry sewage treatment plant (**STP**). The river bank to the south contains a mixture of residential properties, agricultural land and commercial properties including Shoalhaven Caravan Village and Terara Riverside Retreat. The Terara STP is also located in close proximity to Terara Canal.
Topography	The extraction site area is located on expansive sand flats in the tidal portion of Shoalhaven River to the west and north west of Burraga Island. The proposed dredging area has an elevations of 0.19 – 0.25 mAHD in the north, - 1.11 mAHD in the east and – 2.7 mAHD in the west (from site survey).
Drainage	Nearby surface runoff (e.g. Burraga Island and mainland) is directed to the Shoalhaven River either directly or via local creeks and stormwater drainage systems.
Soil Landscape	The NSW Environment and Heritage eSPADE website identifies the site as having Shoalhaven soil landscapes consisting of alluvium – gravel, sand, silt and clay derived mainly from sandstone and shale overlying buried estuarine sediments.
Expected geology	The Wollongong 1:250,000 Geological Series Sheet S1 56.9 (1966) describes site geology as alluvium, gravel, swamp deposits and sand dunes.

2 Existing Water Quality Data

2.1 Project Specific Sampling

Project specific water quality monitoring has been completed as follows (refer to Appendix B for laboratory reports), with sampling locations provided in Map 2 and data summarised in Table 2:

1. Sampling in 2011 as completed in conjunction with the development proposal to extend the sand extraction lease area (Development Application RA12/1001), including WS01 – WS04.

2. Sampling in 2018 completed as part of the current application, including WS201 – WS205.

Table 2: Project specific sampling data.

Parameter	WS01	WS02	WS03	WS04	WS201	WS202	WS203	WS204	WS205
pH	7.6	7.7	7.7	7.7	7.5	7.6	7.7	7.6	7.6
Electrical Conductivity (µs/cm)	18,000	19,000	19,000	17,000	36,000	37,000	38,000	36,000	35,000
Total Suspended Solids (mg/L)	10.0	23.0	16.0	14.0	<5.0	<5.0	<5.0	<5.0	<5.0
BOD_5 (mg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total Nitrogen (mg/L)	1.3	1.1	1.1	1.0	0.2	0.1	0.1	0.1	<0.1
Ammonia (mg/L)	0.050	0.030	0.040	0.040	0.041	0.027	0.032	0.027	0.024
NO_x (mg/L)	0.100	0.080	0.080	0.200	0.009	0.010	0.006	0.010	0.020
Total Kjeldahl Nitrogen (mg/L)	1.2	1.0	1.0	0.9	0.2	0.1	0.1	0.1	<0.1
Total Phosphorus (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.06

2.2 Council Sampling

SCC undertake routine Shoalhaven River water quality monitoring in the vicinity of Burraga Island. Monitoring locations are provided in Map 3 and summarised in Table 3.

Table 3: Summary of SCC average monitoring data near Burraga Island.

Parameter	E-7	E-8	E-9	E-148	E-149	E-294	E-346	Mean[1]
Ph	7.4	7.5	7.6	7.5	7.4	7.7	7.5	7.52
Electrical Conductivity (dS/cm)	23.65	24.64	26.31	23.13	25.60	30.39	24.81	25.89
Total Suspended Sediment (mg/L)[2]	22	27	21	21	70	79	23	42
Total Nitrogen (mg/L)	1.90	0.39	0.40	0.31	0.35	0.32	0.51	0.34
Ammonia (mg/L)	1.32	0.06	0.05	0.06	0.00	0.08	0.09	0.07
Nox (mg/L)	0.78	0.17	0.09	0.05	0.09	0.04	0.18	0.05
Total Phosphorus (mg/L)	0.76	0.07	0.05	0.04	0.03	0.05	0.16	0.05

Notes:
1. Table excludes water quality results from sampling site E-7.
2. Estimated using TSS = $e^{(1.32 \times \ln(\text{Turbidity})+0.15)}$ (Packman *et al*, 1999).

2.3 Commentary

The following commentary is provided in respect of completed monitoring:

1. River water is brackish, which is expected given that all sampling sites are tidal.
2. pH is slightly alkaline but is within the anticipated range of trigger values for NSW estuarine waters given in Table 3.3.2 of the ANZECC 2018 guidelines.
3. Nutrient levels are variable and at times above guideline values for estuaries.[1]
4. Council's sampling location E-7 has the highest nutrient content, this being downstream of the Terara STP discharge location. Ammonia and NO_x are both similarly elevated at this location reflecting the release of treated effluent. It is likely that the throughput of nutrients from location E-7 may at times impact the local water quality environment.
5. Turbidity and suspended solids are variable, although higher levels occurred at monitoring points E-149 and E-294 is likely due to proximity to runoff discharging from local tributaries.
6. The monitoring plan should ideally take account of these local sources of pollutant so that they can be distinguished from site activities.

[1] Refer to Table 3.3.2 of ANZECC (2000).

3 Monitoring Plan

3.1 Sampling Locations

Sampling locations are shown on Map 4. These have been selected on the basis of the following criteria:

- Upstream and downstream control locations.
- Sampling close to the proposed extraction activities.
- Sampling at other potential pollutant source locations.

3.2 Analytes

Analytes to be monitored are provided in Table 4, which includes both grab sampling for NATA accredited laboratory analysis, and in-situ water quality probe sampling.

Table 4: Water quality analytes to be monitored.

Grab Sampling	In-situ Water Quality Probe
• Total Nitrogen • Ammonia-nitrogen • Kjeldahl-nitrogen • Oxidised-nitrogen • Total Phosphorus • Total suspended solids • 5 day Biochemical Oxygen Demand	• pH • Electrical conductivity • Temperature • Dissolved oxygen • Turbidity

3.3 Sampling Protocols

Sampling protocols are summarised in Table 5. Sample volumes are to be sufficient to allow for required physical and chemical analyses to be undertaken in accordance with laboratory analyses procedures. Sample volume, container / bottle and number of samples collected are to be in accordance with laboratory analysis procedures.

In-situ probe sampling shall be undertaken using a fully calibrated water quality meter. Calibration shall be against known standards and at frequencies in accordance with the manufacturer's recommendations. Details of calibration including frequency and details of the person(s) undertaking calibration of meters is to be included in reporting.

Table 5: Sampling protocols.

Sample Type	Sample Collection and Handling
Surface water grab samples	Sample to be collected by hand in laboratory supplied container and stored at appropriate temperature in a suitable container for transportation to laboratory under chain of custody controls. Samples are to be collected at a uniform depth of 0.5 m below the surface.
Surface water probe	Probe to be placed into water column at appropriate depth and measurements taken in accordance with probe instructions (re: minimum sampling time and stabilisation of readings, relevant probe angle, *etc.*). Probe to be decontaminated between sites. Samples are to be collected at a uniform depth of 0.5 m below the surface.

3.4 Recording Field Data

All field and *in-situ* probe sampling results shall be recorded on field data sampling forms which are to include details of unique sampling location identification, time, date and sampler details.

3.5 Decontamination of Sampling Equipment

All sampling equipment (bailers, probes, *etc.*) shall be either single use or be decontaminated between sampling locations. Where a sampling site either shows evidence of contamination or has previously been contaminated (e.g. visual confirmation of surface water conditions such as algal bloom or contaminant spill, sample colour, odour, *etc.*), all sampling equipment shall need to be cleaned thoroughly prior to continuation of sampling.

3.6 Quality Assurance and Control

All samples (including grab samples and field measurements) shall be subject to quality assurance protocols including:

1. During each sampling event duplicates are to be collected at a minimum rate of 1 duplicate rate per 10 primary samples. Duplicates are to be laboratory analysed for the same analytes as primary samples.

2. Quality assurance and control protocols during sampling and recording of field measurements will be undertaken for all monitoring and sampling in accordance with ANZECC/ARMCANZ (2000b) guidelines to ensure data integrity.

3. All grab samples for analysis are to be collected, stored and transported to a NATA accredited laboratory with appropriate sample containers and preservation as relevant to the analyte under chain of custody conditions.

4. Field measurements shall be checked for accuracy, reproducibility and discrepancies, with resampling as required, prior to leaving each sampling / monitoring site.

3.7 Occupational Health and Safety

Sampling shall be undertaken in accordance with relevant occupational health and safety guidelines and any approved risk management plan. Sampling shall only be undertaken at monitoring sites where the Site is able to be accessed safely, following an onsite review of weather and water conditions, relevant transportation means and method (e.g. relevant safety and operational checks of vessel, *etc.* to be used to confirm if it is safe to access monitoring sites), safety equipment (e.g. life preserver vests) and other relevant protocols prior to sampling being undertaken.

3.8 Training, Roles and Responsibilities

Roles, responsibilities and training related to the water quality monitoring are summarised in Table 6. All persons involved in the baseline water quality monitoring program will require a general site induction and specific risk management training relating to the ESWMP monitoring.

Table 6: Roles, training and responsibilities.

Role	Responsibilities	Required Water Quality Training
Site operator	• Organise access and transportation where necessary	• -
Transportation operator	• Maintenance and operation of transportation required to access monitoring sites	• General site induction • Risk assessment and occupational health and safety requirements. • Appropriate NSW vehicle operating licences
Sampling officer	• Organisation of site monitoring events • Collection of water quality grab and probe samples • Decontamination and onsite management of water quality sampling and testing equipment • Organisation of laboratory analyses of grab samples including full chain of custody • Review of site monitoring and debrief following each site monitoring event	• General site induction • Field sampling training including sample collection, storage and transport, field measurement using water quality probe(s) and familiarisation with field results sheets • Equipment maintenance and decontamination in field • Quality assurance training
Water quality data manager	• Management / collation of water quality data including all laboratory results and field measurements • Collation and review of other relevant climate or environmental data	• Water quality data analyses and management
Environmental engineer	• Process and analyse data • Write up water quality reports • Modify ESWMP as necessary	• Water quality data interpretation and reporting

3.9 Data Management

Surface water quality data management shall include the following:

1. All surface water quality sampling sites to be established and identified by GPS coordinates. GPS shall be used during subsequent testing and sampling events to ensure correct monitoring locations are assessed.

2. Each sample shall be identified by the unique sampling location name and dated.

3. Field data are to be transferred into an appropriate data storage system including data entry into databases, scanning field data sheets, uploading georeferenced photos as soon as practical following each site monitoring event.

4. Electronic storage of laboratory analysis reports.

3.10 Interim Monitoring Requirements

3.10.1 Objective

The interim monitoring plan seeks to confirm existing water quality conditions to verify and validate water quality modelling outcomes prepared in respect of the development application.

3.10.2 Additional Sampling Locations

The following supplementary monitoring locations (8 locations) are required in addition to the monitoring locations identified at Map 4:

- Samples collected 2 m upstream and downstream of the operating dredge, with one at 0.5 m depth and one at 1 m from the river bed.

- Samples collected 20 m upstream and downstream of the operating dredge, with one at 0.5 m depth and one at 1 m from the river bed.

3.10.3 Sampling Period and Frequency

Interim sampling shall be undertaken for a period of 2 months at 2 weekly intervals. A minimum of 4 sampling rounds shall be collected.

3.10.4 Reporting

At the completion of the interim sampling period, an interim water quality monitoring report shall be prepared to include the following:

1. A summary of collected water quality data.

2. Verification and validation that the observed data are consistent with modelling outcomes.

3. Recommendations for any amendments to the ESWMP including any variation to site specific trigger values.

3.11 Operational Monitoring Requirements

3.11.1 Objective

Ongoing operational water quality monitoring shall be undertaken to enable the environmental performance of extraction operations to be routinely assessed.

3.11.2 Sampling Period and Frequency

For the period encompassing the extraction works, water quality monitoring shall occur at monthly intervals (12 rounds per year) or as otherwise varied by this plan following review.

3.11.3 Site Specific Trigger Values

Site-specific trigger values (**SSTVs**), these being based on range of sources, are shown in Table 7.

Table 7: Site specific trigger values.

Analyte	Unit	ANZECC Default	SCC Average[B]	SCC 90th Percentile[B]	Adopted Interim SSTV
pH	-	6.5-7.5[A]	-	-	< 6.5 or > 8.0
EC	µS/cm	-	-	-	> 50,000[C]
TN	mg/L	0.30[A]	0.36	0.74	> 0.75
TP	mg/L	0.03[A]	0.05	0.09	> 0.09
Ammonia	mg/L	0.91[D]	0.07	0.09	> 0.09
NOx	mg/L	0.015[A]	0.05	0.18	> 0.10
TSS	mg/L	75[E]	67	83	> 75
Turbidity	ntu	10-50[F]	14	26	> 14
DO	% saturation	80-110[A]	-	-	< 80 %

Notes

A. Based on ANZECC (2000) Table 3.3.2.

B. Based on long-term SCC monitoring data excluding site E-7.

C. Based on estimated sea water maximum.

D. Based on ANZECC (2018) toxicity criteria for 95% level of species protection.

E. Based on ANZECC (2000) Table 4.4.2 under brackish water stressors for aquaculture species.

F. Range based on ANZECC (2000) Table 3.3.2 for estuaries and lowland rivers which are highly variable.

3.11.4 Amending Trigger Values

SSTV should be reviewed as necessary and as further data are collated and assessed. Proposed modifications to SSTV shall be documented in the annual surface water quality

monitoring report with a full explanation and justification given for any proposed modified value(s).

3.11.5 Actions Following Sampling

Within 72 hours of the receipt of water quality sampling results:

1. Data shall be recorded in the relevant electronic database.
2. Data shall be compared to SSTVs and overall averages for the monitoring period.
3. If a SSTV is exceeded in two consecutive rounds of monitoring at any downstream / downgradient location and this is, based on the monitoring data, determined to be possibly caused by the extraction activities, an additional monitoring round within two weeks shall be undertaken. Should the trend remain a review of possible causes of the exceedance will be undertaken.
4. Interim management and mitigation responses shall be implemented where the trend remains and as necessary. These shall include:
    a. Halting of dredging operations.
    b. Investigation of sediment profile near cutting head by an appropriately qualified environmental consultant to assess potential for extensive silty clay or clay lenses containing organics.
    c. Documentation of investigations and provision of recommendations to amend the dredging operation to bring water quality results below trigger values.

3.11.6 Annual Reporting

An annual surface water quality report shall be prepared by a suitably qualified individual and submitted to the consent authority. Reporting is to include:

1. Rainfall conditions for the monitoring period.
2. Progress of dredging operations.
3. A summary of any sediment and erosion 'events' (e.g. flooding, bank failures).
4. All water quality monitoring sampling and data collected.
5. An analysis of water quality data, including comparison of records with the previous year and any long-term observations / trends.
6. Identification of events where trigger criteria were exceeded and any management / remedial processes implemented, and if none taken, an explanation why not.
7. Recommendations for site management and operation measures.

8. Recommendations for any updates to SSTVs and the ESWMP.

3.11.7 Review Process and On-going Improvement

The ESWMP shall be reviewed annually. Where review identifies opportunities for improvement in the process of data acquisition or data management, adjustments to the program shall be made to respond. If implementation of this ongoing improvement of the monitoring program requires, the consent authority may be consulted prior to the implementation of the improvement measures for approval. Review shall include for example:

1. Identification of any issues with water quality sampling and testing (e.g. access to monitoring sites) and results of sampling and testing.

2. Improvement in sampling techniques and management as necessary (e.g. improved technology / sampling probes, *etc.*).

3. Documentation of changes required to any procedures, sample locations and data management.

4. Liaison with consent authorities as required.

4 Resources

https://shoalhaven.nsw.gov.au/Environment/Aqua-Data>

Australian and New Zealand Environment and Conservation Council (2018) *National Water Quality Management Strategy – Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

Dalmazzo, P. (2012) Aquatic Habitat, Flora and Fauna Assessment for Proposed Expansion of Sand Extraction Area, Shoalhaven River Adjacent to Pig Island, Terara

John Procter Surveyors Pty Ltd (2018), Plan of Sea Grass Location and Level Spot Heights Within the Shoalhaven River for Shoalhaven Sand Pty Ltd.

Martens & Associates (2012b) Proposed Expansion of Sand Extraction Area: Pig Island, Lower Shoalhaven, NSW (ref P1103077JR01V03).

Martens & Associates (2012a) Supplementary Environmental Details- Proposed Expansion of Sand Extraction: Pig Island, Lower Shoalhaven, NSW (ref P1103077JR04V01).

Martens & Associates (2019), Estuarine Water Quality Impact Assessment (P1806743JR06).

NSW DPI Office of Water (2018) *Crookhaven River Oyster Harvest Area Management Plan.*

NSW DPI Office of Water (2018) *Guidelines for riparian corridors on waterfront land*.

Packman, J., Comings, K., & Booth, D. (1999). *Using turbidity to determine total suspended solids in urbanizing streams in the Puget Lowlands. In: Confronting Uncertainty: Managing Change in Water Resources and the Environment*; Canadian Water Resources Association Annual Meeting

Shoalhaven City Council (2012) *Draft Shoalhaven Coastal Zone Management Plan*.

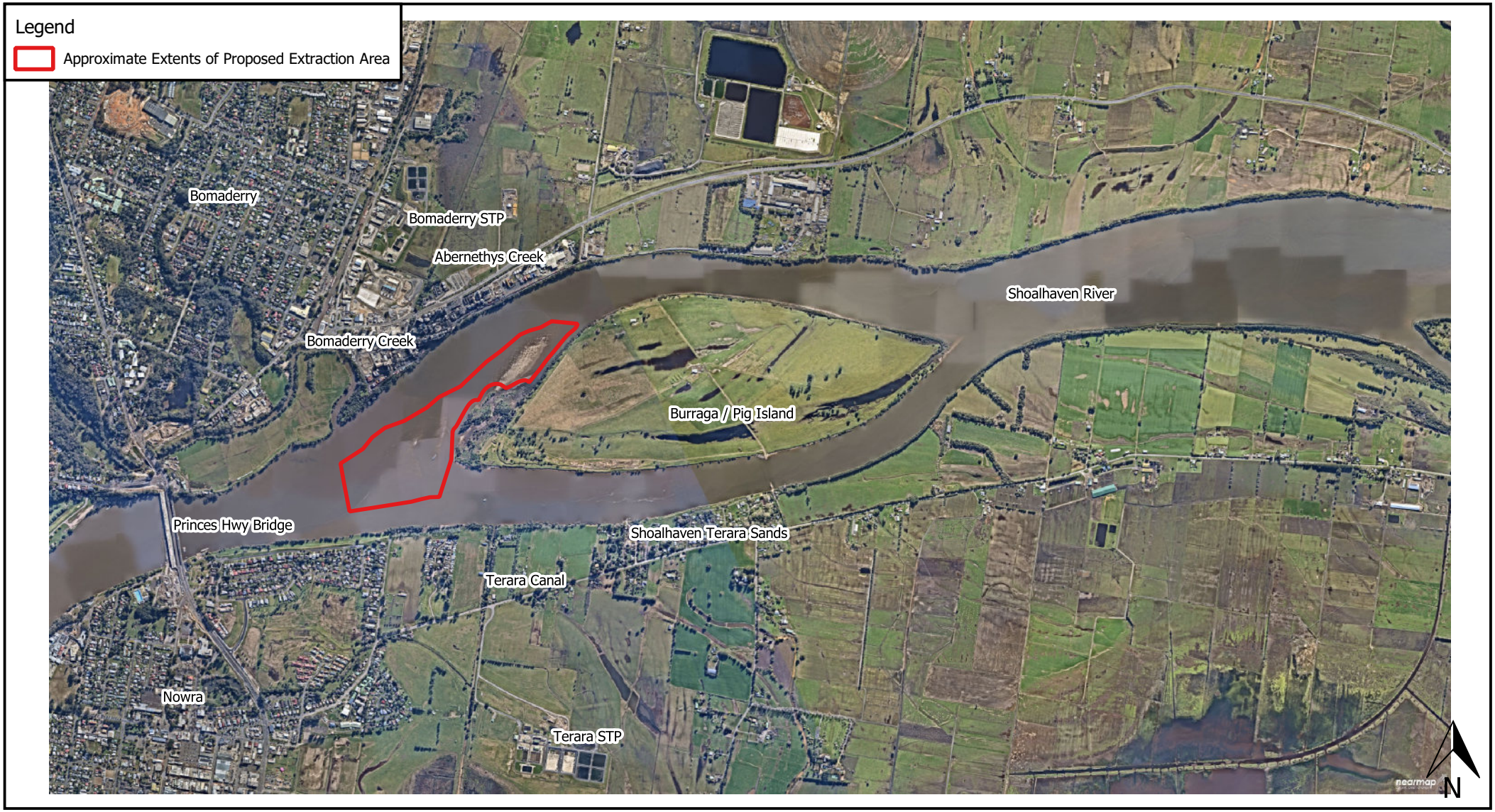
Shoalhaven City Council (2014) *Development Control Plan*.

Shoalhaven City Council (2014) *Local Environment Plan*.

State Environmental Planning Policy (Resilience and Hazards) 2021.

Umwelt (Australia) Pty Ltd on behalf of SCC (2006) *Shoalhaven River Estuary Management Plan.*

Appendix A – Maps



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Viewport

Aerial photo: www.nearmap.com.au

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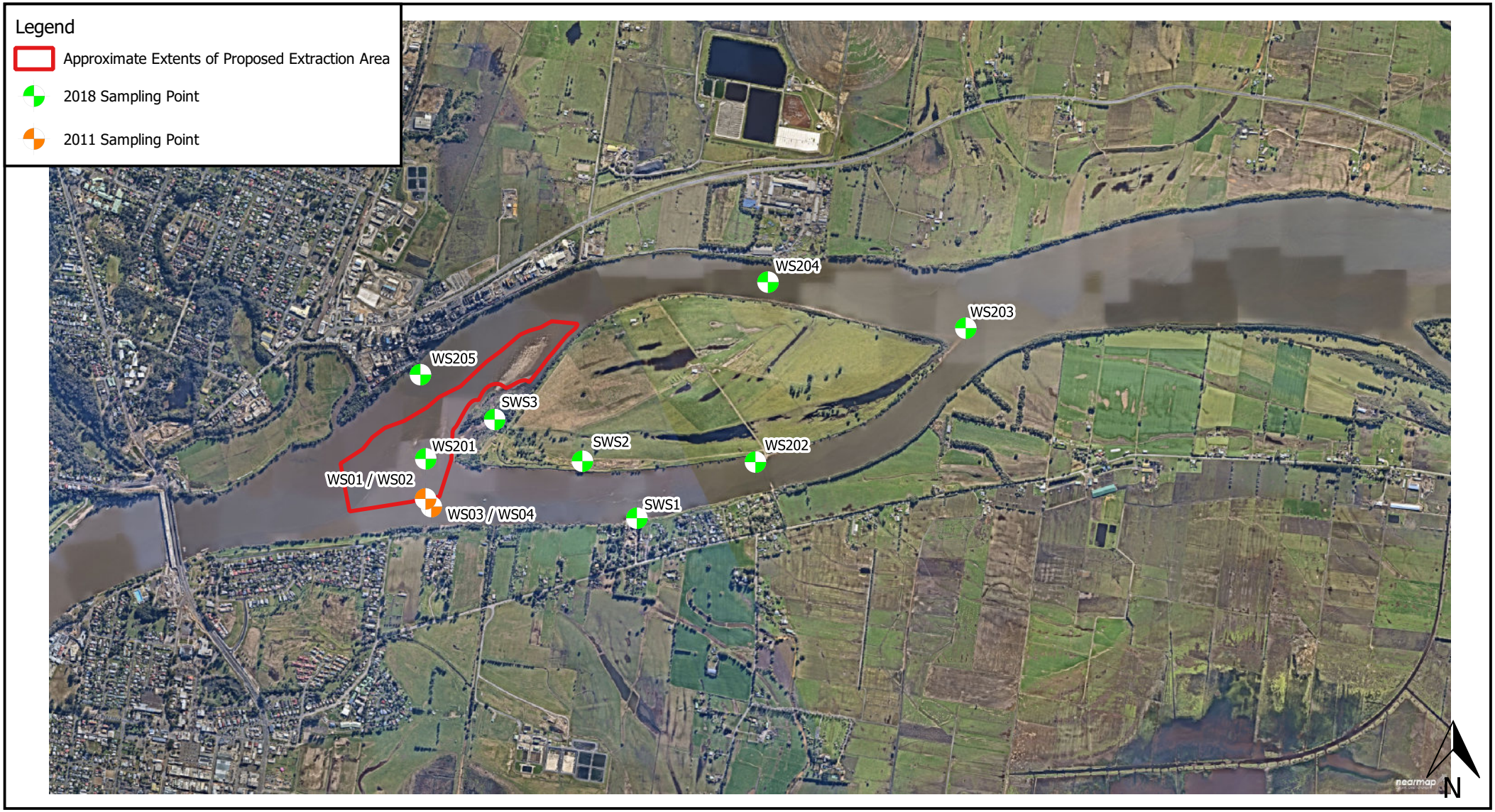
Project No: P1806743 Map Set: MS01-R01 EPSG: 28356

Map Title / Figure:

Proposed expanded extraction area

Map 01	Map
Burraga Island, Shoalhaven River, Terara, NSW	Site
Proposed Expansion of Sand Extraction Operation	Project
Estuarine Surface Water Monitoring Program	Sub-Project
Terara Shoalhaven Sand	Client
15/09/2022	Date



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Viewport

Aerial photo: www.nearmap.com.au

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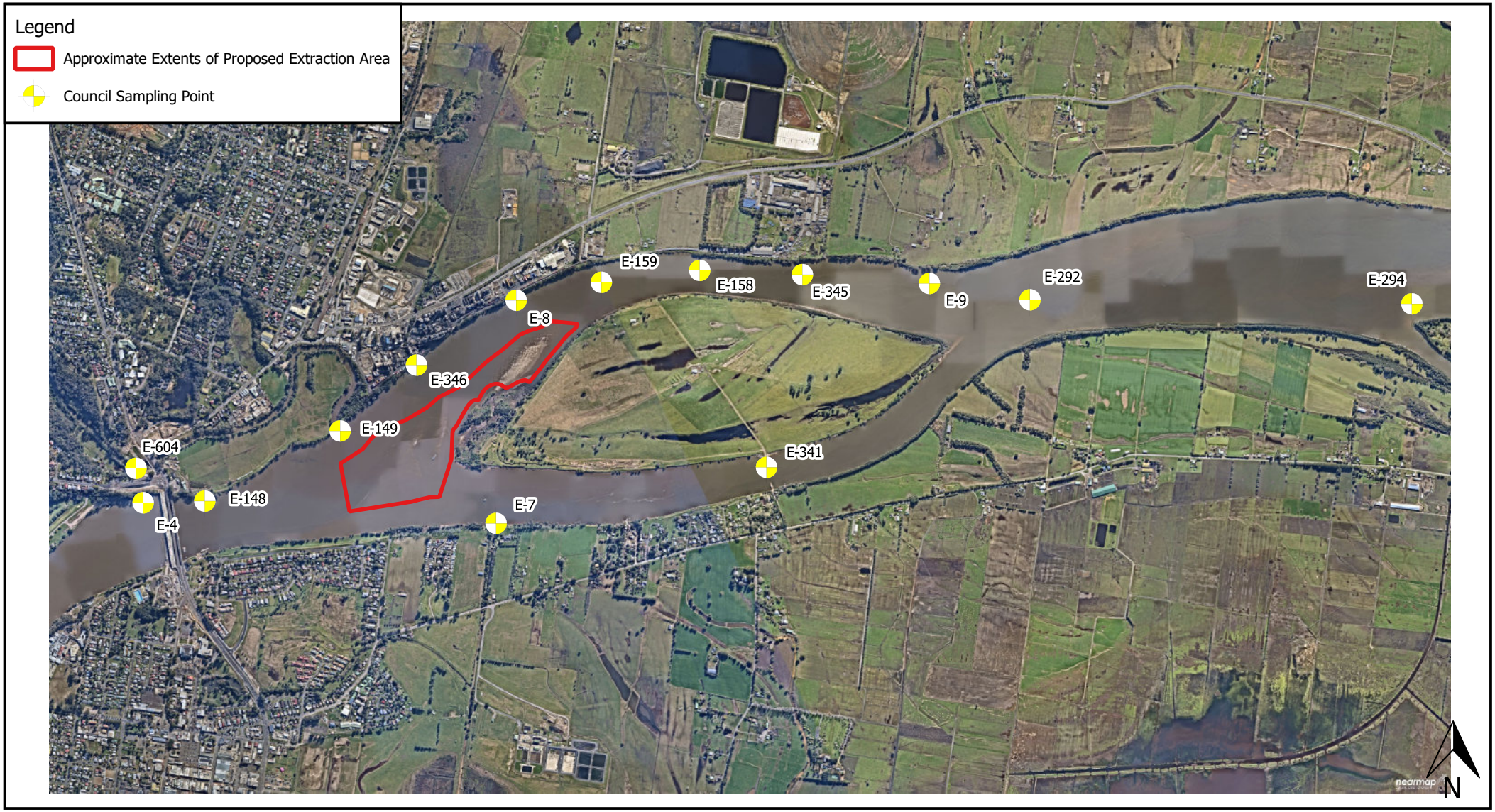
Map Title / Figure:

Historical project specific sampling locations

Map 02	Map
Burraga Island, Shoalhaven River, Terara, NSW	Site
Proposed Expansion of Sand Extraction Operation	Project
Estuarine Surface Water Monitoring Program	Sub-Project
Terara Shoalhaven Sand	Client
15/09/2022	Date

Project No: P1806743 Map Set: MS01-R01 EPSG: 28356



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Aerial photo: www.nearmap.com.au

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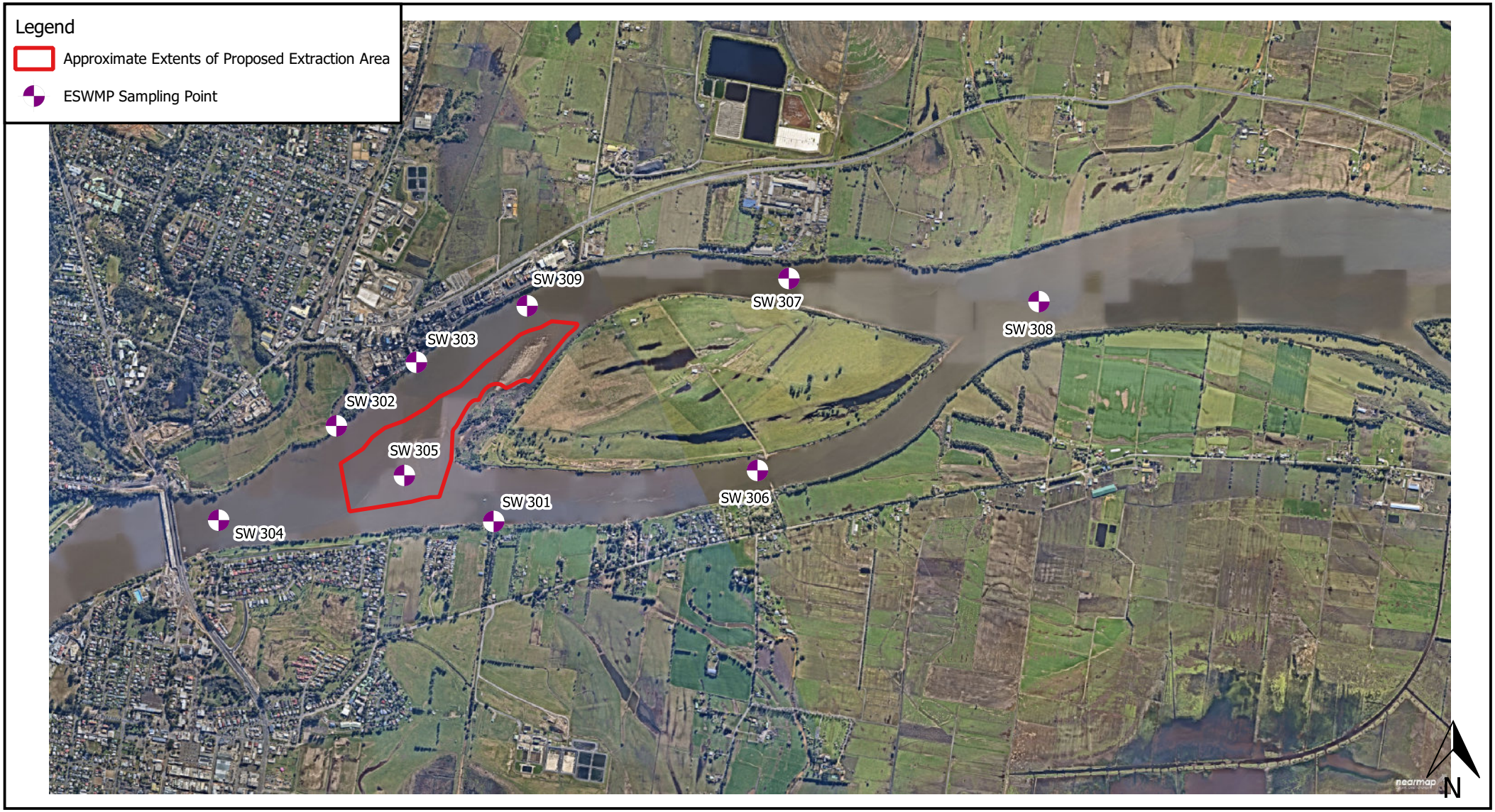
Map Title / Figure:

SCC water sampling locations

Map 03	Map
Burraga Island, Shoalhaven River, Terara, NSW	Site
Proposed Expansion of Sand Extraction Operation	Project
Estuarine Surface Water Monitoring Program	Sub-Project
Terara Shoalhaven Sand	Client
15/09/2022	Date

Project No: P1806743 Map Set: MS01-R01 EPSG: 28356



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Viewport

Aerial photo: www.nearmap.com.au

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Project No: P1806743 Map Set: MS01-R01 EPSG: 28356

Map Title / Figure:

Proposed monitoring locations

Map 04	Map
Burraga Island, Shoalhaven River, Terara, NSW	Site
Proposed Expansion of Sand Extraction Operation	Project
Estuarine Surface Water Monitoring Program	Sub-Project
Terara Shoalhaven Sand	Client
15/09/2022	Date

Appendix B – Laboratory Reports

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 58246

Client:
Martens & Associates Pty Ltd
6/37 Leighton Place
Hornsby
NSW 2077

Attention: Megan Bowling

Sample log in details:

Your Reference:	**P1103077, Terara Sands Nowra**
No. of samples:	4 Waters
Date samples received / completed instructions received	08/07/11 / 08/07/11

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

Report Details:

Date results requested by: / Issue Date:	15/07/11 / 18/07/11
Date of Preliminary Report:	Not issued

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Miscellaneous Inorganics					
Our Reference:	UNITS	58246-1	58246-2	58246-3	58246-4
Your Reference	----------	WS01	WS02	WS03	WS04
Date Sampled	----------	06/07/2011	06/07/2011	06/07/2011	06/07/2011
Type of sample		Water	Water	Water	Water
Date prepared	-	8/7/2011	8/7/2011	8/7/2011	8/7/2011
Date analysed	-	8/7/2011	8/7/2011	8/7/2011	8/7/2011
pH	pH Units	7.6	7.7	7.7	7.7
Electrical Conductivity	µS/cm	18,000	19,000	19,000	17,000
Total Suspended Solids @ 103-105^{O}C	mg/L	10	23	16	14
BOD5	mg/L	<5	<5	<5	<5
Total Nitrogen in water	mg/L	1.3	1.1	1.1	1.0
Ammonia as N in water	mg/L	0.05	0.03	0.04	0.04
NOx as N in water	mg/L	0.1	0.08	0.08	0.2
TKN in water	mg/L	1.2	1.0	1.0	0.9
Phosphorus - Total	mg/L	<0.05	<0.05	<0.05	<0.05

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 21st ED 2510 and Rayment & Higginson.
Inorg-019	Suspended Solids - determined gravimetrcially by filtration of the sample, in accordance with APHA 21st ED, 2540-D.
Ext-044	Analysed by LabPoint NATA accreditation 11111.
Inorg-055/062	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen.
Inorg-057	Ammonia - determined colourimetrically based on EPA350.1 and APHA 21st ED 4500-NH3 F, Soils are analysed following a KCl extraction.
Inorg-055	Nitrate - determined colourimetrically based on EPA353.2 and APHA 21st ED NO3- F. Soils are analysed following a water extraction.
Inorg-062	TKN - determined colourimetrically based on APHA 21st ED 4500 Norg.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			11/7/2011	58246-1	8/7/2011 || 8/7/2011	LCS-W1	8/7/2011
Date analysed	-			11/7/2011	58246-1	8/7/2011 || 8/7/2011	LCS-W1	8/7/2011
pH	pH Units		Inorg-001	[NT]	58246-1	7.6 || 7.6 || RPD: 0	LCS-W1	102%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	58246-1	18000 || 17000 || RPD: 6	LCS-W1	106%
Total Suspended Solids @ 103-105^{O}C	mg/L	5	Inorg-019	<5	58246-1	10 || [N/T]	LCS-W1	99%
BOD5	mg/L	5	Ext-044	<5	58246-1	<5 || <5	[NR]	[NR]
Total Nitrogen in water	mg/L	0.1	Inorg-055/062	<0.1	58246-1	1.3 || 1.3 || RPD: 0	LCS-W1	108%
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	58246-1	0.05 || 0.05 || RPD: 0	LCS-W1	100%
NOx as N in water	mg/L	0.005	Inorg-055	<0.005	58246-1	0.1 || 0.09 || RPD: 11	LCS-W1	96%
TKN in water	mg/L	0.1	Inorg-062	<0.1	58246-1	1.2 || 1.2 || RPD: 0	LCS-W1	108%
Phosphorus - Total	mg/L	0.05	Metals-020 ICP-AES	<0.05	58246-1	<0.05 || [N/T]	LCS-W1	96%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	58246-4	8/7/2011 || 8/7/2011	58246-2	8/7/2011
Date analysed	-	58246-4	8/7/2011 || 8/7/2011	58246-2	8/7/2011
BOD5	mg/L	58246-4	<5 || <5	[NR]	[NR]
Ammonia as N in water	mg/L	58246-4	0.04 || [N/T]	58246-2	108%
NOx as N in water	mg/L	58246-4	0.2 || [N/T]	58246-2	86%

Report Comments:

BOD analysed by LabPoint. Report No.NAA11-1347.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

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

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

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CERTIFICATE OF ANALYSIS 201238

Client Details

Client	Martens & Associates Pty Ltd
Attention	Dan O'Sullivan
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**P1806743, Nowra**
Number of Samples	5 Water
Date samples received	20/09/2018
Date completed instructions received	20/09/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	27/09/2018
Date of Issue	27/09/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Long Pham, Team Leader, Metals
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		201238-1	201238-2	201238-3	201238-4	201238-5
Your Reference	UNITS	WS201	WS202	WS203	WS204	WS205
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/09/2018	20/09/2018	20/09/2018	20/09/2018	20/09/2018
Date analysed	-	20/09/2018	20/09/2018	20/09/2018	20/09/2018	20/09/2018
pH	pH Units	7.5	7.6	7.7	7.6	7.6
Electrical Conductivity	µS/cm	36,000	37,000	38,000	36,000	35,000
Total Suspended Solids	mg/L	<5	<5	<5	<5	<5
BOD	mg/L	<5	<5	<5	<5	<5
Total Nitrogen in water	mg/L	0.2	0.1	0.1	0.1	<0.1
Ammonia as N in water	mg/L	0.041	0.027	0.032	0.027	0.024
NOx as N in water	mg/L	0.009	0.01	0.006	0.01	0.02
TKN in water	mg/L	0.2	0.1	0.1	0.1	<0.1

Metals in Waters - Total						
Our Reference		201238-1	201238-2	201238-3	201238-4	201238-5
Your Reference	UNITS	WS201	WS202	WS203	WS204	WS205
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	21/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018
Date analysed	-	21/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018
Phosphorus - Total	mg/L	<0.05	<0.05	<0.05	0.05	0.06

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-019	Suspended Solids - determined gravimetricially by filtration of the sample. The samples are dried at 104+/-5°C.
Inorg-055	Nitrate - determined colourimetrically. Soils are analysed following a water extraction.
Inorg-055/062	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.
Inorg-062	TKN - determined colourimetrically based on APHA latest edition 4500 Norg. Alternatively, TKN can be derived from calculation (Total N - NOx).
Inorg-091	BOD - Analysed in accordance with APHA latest edition 5210 D and in house INORG-091.
Metals-020	Determination of various metals by ICP-AES.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	201238-2
Date prepared	-			20/09/2018	1	20/09/2018	20/09/2018		20/09/2018	20/09/2018
Date analysed	-			20/09/2018	1	20/09/2018	20/09/2018		20/09/2018	20/09/2018
pH	pH Units		Inorg-001	[NT]	1	7.5	7.6	1	101	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	36000	36000	0	97	[NT]
Total Suspended Solids	mg/L	5	Inorg-019	<5	1	<5	<5	0	92	[NT]
BOD	mg/L	5	Inorg-091	<5	1	<5	<5	0	81	[NT]
Total Nitrogen in water	mg/L	0.1	Inorg-055/062	<0.1	1	0.2	0.2	0	89	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	0.041	0.040	2	103	121
NOx as N in water	mg/L	0.005	Inorg-055	<0.005	1	0.009	0.01	11	98	81
TKN in water	mg/L	0.1	Inorg-062	<0.1	1	0.2	0.2	0	89	[NT]

QUALITY CONTROL: Metals in Waters - Total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	201238-2
Date prepared	-			21/09/2018	1	21/09/2018	21/09/2018		21/09/2018	21/09/2018
Date analysed	-			21/09/2018	1	21/09/2018	21/09/2018		21/09/2018	21/09/2018
Phosphorus - Total	mg/L	0.05	Metals-020	<0.05	1	<0.05	<0.05	0	104	108

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

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

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.