Brou Landfill Post Bushfire Expansion

Geotechnical Investigation Report

Public Works | Department of Regional NSW

Reference: 754-CBRGE301356-R01

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PREPARED FOR

Public Works | Department of Regional NSW

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AHD	Australian Height Datum
ASS	Acid Sulfate Soils
bgl	below ground level
Coffey	Tetra Tech Coffey Pty Ltd
DCP	Dynamic Cone Penetrometer
ESC	Eurobodalla Shire Council
NATA	National Association of Testing Authorities
NSW EPA	NSW Environment Protection Authority
PASS	Potential Acid Sulfate Soils
PSD	Particle Size Distribution
Public Works	NSW Public Works
RAP	Registered Aboriginal Party

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by Tetra Tech Coffey Pty Ltd (Coffey) for proposed developments at Brou Lake Road, Bodalla NSW 2545. The investigation was commissioned by NSW Public Works (Public Works), on behalf of Eurobodalla Shire Council (ESC), to inform preliminary design for proposed expansion works at the existing Brou Landfill.

The proposed expansion works include the construction of a new landfill cell and associated ponds to the west of the current landfill footprint, along with a new transfer station and administration centre to the south east. A site locality plan and site layout plan for the proposed development areas (herein referred to as “the site”) are presented in Appendix A, Figures 1 and 2 respectively.

The investigation was undertaken in August 2022, in accordance with Coffey’s tender submission for the project (ref: *754-CBRGE301336-P01*, dated 27 April 2022).

1.1 BACKGROUND

ESC’s Waste Management Facilities were put under considerable strain during the 2019/20 bushfire season, suffering direct damage and then having service interrupted while the landfills received debris and waste from fire impacted properties.

ESC applied to NSW EPA for funding to upgrade the Brou and Surf Beach waste facilities to enhance the ability to meet demands and increase capacity to deal with natural disasters.

Accordingly, ESC are planning expansion works to the Brou Landfill following impacts from the 2019/2020 bushfire season. The proposed upgrades are summarised in table 1.1, below.

Table 1.1 – Summary of proposed developments

Development phase	Summary of Proposed Developments
Phase 1 – West of existing landfill facilities	• Construction of a new landfill cell • Relocation of existing water services • Construction of a new sediment pond and treatment plant
Phase 2 – South-west of existing landfill facilities	• Construction of a new transfer station, resource recovery hub, weighbridge, commercial operational area, amenities and office facilities.

Coffey have not been provided with any design drawings or further design information. The concept design for the above developments is expected to be based on various factors including cultural and heritage constraints, groundwater, topography, and the findings of the geotechnical investigation.

It is noted that the final site boundaries may also be modified (potentially extending over larger areas than those shown in Appendix A, Figure 2), dependent on the outcomes of the ongoing cultural heritage and ecological surveys at the site. However, at the time of this geotechnical investigation, site access approvals were limited to the approximate extent shown in Appendix A, Figure 2. Areas under further assessment by ESC are shown in Appendix A, Figure 6, however these locations had not been cleared for cultural and environmental heritage at the time of this investigation and, as such, were not assessed as part of this geotechnical investigation.

1.2 OBJECTIVES

The purpose of this geotechnical investigation was to obtain information on ground conditions for the proposed development areas, and to provide recommendations on:

- Excavation conditions for the proposed cell expansion.
- Dispersive nature / erodibility of soils.
- Occurrence or risk of acid sulfate soils at the site.
- Groundwater conditions.
- Suitability of clay soils for use as a clay liner or capping material.
- Site classification to AS 2870 and in-situ bearing capacity for soils in the Phase 2 Development Area for the proposed administration facility.
- Foundation conditions and geotechnical design parameters for shallow footings.

1.3 SCOPE OF WORK

Coffey conducted the following scope of work:

- Desktop review of geological maps, acid sulfate risk maps and other publicly available information.
- Site walkover with a Registered Aboriginal Party (RAP – engaged independently by ESC), along with ESC and Public Works Representatives.
- Service location to clear boreholes of underground services.
- Ground investigation, comprising a client-nominated scope of work of:
  - 12 boreholes in the proposed Phase 1 cell expansion area, up to V-bit refusal in bedrock or encountering groundwater (whichever occurred first)
  - 8 test pits in the proposed Phase 2 development area, up to 2 m below ground level (bgl) or prior refusal in bedrock.
- Sampling and laboratory testing.
- Preparation of this Geotechnical Investigation Report, with data from the field investigation, laboratory test results, and geotechnical recommendations.

2. INVESTIGATION METHODOLOGY

2.1 DESKTOP STUDY

Prior to mobilisation to site, Coffey conducted a preliminary desktop study to review:

- Local geology, hydrogeology, topography and acid sulfate risk maps.
- Registered groundwater bore information in the public register held by Bureau of Meteorology.

2.2 SITE WALKOVER

Prior to the commencement of drilling works, a Coffey representative attended the site on 15 August 2022 to complete a site walkover with a RAP, representatives from ESC and Public Works, and an accredited underground service locator from Coastal Cable Locators.

The site walkover was undertaken with all parties to:

- Observe features of geotechnical significance.
- Select borehole locations and identify cultural and environmental “no-go” areas
- Clear the proposed borehole locations of underground services

The site walkover was undertaken across both Phase 1 and Phase 2 development areas. Selected site photographs taken during the walkover are presented in Appendix B. Site observations are summarised in section 3.5 of this report.

2.3 GROUND INVESTIGATION

Ground investigations at both sites were undertaken between 16-18 August 2022, as described below. Ground investigations were undertaken at accessible locations (agreed with ESC, Public Works and the RAP) to avoid the disturbance of protected flora onsite. RAP, ESC and Public Works representatives attended the site on various occasions during the fieldworks to monitor works progress and assess the sites for features of cultural or environmental heritage.

2.3.1 Boreholes – Phase 1 Development Area

Ground investigations at the Phase 1 Development Area (for the proposed cell expansion) were undertaken between 16 and 18 August 2022, and comprised the excavation of 12 auger boreholes across the area at the locations shown in Appendix A, Figure 3.

A drilling contractor (GE Drilling Pty Ltd) was engaged to mobilise a *Hanjin D&B 8D* track-mounted drilling rig to the site to excavate all boreholes using solid stem auger attachments. Boreholes were advanced to depths ranging between 7.1 m and 15.0 m below ground level, terminated on refusal in rock or encountering groundwater[1] (whichever occurred first).

A Coffey project engineer was onsite for the duration of the drilling works to observe borehole excavation, log the boreholes, monitor field testing and collect samples for laboratory testing. Soils were logged in accordance with Australian Standard *AS1726:2017 – Geotechnical Site*

[1] Boreholes BH08-BH12 were terminated upon encountering groundwater to reduce the potential for cross-contamination of groundwater. It is noted that boreholes BH08-BH12 were positioned downgradient from the existing landfill cell. This precautionary approach was agreed with ESC and NSW Public Works during fieldworks.

Investigations, shown on borehole logs included in Appendix C. A summary of the encountered ground conditions is presented in Section 4.

On completion of drilling, all boreholes were backfilled with remaining soil cuttings with excess cuttings left at the surface (some potential settlement might be experienced at these locations). Borehole BH12 was left open for ESC to arrange groundwater sampling at this location to be undertaken prior to backfilling (as agreed with ESC).

2.3.2 Test Pits – Phase 2 Development Area

Ground investigations at the Phase 2 Development Area (for the proposed administration, resource recovery and transfer facilities) were undertaken on 16 August 2022, and comprised the excavation of 8 test pits across the Phase 2 area at the locations shown in Appendix A, Figure 3. Dynamic Cone Penetrometer (DCP) tests were also undertaken at all test pit locations to provide an indication on soil consistency for design purposes.

An earthmoving contractor (PK Excavations Pty Ltd) was engaged to mobilise a *Sumitomo* 8-tonne excavator to the site to excavate all boreholes using a narrow 350 mm-wide bucket attachment. Test pits were advanced to depths ranging between 1.7 m and 2.2 m bgl, with all test pits terminated on refusal in rock.

A Coffey project scientist was onsite for the duration of the test pit excavation works to observe test pit excavation, log the encountered ground conditions, undertake field DCP testing and collect samples for laboratory testing. Soils were logged in accordance with *AS1726:2017*, shown on borehole logs included in Appendix C, with DCP test results included on the logs and in Appendix D. A summary of the encountered ground conditions is presented in Section 4.

On completion of test pit excavation, all test pits were backfilled with excavated spoil and track-rolled at the surface (some potential settlement might be experienced at these locations).

2.4 LABORATORY TESTING

Selected samples were dispatched to NATA-accredited laboratories for a range of geotechnical and acid sulfate soil testing, as summarised in Table 2.1, below.

Table 2.1 – Summary of geotechnical and acid sulfate soils laboratory testing undertaken

Test / Method	Number of Tests
Emerson Tests (Dispersivity)	10
Particle Size Distribution	2
Atterberg Limits	2
Acid Sulfate Soils – Field pH Screen (1)	24
Acid Sulfate Soils – Chromium Reducible Sulfur (1)	4

Notes: 1) Field pH screening is used as a preliminary indicator for the presence of acid sulfate soils or potential acid sulfate soils. Chromium Reducible Sulfur testing is then used for confirmation in accordance with the *Acid Sulfate Soils Manual 1999*.

3. DESK STUDY AND SITE OBSERVATIONS

A desktop review of publicly available information was undertaken before mobilisation to the site. The below sections summarise the findings of the desktop review and site walkover.

3.1 GEOLOGY AND SOILS

The *Narooma 1:100,000 Geological Sheet Series 8925* (Chalker and Bembrick, 1975) indicates that the site is underlain the Ordovician Bogolo Formation, comprising pelite with minor quartz arenite and thin chert beds. The map also indicates that adjacent areas to the north east and south west of the site are also underlain by undifferentiated Tertiary quartz sandstone with minor pebble and cobble conglomerate.

Conversely, publicly available information provided in the Geoscience Australia *MinView* portal indicates that the site is predominantly underlain by the Adaminaby Formation, comprising Tertiary pebble and cobble conglomerate, quartz sandstone poorly cemented in part, buff and grey claystone and sand. The *MinView* portal also indicates that Quaternary alluvial fan deposits may be present in the north-eastern portion of the Phase 1 Development Area.

Based on the above, the Tertiary and Quaternary units are expected to overlie the Ordovician Bogolo Formation.

3.2 TOPOGRAPHY

The Phase 1 development area is located at elevations ranging between 17 m above Australian Height Datum (AHD) in the central-eastern portion to approximately 30 m AHD in the south-western portion. A drainage line runs through the centre of the Phase 1 area in a north-south direction. Land to the west comprises a hill with an easterly aspect, and land to the east comprises a built-up landfill embankment sloping towards the north. The phase 1 development area is expected to drain towards an unnamed tributary and dam to the north, gradually flowing into Whittakers Creek and Lake Brou approximately 1km to the north east.

The Phase 2 development area is situated at generally higher elevations ranging between 24 to 30 m AHD, on the upper slopes of a hillside with an easterly gradient. The southern portion of the Phase 2 development area slopes towards the south-east. The Phase 2 development area is expected to predominantly drain towards an unnamed tributary to the south and eventually into Mummaga Lake, approximately 900 m to the south.

3.3 REGIONAL HYDROGEOLOGY

The 1:5,000,000 Hydrogeology Map of Australia (Jacobson & Lau, 1987), indicates that the site is underlain by fractured or fissured, extensive aquifers of low to moderate productivity. A search of publicly available groundwater records held by the Bureau of Meteorology did not reveal any groundwater monitoring bores within a 2km radius of the site.

It is considered that groundwater levels at the site would fluctuate in response to seasonal variations and would generally flow towards Lake Brou to the north, or Mummaga Lake to the south.

3.4 ACID SULFATE SOILS

Acid Sulfate Soil risk maps available on NSW Government's ESPADE viewer indicates that the site has not been assessed for the probability of acid sulfate soils (ASS) or potential acid sulfate soils (PASS). Land approximately 500m to the north (around Whittakers Creek) and 700m to the south (around Mummaga Lake) are mapped as having a high probability of occurrence of ASS / PASS.

It is considered that ASS / PASS may potentially occur in alluvial sediments in undrained areas at the site (if present), although alluvial sediment was not encountered during the geotechnical investigation.

3.5 SURFACE CONDITIONS – SITE WALKOVER

A site walkover was undertaken on 15 August 2022, with selected site photographs included in Appendix B. Key site observations are summarised below:

- The Phase 1 development area lies partially within the existing Brou Landfill operational area, with surface conditions summarised as follows:
  - The eastern portion is within the Brou Landfill operational area and comprises cleared land occupied by an access road, hardstand / laydown area and unsealed open drains. The eastern portion of the site generally slopes towards the north.
  - The western portion comprises undeveloped, dense bushland and generally slopes towards the east and north-east.
- The Phase 2 development area lies on the upper slopes of a hill, to the south west of the Brou Landfill. The Phase 2 development area slopes towards the east and south-east, and is occupied by dense bushland.
- An access road bounds the western edge of the Phase 1 development area, which appears to have been cut into the surrounding hillside using cut / fill earthworks. Weathered sandstone was visible in small portions of the road cutting.
- Surface conditions across both sites generally comprised silt topsoil with dense vegetation cover (except for cleared areas in the eastern portion of the Phase 1 development area). No rock outcrops or ponded water were observed at the ground surface during the site investigation.

4. RESULTS OF INVESTIGATION

4.1 SUBSURFACE CONDITIONS AND GEOTECHNICAL MODEL

Table 4.1 provides a summary of inferred geotechnical units encountered at the site. The depth range of each unit is summarised in Table 4.2. Further details are provided in the Engineering Borehole Logs and accompanying explanation sheets, included as Appendix C. Interpretive geological cross-sections are provided in Figures 4 and 5, Appendix A.

Ground conditions typically comprised shallow topsoil, underlain by residual soil (ranging from granular sandy silt to cohesive clays), extremely weathered material and weathered rock. Basement rock comprised variable sandstone / siltstone, which was generally considered to be interbedded. NMLC rock coring would be required to further assess bedrock geology at the site, and was outside the scope of this investigation. The Phase 1 development area typically showed deeper soil and rock weathering profiles compared to the Phase 2 development area.

Fill material was encountered to considerable depth in boreholes BH08, BH07, BH10 and BH12 (ranging between 1-2m), inferred to be fill used in embankment construction around the existing landfill access track. The fill material was visually assessed to be similar to the underlying residual soil units, and is considered likely to be site-won material (potentially excavated out during construction of the existing landfill cells).

Fill was encountered in borehole BH03 to greater depth (3.2m), inferred to be placed during cut and fill earthworks as part of the construction of Brou Lake Road. It is considered that the lower portion of the identified fill in BH03 could also be colluvial soil or slopewash.

Table 4.1 – Summary of inferred geotechnical units encountered

Unit	Material	Description
1	Topsoil	Sandy SILT to silty SAND, sand is typically fine to medium grained, silt is typically low plasticity, pale grey to dark brown, with rootlets and organic fines.
2	Fill	Variable fill, typically comprising sandy SILT to silty SAND, low plasticity, fine to medium grained sand, brown to dark brown.
3a	Residual Soil (cohesive)	Sandy SILT to sandy CLAY, low to medium plasticity, pale brown to red-brown, sand is typically fine to medium, traces of extremely weathered material.
3b	Residual Soil (granular)	Silty SAND to clayey SAND, fine to medium grained, pale grey-brown to dark brown, trace fine to medium grained gravel.
4	Extremely Weathered Material	Variable sandstone / siltstone, extremely weathered, very low strength, typically crumbles under hand pressure to silty sand or sandy silt.
5	Weathered Rock	Variable sandstone / siltstone, typically interbedded, generally highly weathered and low strength, grading to moderately weathered, medium strength with increasing depth.

Table 4.2 – Summary of depths to inferred geotechnical units

Location		Surface elevation (m AHD)	Depth to base of unit (m bgl) [1]					
			1	2	3a	3b	4	5
Phase 1 Development Area	BH01	30.5	0.2	NE	1.8	NE	3.5	>12.1
	BH02	24.5	0.3	NE	2.3	NE	3.6	>11.1
	BH03	25.5	0.3	3.2[2]	NE	4.0	6.2	>14.4
	BH04	25	0.2	NE	0.8	NE	3.5	>7.1
	BH05	24	0.2	NE	2.0	NE	3.0	>7.2
	BH06	25.5	0.2	NE	1.0	NE	2.5	>11.4
	BH07	22.5	0.2	1.8	1.8	2.5	4.7	>12.1
	BH08	23	NE	2.0	2.5	NE	5.8	>15.0
	BH09	20	0.2	NE	0.8	NE	3.2	>14.10
	BH10	17.2	NE	1.0	3.1	NE	7.6	>12.12
	BH11	19.3	0.2	NE	3.2	0.8 [3]	4.5	>14.5
	BH12	17	0.2	1.8	3.5	NE	4.5	>15.0
Phase 2 Development Area	TP01	23.5	0.15	NE	NE	0.75	1.4	>1.8
	TP02	28.5	0.1	NE	0.6	NE	1.45	>2.2
	TP03	29.5	0.15	NE	NE	0.4	NE	>1.7
	TP04	24.5	0.1	NE	0.5	NE	1.2	>1.7
	TP05	24.5	0.15	NE	0.55	NE	1.2	>2.0
	TP06	23.5	0.15	NE	0.7	NE	1.2	>1.9
	TP07	27.5	0.2	NE	NE	0.5	NE	>1.7
	TP08	25.5	0.1	NE	0.45	NE	1.2	>1.9

Notes: 1) NE = Not encountered
2) Unit 2 considered as possible colluvial soil in borehole BH03
3) Unit 3b overlies unit 3a in borehole BH11

4.2 GROUNDWATER

Groundwater was encountered in 5 boreholes (BH08-BH12) in the eastern portion of the Phase 1 development area, as summarised in table 4.3 below. Groundwater was not encountered in in the southern or western portions of the Phase 1 development area (boreholes BH01-BH07), or in the Phase 2 development area (test pits TP01-TP08).

Table 4.3 – Summary of groundwater levels encountered

Location	Approximate Groundwater Level Encountered	
	Depth (m bgl)	Elevation (m AHD)
BH08	14.8	8.2
BH09	13.6	6.4
BH10	10.5	6.7
BH11	14	5.3
BH12	9.5	7.5

4.3 DYNAMIC CONE PENETROMETER TEST RESULTS

DCP testing undertaken in the Phase 2 Development Area indicated blow counts typically greater than 5 blows per 100 mm penetration in the upper 0.5 m (unit 1 and upper portions of units 3a/3b). DCP results at greater depths in units 3a/b and unit 4 were typically greater than 7 blows per 100 mm penetration. DCP test results are shown on the borehole logs in Appendix C, with raw results also provided in Appendix D.

4.4 LABORATORY TEST RESULTS

The following sections summarise laboratory test results. Laboratory reports are provided in Appendix E.

4.4.1 Atterberg Limits

Laboratory results for Atterberg Limits testing are summarised in Table 4.4.

Table 4.4 – Summary of Atterberg Limits test results

Location	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH10	1.5-1.95 (unit 3a)	48	24	24	7.0
TP08	0.3-0.4 (unit 3a)	35	23	12	4.5

4.4.2 Particle Size Distribution

Particle Size Distribution (PSD) testing results are summarised in Table 4.5.

Table 4.5 – Summary of particle size distribution test results

Location	Sample Depth (m bgl)	Material	Sieve (mm)	Passing (%)
BH07	0.5-1.0 (unit 3a)	Sandy SILT, low plasticity, with medium to coarse sand and traces of fine gravel	4.75	93
			2.36	86
			0.425	69
			0.15	58
			0.075	53
TP04	0.4-0.5 (unit 3a)	Sandy CLAY, medium plasticity, sand is fine to medium	4.75	99
			2.36	98
			0.425	92
			0.15	76
			0.075	63

4.4.3 Emerson Class – Dispersivity

Results of Emerson Class testing are summarised in Table 4.6, below.

Table 4.6 – Summary of Emerson Class test results

Location	Depth range (m)	Unit	Material Description	Emerson Class
BH06	1.5-2.0	4	Sandy SILT (extremely weathered material)	5
BH07	0.5-1.0	3a	Residual sandy SILT	5
BH10	1.5-1.95	3a	Residual sandy CLAY	6
BH11	0.5-1.0	3b	Residual silty SAND	5
BH12	2.0-2.5	4	Sandy SILT (extremely weathered material)	6
TP02	0.4-0.5	3a	Residual sandy CLAY	5
TP04	0.2-0.3	3a	Residual sandy CLAY	5
TP04	0.4-0.5	4	Sandy CLAY (extremely weathered material)	5
TP05	0.9-1.0	4	Sandy CLAY (extremely weathered material)	6
TP08	0.3-0.4	3b	Residual clayey SAND	5

4.4.4 Acid Sulfate Soils

Acid sulfate soil test results are summarised in table 4.7, below. No visual or olfactory indicators of ASS / PASS were observed during fieldworks (such as blue-grey staining, waterlogged soils or sulfide odours). It is noted that the encountered soil units were considered to be of either residual origins or imported fill material. Alluvial or lacustrine deposits, which typically have a greater risk of ASS / PASS formation, were not encountered in the investigation.

Table 4.7 – Summary of Acid Sulfate Soil test results

Location	Depth (m)	pH-F [1]	pH-FOX [2]	Reaction rating [3]	Moisture content (%)	Chromium Reducible Sulfur (%S)	Net Acid Soluble Sulfur (%S)
BH01	0.5-0.8	5.7	4	3	-	-	-
BH02	0.5-0.8	5.3	3.8	3	-	-	-
BH03	1.5-2	5.8	2.7	3	17	<0.005	<0.02
BH03	3-3.5	5.7	3.6	4	11	<0.005	-
BH04	1.5-2	5.1	4.5	4	-	-	-
BH05	0.5-0.8	6	3.9	4	13	<0.005	-
BH06	2.5-2.8	4.7	4	3	-	-	-
BH07	2-2.3	5.1	4.2	4	-	-	-
BH08	2-2.3	5.4	4	4	-	-	-
BH09	13.5-13.8	5.6	4.8	4	-	-	-

Location	Depth (m)	pH-F [1]	pH-FOX [2]	Reaction rating [3]	Moisture content (%)	Chromium Reducible Sulfur (%S)	Net Acid Soluble Sulfur (%S)
BH10	2-2.5	6.1	4.5	4	-	-	-
BH10	4-4.3	5.4	4.2	4	-	-	-
BH10	9.5-9.8	5.4	4.7	4	-	-	-
BH11	2.5-2.8	4.6	4	4	-	-	-
BH12	5-5.5	5.3	4	3	-	-	-
BH12	9.5-10	5.9	6.3	4	-	-	-
TP01	0.9-1	5.9	4.5	2	-	-	-
TP02	0.4-0.5	5.9	4.2	3	-	-	-
TP03	0.2-0.3	5.8	4.5	3	-	-	-
TP04	0.4-0.5	6	4.7	3	-	-	-
TP05	0.2-0.3	6	3.1	4	7.6	<0.005	<0.02
TP06	1.4-1.5	6.3	4.8	3	-	-	-
TP07	0.2-0.3	5.5	4.3	3	-	-	-
TP08	0.4-0.5	5.8	4.9	3	-	-	-

Notes: 1) pH field value (before oxidation with peroxide)
2) pH field value (following oxidation with peroxide)
3) Field Screen uses the following reaction ratings to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Acid sulfate field screening indicated reaction ratings of “Strong” to “Extreme” in all cases, with four samples showing a moderate drop in pH values during field screening. Follow-up chromium reducible sulfur testing on these samples indicated sulfur and acid soluble sulfur below the laboratory limit of reporting and below the action criteria in the ASSMAC acid sulfate soils manual, indicating a low likelihood for the presence of ASS or PASS. The high reaction ratings could be attributed to organic matter or other chemicals present in the soil samples.

5. DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL

The geotechnical interpretation presented in this report was prepared based on the interpreted subsurface conditions, in-situ and laboratory test results, and information gathered by Coffey.

Foundation design, earthworks and construction should be undertaken in accordance with the applicable standards and industry guidance. Earthworks should be carried out in accordance with the principles set out in AS3798-2007 Guidelines on Earthworks for Commercial and Residential Developments.

Landfill cell design should be undertaken in accordance with the relevant NSW EPA and national guidance, including the NSW EPA *Environmental Guidelines: Solid Waste Landfills, Second Edition* (NSW EPA, 2016).

5.2 EARTHWORKS

5.2.1 General

Extensive earthworks may be required for the proposed cell expansion in the Phase 1 development area. This includes the potential for excavation into the hillside to the west of the existing landfill cell, however the extent and depth of the new cell footprint are yet to be finalised. Based on preliminary discussions with ESC we understand the vertical extent of excavation is intended to be limited to the upper 2-3m.

Excavations in the Phase 2 development area are expected to be shallower, generally limited to levelling / landform modifications, footing excavations and underground service excavations.

In any case, bulk excavations are expected to extend into Unit 4 (extremely weathered material) across both development areas, extending into the upper portions of unit 5 (weathered rock) in some areas, particularly in the Phase 1 development area.

Excavated material is intended to be reused and recompacted onsite during construction works. Residual clay material (within Unit 3a) is intended to be reused in capping material and potentially in clay liners (if deemed suitable from a geotechnical perspective).

5.2.2 Excavatability

Based on the ground conditions interpreted from the boreholes, it is expected that Units 1, 2, 3a/3b and the upper portions of Unit 4 could be excavated using conventional earthmoving equipment (such as an excavator with bucket attachment). Deeper excavations into Unit 4 and Unit 5 may require more specialised equipment, such as larger excavators (with ripper attachments) or bulldozers. Harder material may be encountered in some areas, which may require the use of rock hammers.

5.2.3 Reuse of Site-Won Material – Capping Layers

Emerson testing indicated that the residual soil units (unit 3a/3b) and extremely weathered material (unit 4) showed a tendency for slaking, however did not show dispersion under testing. It is considered that these units may be reused onsite, however ground cover should be maintained in the long term where possible with vegetation, pavements or similar cover to minimise erosion.

Residual clay material could be potentially reused in liner construction, subject to permeability testing to evaluate the suitability of the material as an aquitard or confining layer. Permeability testing was outside the scope of this investigation.

Clay soils were observed to be more prevalent in the Phase 2 development area (proposed admin / transfer station) compared to the Phase 1 development area (proposed cell expansion area). Clay material was observed to be present generally in thin layers and often grading to silt and sandy material.

In any case, the quantity of clay required for landfill capping and lining would depend on the landfill cell design and the practicality of separating residual clay from the surrounding soil / extremely weathered material units. It may be necessary to import clay material from offsite areas where the recovered volumes do not meet the design requirements.

The use of geofabric liners should also be considered, in accordance with the relevant NSW EPA and national guidance.

5.3 SHALLOW FOOTINGS

Shallow footings are expected to be required in the Phase 2 Development Area for the proposed administration buildings, weighbridge, transfer station and other structures. The below sections provide general recommendations for shallow footings, based on DCP and laboratory test results.

5.3.1 Site Classification

The site classification for the Phase 2 Development Area has been assessed in accordance with *AS2870-2011 Residential Slabs and Footings*. This provides an indication on potential characteristic ground surface movements to be considered in structural design.

Laboratory results for Atterberg Limits testing indicated Unit 3A cohesive soil to be low to medium plasticity, with linear shrinkage from laboratory results in the range of 4.5-7.0%. It is noted that no groundwater was observed in the Phase 2 development area, and residual soils were generally shallow (<1m). Weathered rock was encountered above the inferred typical zone of seasonal moisture variation within the Phase 2 Development Area, however the potential for moisture variation within the residual soil units has been considered as a precautionary measure.

Preliminary calculations assuming a shrink-swell index of 2.5%[2] and a depth of soil moisture variation of 1.5 m indicate potential characteristic ground surface movements in the range of 20-40mm. Consequently, it would be prudent to adopt a footing system appropriate for Class M (Moderately Reactive Sites) site conditions.

Where structures are proposed within the Brou Landfill site (in the Phase 1 Development Area), deeper soil and fill material may be encountered. In this case, the site classification should be assessed on a case-by-case basis. The presence of extensive fill material may require footings to be sized based on a Class P classification.

5.4 BEARING CAPACITY FOR SHALLOW FOOTINGS

Shallow footing systems founded at least 0.3 m into Units 3a / 3b (or to the minimum depth requirement in AS2870-2011, whichever is greater) in the Phase 2 Development Area could achieve an allowable bearing pressure of 150 kPa. Footings constructed in Unit 4 (extremely weathered material) could be sized for an allowable bearing pressure of 200 kPa. Unit 5 (weathered rock) was encountered at greater depths, and it is not expected to be encountered in shallow footing construction.

The recommended bearing pressures are contingent upon inspection by a geotechnical engineer to confirm that a suitable founding stratum has been reached and foundation conditions are suitable for the design parameters. All footings for a single structure should be founded in strata with similar bearing and reactivity characteristics to reduce the potential for differential movements across material transitions.

Construction of footings within Unit 1 (topsoil) and Unit 2 (fill) is not recommended. These units would require removal prior to construction of shallow footings or pavements onsite. Alternatively, further investigation and settlement analysis should be undertaken where footings are proposed to be constructed in fill material.

[2] The adopted shrink-swell value was based on typical correlations for Australian reactive soils, published in Cameron, (1989) and Fityus *et al* (2005)

5.5 ACID SULFATE SOILS

Acid sulfate soil risk maps and laboratory testing indicated a low probability of ASS / PASS being present at the site. It is considered that the risk of encountering ASS / PASS as part of the proposed developments is therefore *low*, for the areas assessed as part of this geotechnical investigation.

5.6 GROUNDWATER

Groundwater was encountered in five boreholes (BH08 to BH12) in the eastern portion of the Phase 1 Development Area, at depths ranging between 9.5m bgl (BH12) and 14.8m bgl (BH08). This correlates to elevations of approximately 5-8 m AHD.

Fluctuations are expected in response to seasonal factors, which should be considered in landfill cell design. Sea level rise may also contribute to long-term rising groundwater levels. Specific design guidance is provided in the NSW EPA (2016) *Environmental Guidelines: Solid Waste Landfills*. A detailed groundwater assessment was outside the scope of this investigation, but may be required where extensive cut is required in landfill design.

6. CLOSING

The descriptions of subsurface conditions described in this report are based on a limited number of test locations. Ground conditions can change over relatively short distances (and time); as such, the recommendations outlined in this report should be confirmed during construction by appropriate input from an experienced Geotechnical Engineer.

In addition to our comments and recommendations, Safety in Design considerations in accordance with Workplace Health and Safety legislation must be considered and included in the design of project elements.

The attached limitations sheet (titled “Important Information About Your Tetra Tech Coffey Report”) provides additional information on the uses and limitations of this report and should be read in conjunction with the recommendations in this report.

7. REFERENCES

Ahern C R, Stone, Y, and Blunden B (1998), *Acid Sulfate Soils Assessment Guidelines*, NSW Acid Sulfate Soils Management Advisory Committee (ASSMAC, 1999) Wollongbar NSW.

AS 2870-2011 Residential slabs and footings. Council of Australian Standards Australia, 2010.

AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments. Council of Australian Standards Australia, 2007.

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Chalker, L. and Bembrick, C (1975), *Narooma 1:100 000 Geological Sheet 8925, 1st edition,* Geological Survey of New South Wales, Sydney.

Fityus, S, Cameron, D., and Walsh, P. (2005), *The Shrink Swell Test,* Geotechnical Testing Journal, Vol. 28, No. 1

Jacobson, G. and Lau, J. (1947), *Hydrogeology of Australia 1:5,000,000 Map*, Bureau of Mineral Resources, Canberra.

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NSW government, Geological Survey of NSW (2022), *MinView*, available online: https://minview.geoscience.nsw.gov.au/

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY REPORT

As a client of Tetra Tech Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Tetra Tech Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Tetra Tech Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Tetra Tech Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Tetra Tech Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Tetra Tech Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Tetra Tech Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Tetra Tech Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Tetra Tech Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Tetra Tech Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Tetra Tech Coffey to work with other project design professionals who are affected by the report. Have Tetra Tech Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Tetra Tech Coffey for information relating to geoenvironmental issues.

Rely on Tetra Tech Coffey for additional assistance

Tetra Tech Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Tetra Tech Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Tetra Tech Coffey to other parties but are included to identify where Tetra Tech Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Tetra Tech Coffey closely and do not hesitate to ask any questions you may have.

APPENDIX A: FIGURES

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:40000

IMAGERY SOURCE: WORLD STREET MAP
SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A4

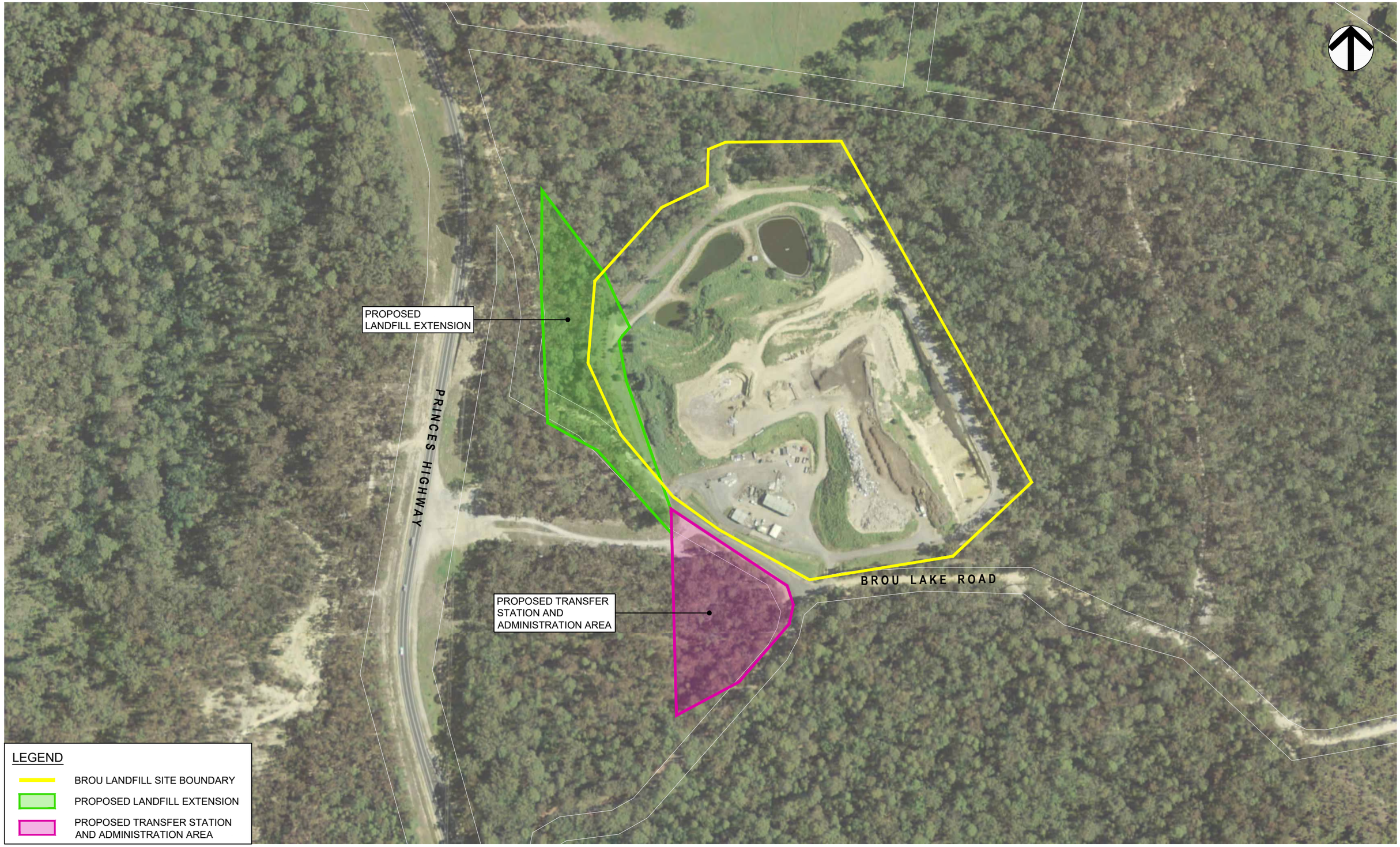
TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: SITE LOCATION PLAN

project no: 754-CBRGE301356 | figure no: FIGURE 1 | rev: A



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	14-10-2022

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:3000

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: SITE LAYOUT PLAN

project no: 754-CBRGE301356 | figure no: FIGURE 2 | rev: A

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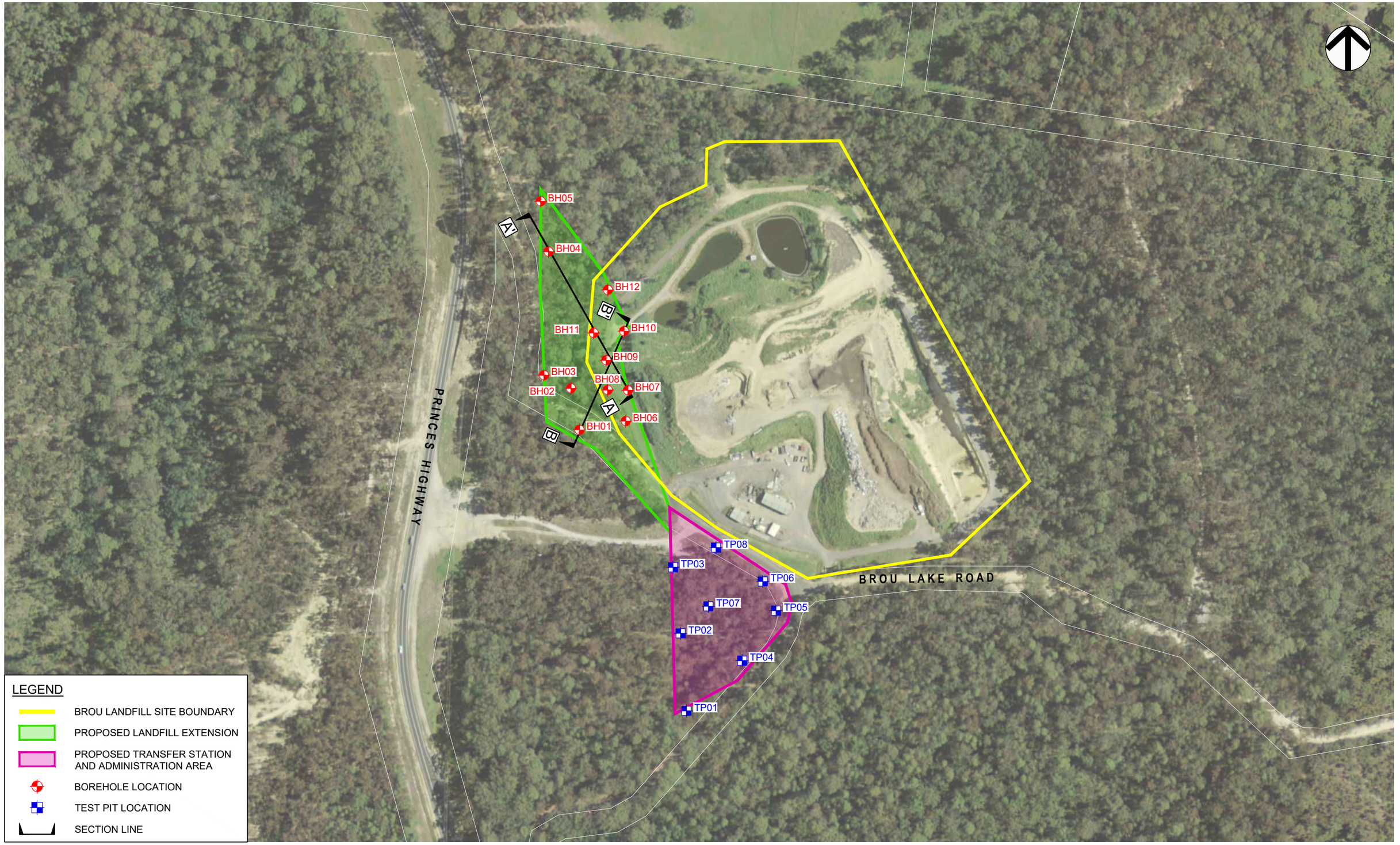

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	14-10-2022

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:3000

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: LAYOUT TITLE

project no: 754-CBRGE301356 | figure no: FIGURE 3 | rev: A

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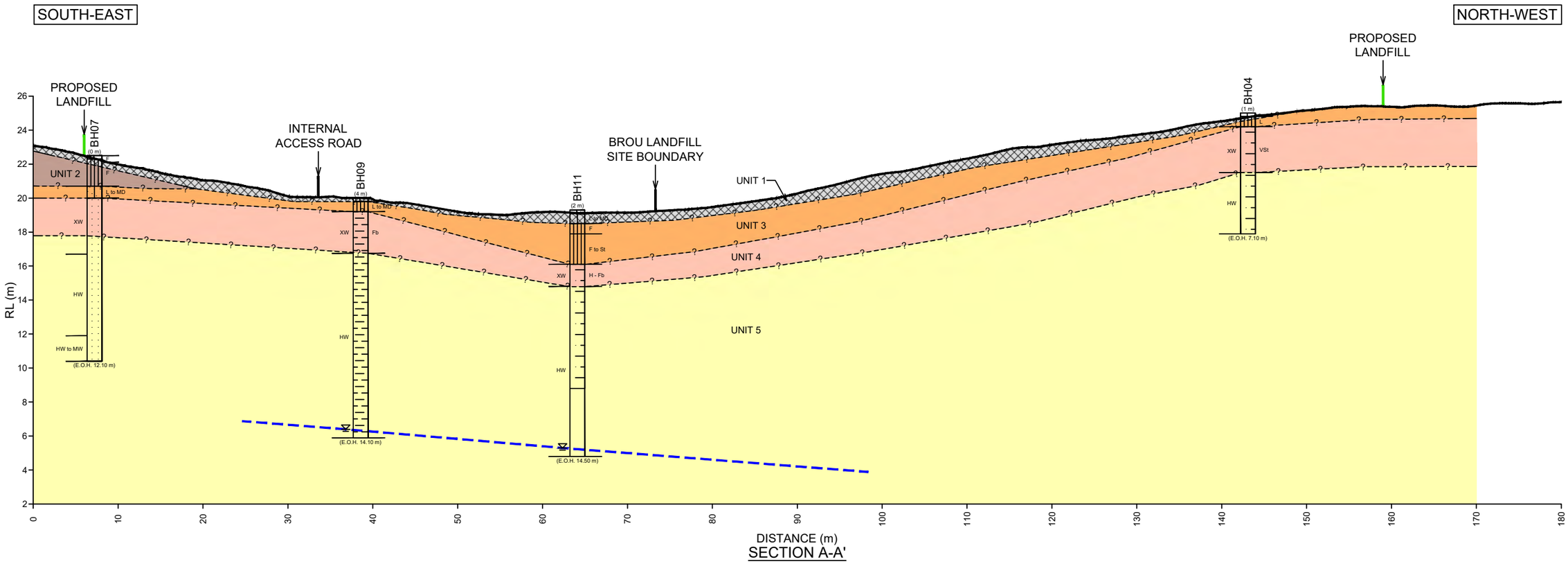

SECTION A-A'

LEGEND

- TOPSOIL
- SILT
- SILTSTONE
- SANDY SILTSTONE
- SILTY SAND
- SANDSTONE
- SHALE
- GRAVELLY SILT
- SANDY CLAY
- CLAY
- SANDY SILT

SECTION LEGEND

- EXISTING GROUND SURFACE
- INFERRED GEOLOGICAL BOUNDARY
- GROUNDWATER LEVEL
- WATER LEVEL

UNIT LEGEND

- UNIT 1 - TOPSOIL
- UNIT 2 - FILL
- UNIT 3 - RESIDUAL SOIL
- UNIT 4 - EXTREMELY WEATHERED MATERIAL
- UNIT 5 - WEATHERED ROCK

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	14-10-2022

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Horizontal Scale (metres) 1:500

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Vertical Scale (metres) 1:250

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

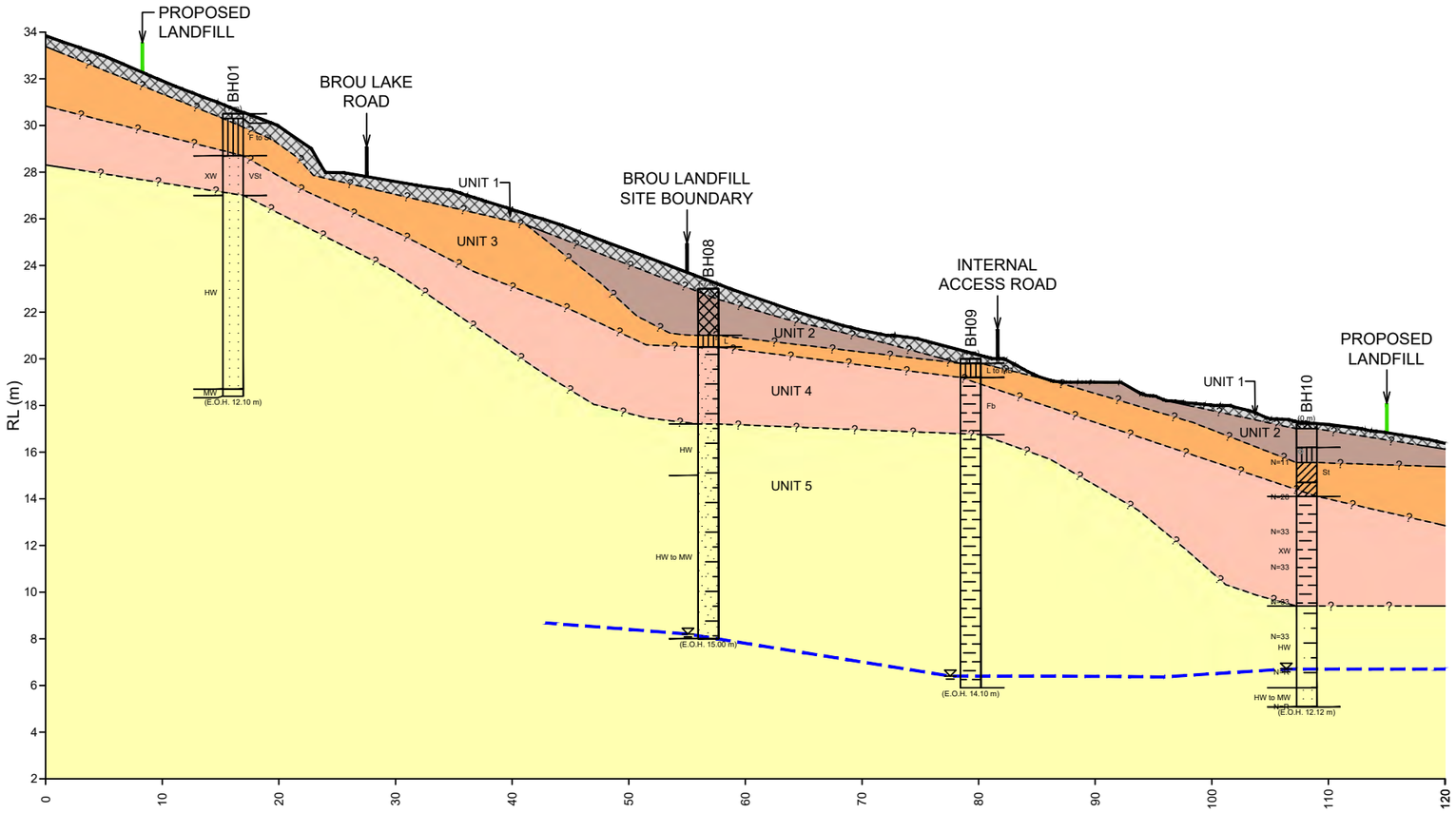
project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: SECTION A-A'

project no: 754-CBRGE301356 | figure no: FIGURE 4 | rev: A

SOUTH-WEST

NORTH-EAST



SECTION B-B'

LEGEND

- TOPSOIL
- SILT
- SILTSTONE
- SANDY SILTSTONE
- SILTY SAND
- SANDSTONE
- SHALE
- GRAVELLY SILT
- SANDY CLAY
- CLAY
- SANDY SILT

SECTION LEGEND

- EXISTING GROUND SURFACE
- INFERRED GEOLOGICAL BOUNDARY
- GROUNDWATER LEVEL
- WATER LEVEL

UNIT LEGEND

- UNIT 1 - TOPSOIL
- UNIT 2 - FILL
- UNIT 3 - RESIDUAL SOIL
- UNIT 4 - EXTREMELY WEATHERED MATERIAL
- UNIT 5 - WEATHERED ROCK

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	14-10-2022

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Horizontal Scale (metres) 1:500

2.5 0 5 10
Vertical Scale (metres) 1:250

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: SECTION B-B'

project no: 754-CBRGE301356 | figure no: FIGURE 5 | rev: A

PLOT DATE: 14/10/2022 10:10:15 AM DWG FILE: \\TTLOCAL\OOF\S779\P\1. PROJECTS\4. SYD-GEOTECHNICS\2. OTHER OFFICES\4.0 CBR-GE\754-CBRGE301356\CAD\754-CBRGE301366.DWG

NO-GO / POSSIBLE FUTURE EXPANSION AREA (CURRENTLY UNDER ASSESSMENT)

PROPOSED LANDFILL EXTENSION

PRINCES HIGHWAY

BROU LAKE ROAD

NO-GO / POSSIBLE FUTURE EXPANSION AREA (CURRENTLY UNDER ASSESSMENT)

PROPOSED TRANSFER STATION AND ADMINISTRATION AREA

LEGEND

- BROU LANDFILL SITE BOUNDARY
- PROPOSED LANDFILL EXTENSION
- PROPOSED TRANSFER STATION AND ADMINISTRATION AREA
- NO-GO AREAS (OUTSIDE OF GEOTECHNICAL INVESTIGATION SCOPE)

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	14-10-2022

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:3000

drawn	PP / AW
approved	-
date	14-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: NSW PUBLIC WORKS ADVISORY

project: GEOTECHNICAL INVESTIGATION
BROU LANDFILL EXPANSION
BROU LAKE ROAD, BODALLA, NSW

title: ADDITIONAL AREAS UNDER ASSESSMENT – EXCLUDED FROM GEOTECHNICAL INVESTIGATION)

project no: 754-CBRGE301356 | figure no: FIGURE 6 | rev: A

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APPENDIX B: SELECTED SITE PHOTOGRAPHS

APPENDIX B: SELECTED SITE PHOTOGRAPHS

Photo 1: View of the Phase 1 development area near BH02.

Photo 2: View of the Phase 1 development area with dense vegetation near BH03.

Photo 3: Hanjin D&B 8D drilling rig setup in the Phase 1 development area at BH11.

Photo 4: Groundwater encountered in the Phase 1 development area at BH12.

Photo 5: Hanjin D&B 8D drilling rig used for borehole drilling in the Phase 1 development area.

Photo 6: Drilling rig setup at BH10.

Photo 7: Sumitomo 8-tonne excavator used for test pit excavation in the Phase 2 development area.

Photo 8: Test pit TP02 following excavation.

Photo 9: Extremely weathered siltstone recovered from test pit TP02.

Photo 10: Extremely weathered sandstone recovered from test pit TP06.

Photo 11: View of dense vegetation, test pit TP07 and access trail in the Phase 2 development area.

APPENDIX C: GEOTECHNICAL LOGS

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH01***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,617; N: 5,996,145 (MGA94 Zone 56) | surface elevation: 31 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N		Not Encountered	D: BH01 / 0.5-0.8 D: BH01 / 0.5-1.0	30	0.0			**TOPSOIL: SILT**: low liquid limit, brown, trace of fine grained sand and gravel.	<Wp	F		**TOPSOIL**
								SILT: low liquid limit, brown to grey brown, trace of gravel (extremely weathered siltstone).	<Wp	F to St		**RESIDUAL SOIL**
				29	1.0							
					2.0			**SANDSTONE**: yellow brown, extremely weathered, very low strength, crumbles under hand pressure to sandy SILT, low plasticity, very stiff consistency, sand is fine to medium, very low strength.	D	VSt		**EXTREMELY WEATHERED MATERIAL**
				28								
					3.0							
				27				**SANDSTONE**: grey-brown, interbedded siltstone, highly weathered, low strength.	D			**WEATHERED ROCK**
			D: BH01 / 4.0-4.5		4.0							
				26								
					5.0							
				25								
					6.0							
				24								
					7.0							
				23								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH01***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,617; N: 5,996,145 (MGA94 Zone 56) | surface elevation: 31 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information							material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N		Not Encountered	D: BH01 / 9.0-9.5	22	9.0			**SANDSTONE**: grey-brown, interbedded siltstone, highly weathered, low strength. *(continued)* 8.5 m: purple banding observed	D			**WEATHERED ROCK**
				21	10.0							
			D: BH01 / 11.5-12.0	20	11.0							
				19	12.0			**SHALE**: pale brown, moderately weathered, medium strength.				
				18	13.0			Borehole BH01 terminated at 12.10 m Refusal				
				17	14.0							
				16	15.0							
				15								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH02***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,610; N: 5,996,180 (MGA94 Zone 56) | surface elevation: 25 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	soil origin, structure and additional observations
AD, N		Not Encountered	E: BH02 / 0.5-0.8	24	0			**TOPSOIL: Gravelly Sandy SILT**: fine grained, dark brown, fine sized sub-angular gravel.	<Wp	F		**TOPSOIL**
								Sandy SILT: brown, fine grained sand, with some fine sized sub-angular gravel.	<Wp	F to St		**RESIDUAL SOIL**
			D: BH02 / 1.0-1.5		1.0			**SILT**: orange brown, trace of extremely weathered siltstone fragments.	<Wp	St		
				23	2.0							
				22	3.0			**SILTSTONE**: yellow brown, extremely weathered, very low strength, crumbles under hand pressure to sandy SILT, low plasticity, very stiff consistency, sand is fine to medium.	D	VSt		**EXTREMELY WEATHERED MATERIAL**
			D: BH02 / 3.5-4.0	21								
					4.0			**SILTSTONE**: yellow brown, interbedded sandstone, highly weathered to moderately weathered, low to medium strength.	D			**WEATHERED ROCK**
				20	5.0							
			D: BH02 / 5.5-6.0	19								
					6.0							
				18	7.0							
				17								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH02***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,610; N: 5,996,180 (MGA94 Zone 56) | surface elevation: 25 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information							material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N		Not Encountered	D: BH02 / 8.0-8.5	16	9.0			**SILTSTONE**: yellow brown, interbedded sandstone, highly weathered to moderately weathered, low to medium strength. *(continued)*	D			**WEATHERED ROCK**
			D: BH02 / 10.0-10.5	15	10.0							
				14	11.0							
				13	12.0			Borehole BH02 terminated at 11.10 m Refusal				
				12	13.0							
				11	14.0							
				10	15.0							
				9								

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH03***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,587; N: 5,996,191 (MGA94 Zone 56) | surface elevation: 26 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD, N		Not Encountered		25	0			**TOPSOIL: Gravelly Sandy SILT**: low liquid limit, brown, sand is fine to medium, gravel is fine to coarse, with rootlets and organic fines.	<Wp	F		**TOPSOIL**
			D: BH03 / 1.0-1.5		1.0			**FILL: SILTY SAND**: fine grained, brown.	D	L to MD		**FILL**
			E: BH03 / 1.5-2.0	24				**Sandy CLAY**: low to medium plasticity, dark brown, sand is fine to medium grained.	<Wp	S to F		**COLLUVIUM / FILL**
			D: BH03 / 2.0-2.5		2.0							
				23								
			E: BH03 / 3.0-3.5		3.0			**Sandy CLAYEY GRAVEL**: medium to coarse grained, sub-angular, brown, clay is low plasticity, sand is fine to medium.	D	MD		
				22				**CLAYEY SAND**: fine to medium grained, brown, clay is low plasticity, some fine sized sub-angular gravel.	D	D		**RESIDUAL SOIL**
					4.0			**SILTSTONE**: orange brown, extremely weathered, very low strength, remoulds as SILT, low plasticity, stiff consistency.	<Wp	St		**EXTREMELY WEATHERED MATERIAL**
			D: BH03 / 4.5-5.0	21								
					5.0							
				20								
					6.0							
				19				**SILTSTONE**: orange brown, interbedded with sandstone, highly weathered, low strength.	D			**WEATHERED ROCK**
					7.0							
			D: BH03 / 7.5-8.0	18								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration: 1 2 3 — no resistance ranging to refusal

water: 10-Oct-12 water level on date shown; water inflow; water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH03***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,587; N: 5,996,191 (MGA94 Zone 56) | surface elevation: 26 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N		Not Encountered		17 16 15 14 13 12 11 10	9.0 10.0 11.0 12.0 13.0 14.0 15.0			**SILTSTONE**: orange brown, interbedded with sandstone, highly weathered, low strength. *(continued)*	D			**WEATHERED ROCK**
			D: BH03 / 12.5-13					**SHALE**: yellow brown to pale brown, highly weathered to moderately weathered, low to medium strength.				
								Borehole BH03 terminated at 14.4 m Refusal				

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,591; N: 5,996,296 (MGA94 Zone 56) | surface elevation: 25 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD, N		Not Encountered		25				**TOPSOIL: SILT**: brown, trace of fine sized sub-angular gravel, trace of rootlets.	<Wp			**TOPSOIL**
								SILT: brown to yellow brown.	<Wp	L		**RESIDUAL SOIL**
			BH04 / 1.5-2.0	24	1.0			**SILTSTONE**: yellow-brown, extremely weathered, very low strength. Recovered as SILT, low plasticity, with extremely weathered gravel.	<Wp	VSt		**EXTREMELY WEATHERED MATERIAL**
				23	2.0							
				22	3.0							
				21	4.0			**SILTSTONE**: yellow-brown, some interbedded sandstone, occasional purple laminations, highly weathered.	D			**WEATHERED ROCK**
				20	5.0							
				19	6.0			becoming highly to moderately weathered, low to medium strength				
				18	7.0							
								Borehole BH04 terminated at 7.10 m Refusal				

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH05***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***18 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***18 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,584; N: 5,996,339 (MGA94 Zone 56) | surface elevation: 24 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD, N		Not Encountered	BH05 / 0.5-0.8	24				**TOPSOIL: SILT**: brown to dark brown, trace organic matter.	D	L		**TOPSOIL**
								SILT: brown, with some fine sub-angular gravel.	D	F / St		**RESIDUAL SOIL**
				23	1.0			1.2 m: becoming grey brown				
				22	2.0			**SILTSTONE**: extremely weathered, brown, remoulded as: Clayey Silt with trace gravel.	D	VSt - H		**EXTREMELY WEATHERED MATERIAL**
				21	3.0			**SILTSTONE**: grey brown, some interbedded sandstone, highly weathered, low to medium strength.				**WEATHERED ROCK**
				20	4.0							
				19	5.0							
				18	6.0							
				17	7.0							
								Borehole BH05 terminated at 7.2 m Refusal				

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remoulded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH06***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,657; N: 5,996,152 (MGA94 Zone 56) | surface elevation: 26 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	soil origin, structure and additional observations
AD, N		Not Encountered		25	1.0			**TOPSOIL: SILT**: brown, trace of fine sized sub-angular gravel.	D	L		**TOPSOIL**
								SILT: brown, trace of fine sized sub-angular gravel.	D	F - St		**RESIDUAL SOIL**
			D: BH06 / 1.5-2.0	24	2.0			**SILTSTONE**: brown, extremely weathered, very low strength. Remoulded as: Silt, low plasticity, brown.	D	St - VSt		**EXTREMELY WEATHERED MATERIAL**
			E: BH06 / 2.5-2.8	23	3.0			**SILTSTONE**: pale brown, some interbedded sandstone, moderately weathered, very low to medium strength.	D			**WEATHERED ROCK**
			D: BH06 / 3.5-4.0	22	4.0							
				21	5.0							
				20	6.0							
				19	7.0							
				18								

method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH06***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,657; N: 5,996,152 (MGA94 Zone 56) | surface elevation: 26 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N		Not Encountered	D: BH06 / 8.0-8.5	17	9.0			**SILTSTONE**: pale brown, some interbedded sandstone, moderately weathered, very low to medium strength. *(continued)*	D			**WEATHERED ROCK**
			E: BH06 / 9.5-9.8	16								
			D: BH06 / 10.0-10.5	15	10.0							
					11.0							
				14				Borehole BH06 terminated at 11.4 m Refusal				
					12.0							
				13								
					13.0							
				12								
					14.0							
				11								
					15.0							
				10								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH07***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,658; N: 5,996,178 (MGA94 Zone 56) | surface elevation: 23 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	soil origin, structure and additional observations
AD, N		Not Encountered						**TOPSOIL: SILT**: low liquid limit, brown, with rootlets and organic fines, trace of fine sized sub-angular gravel.	<Wp	F		**TOPSOIL**
								SILT: low liquid limit, brown, with trace of fine sized sub-angular gravel.	<Wp	F		**RESIDUAL SOIL**
			D: BH7 / 0.5-1.0	22	1.0			1.3 m: becoming yellow brown, trace of fine grained sand				
				21								
			E: BH07 / 2.0-2.3		2.0			**SILTY SAND**: fine grained, yellow brown, with some gravel (extremely weathered sandstone).	D	L to MD		
				20				**SANDSTONE**: yellow brown, extremely weathered, very low strength, remoulds to sandy SILT, LP, very stiff consistency.	D			**EXTREMELY WEATHERED MATERIAL**
			D: BH07 / 3.0-3.5		3.0							
				19								
					4.0							
				18								
					5.0			**SANDSTONE**: fine to medium grained, yellow brown, interbedded siltstone, highly weathered to moderately weathered, low to medium strength.				**WEATHERED ROCK**
				17								
					6.0							
			D: BH07 / 6.5-7.0	16								
					7.0							
				15								

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH07***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,658; N: 5,996,178 (MGA94 Zone 56) | surface elevation: 23 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD, N		Not Encountered	E: BH07 / 10.0-10.3	14	9.0			**SANDSTONE**: fine to medium grained, yellow brown, interbedded siltstone, highly weathered to moderately weathered, low to medium strength. *(continued)*	D			**WEATHERED ROCK**
				13								
				12	10.0			10.6 m: becoming highly to moderately weathered, low to medium strength				
				11	11.0							
				10	12.0			Borehole BH07 terminated at 12.10 m Refusal				
				9	13.0							
				8	14.0							
				7	15.0							

method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH08***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,641; N: 5,996,179 (MGA94 Zone 56) | surface elevation: 23 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N				23								
								FILL: Gravelly SILTY SAND: fine to medium grained, brown to dark brown.	D			**FILL**
				22	1.0							
			E: BH08 / 2.0_2.3	21	2.0			**SILT**: low liquid limit, orange brown, with trace fine grained sand, trace low plasticity clay, trace fine sized gravel.	<Wp	L		**RESIDUAL SOIL**
			D: BH08 / 2.5-3.0					**SILTSTONE**: extremely weathered, very low strength, remoulds to sandy SILT, low plasticity, fine to medium sand.	D			**EXTREMELY WEATHERED MATERIAL**
				20	3.0							
			E: BH08 / 3.5-3.8					3.5 m: becoming yellow brown				
				19	4.0							
				18	5.0							
			D: BH08 / 5.5-6.0									
				17	6.0			**SANDSTONE**: interbedded siltstone, highly weathered, very low to low strength.				**WEATHERED ROCK**
				16	7.0							

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remoulded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH08***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,641; N: 5,996,179 (MGA94 Zone 56) | surface elevation: 23 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N			D: BH08 / 8.0-8.5	15				**SANDSTONE**: interbedded siltstone, highly weathered to moderately weathered, low to medium strength.	D			**WEATHERED ROCK**
				14	9.0							
				13	10.0							
				12	11.0							
				11	12.0			12.1 m: becoming moderately weathered, low to medium strength				
			D: BH08 / 13.5-14.0	10	13.0							
				9	14.0			14.0 m: becoming moist	M			
		▽ 17/08/22						14.7 m: becoming wet	W			
				8	15.0			Borehole BH08 terminated at 15.0 m				

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH09***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,640; N: 5,996,204 (MGA94 Zone 56) | surface elevation: 20 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N				20				**TOPSOIL: SILT**: dark brown, trace of fine sub-angular gravel.	<Wp	F to St		**TOPSOIL**
								SILT: brown.				**RESIDUAL SOIL**
								0.5 m: becoming orange brown				
				19	1.0			**SILTSTONE**: yellow brown, extremely weathered, very low strength, remoulded as SILT, low plasticity, very low strength.	D	Fb		**EXTREMELY WEATHERED MATERIAL**
			BH09 / 1.5-1.8									
				18	2.0			2.5 m: trace of medium plasticity clay				
				17	3.0							
								SILTSTONE: grey brown, some interbedded sandstone, highly weathered to moderately weathered, low to medium strength.				**WEATHERED ROCK**
				16	4.0			4.0 m: becoming pale brown				
								4.5 m: trace of medium plasticity clay (clay seam?)				
				15	5.0							
				14	6.0							
								6.5 m: becoming yellow brown				
				13	7.0							

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH09***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,640; N: 5,996,204 (MGA94 Zone 56) | surface elevation: 20 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD / N		▽ 16/08/22	BH09 / 13.5-13.8	12				**SILTSTONE**: grey brown, some interbedded sandstone, highly weathered to moderately weathered, low to medium strength. *(continued)*	D			**WEATHERED ROCK**
				11	9.0							
				10	10.0							
				9	11.0							
				8	12.0							
				7	13.0				M			
								13.6 m: becoming moist - wet	W			
				6	14.0							
								Borehole BH09 terminated at 14.10 m				
				5	15.0							

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH10***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,655; N: 5,996,228 (MGA94 Zone 56) | surface elevation: 17 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD, N				17	0.0			**FILL: Clayey SILTY GRAVEL**: fine grained, low liquid limit, grey brown.	D	MD		**TOPSOIL**
								FILL: Sandy SILT: fine to medium grained, brown, with some yellow brown fine to medium sized gravel.	<Wp	F to St		**FILL**
			D: BH10 / 1.0-1.5	16	1.0		ML	**Gravelly SILT**: fine to medium grained, orange brown, fine to medium sub-angular gravel.		St		**RESIDUAL SOIL**
			SPT 2, 4, 7 N*=11				CI	**Sandy CLAY**: fine grained, medium plasticity, orange brown, with some fine to medium sized sub-angular gravel.	~Wp			
			E: BH10 / 2.0-2.3	15	2.0							
			D: BH10 / 2.0-2.5				CL-CI	**CLAY**: low to medium plasticity, pale brown.	<Wp			
								2.7 m: some fine to medium sub-angular gravel				
			SPT 8, 13, 15 N*=28	14	3.0			**SILTSTONE**: pale brown, extremely weathered, low to very low strength, some black laminations, remoulds to sandy SILT, very low strength.	D			**EXTREMELY WEATHERED MATERIAL**
			E: BH10 / 4.0-4.3	13	4.0			4.0 m: becoming yellow brown				
			D: BH10 / 4.0-4.5									
			SPT 20, 16, 17 N*=33									
				12	5.0			5.0 m: some purple laminations				
			D: BH10 / 6.0-6.5									
			SPT 15, 15, 18 N*=33	11	6.0							
								6.5 m: becoming pale brown				
				10	7.0							
			SPT 16, 15, 18 N*=33									
												WEATHERED ROCK

method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH10***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,655; N: 5,996,228 (MGA94 Zone 56) | surface elevation: 17 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N			D: BH10 / 8-8.5	9				**SILTSTONE**: yellow brown, some interbedded sandstone, highly weathered, low strength. *(continued)*	D			**WEATHERED ROCK**
			SPT 15, 15, 18 N*=33	8	9.0			9.0 m: becoming moist	M			
			E: BH10 / 9.5-9.8									
		16/08/22	SPT 19 HB N*=R	7	10.0			10.5 m: becoming saturated	W			
				6	11.0			**SANDSTONE**: yellow brown, interbedded siltstone, highly weathered to moderately weathered, low to medium strength.				
			SPT 20/120mm HB N*=R	5	12.0			Borehole BH10 terminated at 12.12 m Refusal				
				4	13.0							
				3	14.0							
				2	15.0							

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH11***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,629; N: 5,996,227 (MGA94 Zone 56) | surface elevation: 19 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N				19				**TOPSOIL: SILT**: brown, with trace of low plasticity clay, trace of rootlets.	<Wp	F		**TOPSOIL**
			D: BH11 / 0.5-1.0				SM	**SILTY SAND**: medium to coarse grained, brown, with some fine to medium sized sub-angular gravel.	M	L to MD		**RESIDUAL SOIL**
				18	1.0		ML	**Sandy SILT**: fine to medium grained, brown, with trace of fine sized sub-angular gravel.	<Wp	F		
				17	2.0		ML	**SILT**: brown, trace of fine sized sub-angular gravel, trace of fine grained sand, trace of low plasticity clay.	M	F to St		
			E: BH11 / 2.5-2.8		3.0							
				16				**SILTSTONE**: orange brown, extremely weathered, very low strength, remoulds as SILT, low plasticity, very low strength.	D	H - Fb		**EXTREMELY WEATHERED MATERIAL**
			D: BH11 / 4.0-4.5	15	4.0							
				14	5.0			**SILTSTONE**: orange brown, trace of fine grained sand, highly weathered, low strength.	D			**WEATHERED ROCK**
				13	6.0							
				12	7.0							

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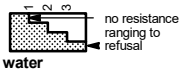
method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

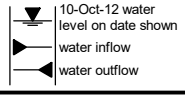
support
- M mud
- C casing
- N nil

penetration



no resistance ranging to refusal

water


10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH11***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***17 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***17 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,629; N: 5,996,227 (MGA94 Zone 56) | surface elevation: 19 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N				11	9.0			**SILTSTONE**: orange brown, trace of fine grained sand, highly weathered, low strength. *(continued)*	D			**WEATHERED ROCK**
				10								
				9	10.0							
			D: BH11 / 11.0-11.5	8	11.0			**SILTSTONE**: yellow brown, interbedded sandstone, moderately weathered, medium strength.				
				7	12.0			12.5 m: becoming grey brown				
			D: BH11 / 13.0-13.5	6	13.0				M			
		17/08/22		5	14.0			14.0 m: groundwater encountered	W			
				4	15.0			Borehole BH11 terminated at 14.5 m				

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH12***
sheet:	1 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,641; N: 5,996,264 (MGA94 Zone 56) | surface elevation: 17 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N				17			ML	**TOPSOIL: SILT**: low liquid limit, brown, trace rootlets and fine to medium gravel.	<Wp	F to St		**TOPSOIL**
							ML	**FILL: SILT**: low liquid limit, brown, trace fine to medium gravel.				**FILL**
			E: BH12 / 1.5-1.8	16	1.0							
			D: BH12 / 2.0-2.5	15	2.0		ML	**SILT**: low liquid limit, orange-brown. 1.8 m: becoming orange brown				**RESIDUAL SOIL**
				14	3.0							
			D: BH12 / 4.0-4.5	13	4.0			**SILTSTONE**: orange-brown, extremely weathered, very low strength, remoulds to sandy SILT, low plasticity, sand is fine to medium, very low strength.	D	VSt to H		**EXTREMELY WEATHERED MATERIAL**
			E: BH12 / 5.0-5.3	12	5.0			**SILTSTONE**: yellow-brown, interbedded sandstone, highly weathered, low strength.				**WEATHERED ROCK**
				11	6.0							
				10	7.0			7.0 m: becoming orange brown				

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remoulded (kPa)
R refusal
HB hammer bouncing

soil group symbol & material description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH12***
sheet:	2 of 2
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date started:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***TX***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,641; N: 5,996,264 (MGA94 Zone 56) | surface elevation: 17 m (AHD) | angle from horizontal: 90°

drill model: Hanjin D&B, Track mounted | drilling fluid: None | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD N			D: BH12 / 8.0-8.5	9				**SILTSTONE**: yellow-brown, interbedded sandstone, highly weathered, low strength. *(continued)*	D			**WEATHERED ROCK**
				8	9.0			9.0 m: becoming brown				
		17/08/22	E: BH12 / 9.5-10 D: BH12 / 9.5-10.0					9.5 m: becoming saturated	W			
				7	10.0							
								10.5 m: becoming moist	M			
				6	11.0							
				5	12.0			12.0 m: becoming saturated	W			
				4	13.0							
				3	14.0							
				2	15.0			Borehole BH12 terminated at 15.0 m				

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & material description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP01***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,708; N: 5,995,906 (MGA94 Zone 56) | surface elevation: 24 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP01 / 0.4-0.5	23.0	0.5		ML	**TOPSOIL: Sandy SILT**: low liquid limit, dark grey-brown, fine to medium grained sand with rootlets and organic fines.	D	L			**TOPSOIL**
								SC	**CLAYEY SAND**: fine to medium grained, pale grey, low plasticity clay, trace rootlets and fine grained gravel (highly weathered siltstone/sandstone).	<Wp	VSt - H			**RESIDUAL SOIL** HP 225 - 350 kPa
				TP01 / 0.9-1.0	22.5	1.0			**SILTSTONE**: extremely weathered, very low strength. Remoulds to: sandy SILT: low plasticity, pale grey-brown, fine to medium grained sand, trace highly weathered siltstone.	D	H			**EXTREMELY WEATHERED MATERIAL** DCP Refusal
					22.0	1.5			**SILTSTONE**: pale grey, low strength, indistinct bedding, minor sand lenses, interbedded sandstone.					**WEATHERED ROCK**
									Test pit TP01 terminated at 1.8 m Target depth					
					21.5	2.0								
					21.0	2.5								
					20.5	3.0								
					20.0	3.5								

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP02***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,703; N: 5,995,972 (MGA94 Zone 56) | surface elevation: 29 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP01 / 0.4-0.5	28.0	0.5		SM	**TOPSOIL: SILTY SAND**: fine to medium grained, dark grey, with rootlets and organic fines.	D	L			**TOPSOIL**
								CL	**Sandy CLAY**: low plasticity, pale grey-brown, fine to medium grained sand, trace rootlets and fine grained gravel (highly weathered sandstone).	<Wp	VSt	×		**RESIDUAL SOIL** HP 175 kPa
				TP01 / 0.9-1.0	27.5	1.0			**SILTSTONE**: extremely weathered, very low strength. Recovered as: Sandy SILT: fine to medium grained, pale grey-brown, low plasticity clay.	D	H	×		**EXTREMELY WEATHERED MATERIAL** HP 350 kPa DCP Refusal
					27.0	1.5			**SILTSTONE**: pale grey-brown, highly weathered to extremely weathered, low to very low strength, sand lenses.					**WEATHERED ROCK**
					26.5	2.0								
					26.0	2.5			Test pit TP02 terminated at 2.2 m Target depth					
					25.5	3.0								
					25.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

		Excavation ID.	***TP03***
		sheet:	1 of 1
		project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***	date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***	date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***	logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***	checked by:	***IO***

position: E: 238,697; N: 5,996,028 (MGA94 Zone 56) | surface elevation: 30 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP03 / 0.2-0.3	29.0	0.5		SM	**TOPSOIL: SILTY SAND**: fine to medium grained, dark grey, trace low plasticity clay, with cobbles and organic fines, trace tree roots.	D	MD	X		**TOPSOIL**
								SC	**CLAYEY SAND**: fine to medium grained, pale brown, low plasticity clay, trace fine to medium grained gravel (highly to moderately weathered sandstone).		VD			HP 75 kPa **RESIDUAL SOIL** **WEATHERED ROCK**
				TP03 / 0.9-1.0	28.5	1.0			**SANDSTONE**: pale brown, highly to extremely weathered, very low strength, trace iron staining.					DCP Refusal
					28.0	1.5			Test pit TP03 terminated at 1.7 m Target depth					
					27.5	2.0								
					27.0	2.5								
					26.5	3.0								
					26.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP04***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,756; N: 5,995,948 (MGA94 Zone 56) | surface elevation: 25 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP04 / 0.4-0.5	24.0	0.5		ML / CL	**TOPSOIL: Sandy SILT**: low liquid limit, pale grey, with rootlets and organic fines, fine to medium grained sand, trace fine grained gravel, fine to medium grained angular to sub-angular sandstone.	<Wp	F / St - VSt			**TOPSOIL** HP 45 kPa **RESIDUAL SOIL**
									Sandy CLAY: low plasticity, pale grey-brown, fine to medium grained sand, trace fine grained gravel (highly weathered siltstone).					HP 175 kPa
				TP04 / 0.9-1.0	23.5	1.0			**SILTSTONE**: extremely weathered, very low strength. Recovered as: Sandy SILT: low plasticity, pale grey-brown, fine to medium grained sand, trace highly weathered siltstone fragments.	D	H			**EXTREMELY WEATHERED MATERIAL**
					23.0	1.5			**SILTSTONE**: pale grey-brown, highly weathered, very low strength, minor sand lenses.					**WEATHERED ROCK**
									Test pit TP04 terminated at 1.7 m Target depth					
					22.5	2.0								
					22.0	2.5								
					21.5	3.0								
					21.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP05***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,785; N: 5,995,991 (MGA94 Zone 56) | surface elevation: 25 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP05 / 0.2-0.3	24.0	0.5		SM	**TOPSOIL: SILTY SAND**: fine to medium grained, pale grey, with rootlets and organic fines.	D	L			**TOPSOIL**
								ML	**Sandy SILT**: low liquid limit, pale grey-brown, fine to medium grained sand, trace tree roots and fine grained gravel (fine to medium grained angular to sub-angular, highly weathered siltstone).	<Wp	St			**RESIDUAL SOIL** HP 150 kPa
				TP05 / 0.9-1.0	23.5	1.0			**SILTSTONE**: pale grey-brown, highly weathered, very low strength. Remoulds to: Sandy CLAY: low plasticity, fine to medium grained, trace highly weathered siltstone.	D	H			**EXTREMELY WEATHERED MATERIAL** DCP Refusal
					23.0	1.5			**SILTSTONE**: pale grey-brown, to pink-grey, highly weathered, low to very low strength, minor sandstone lenses, trace quartz.					**WEATHERED ROCK**
					22.5	2.0			Test pit TP05 terminated at 2.0 m Target depth					
					22.0	2.5								
					21.5	3.0								
					21.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

		Excavation ID.	***TP06***
		sheet:	1 of 1
		project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***	date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***	date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***	logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***	checked by:	***IO***

position: E: 238,773; N: 5,996,016 (MGA94 Zone 56) | surface elevation: 24 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP06 / 0.4-0.5	23.0	0.5		SM	**TOPSOIL: SILTY SAND**: fine to medium grained, pale grey, with rootlet sand organic fines.	D	L			**TOPSOIL**
								ML	**Sandy SILT**: low liquid limit, pale red-brown, fine to medium grained sand, trace tree roots and fine to medium grained gravel (highly weathered sandstone).	<Wp	VSt	X		HP 175 kPa
					22.5	1.0			**SANDSTONE**: fine to medium grained, pale grey, Recovered as: Clayey SAND: fine to medium grained, minor silt laminations.	D	H			**EXTREMELY WEATHERED MATERIAL**
				TP06 / 1.4-1.5	22.0	1.5			**SANDSTONE**: fine to medium grained, pale grey, highly weathered, very low strength.					**WEATHERED ROCK** DCP Refusal
					21.5	2.0			Test pit TP06 terminated at 1.9 m Target depth					
					21.0	2.5								
					20.5	3.0								
					20.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

		Excavation ID.	***TP07***
		sheet:	1 of 1
		project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***	date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***	date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***	logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***	checked by:	***IO***

position: E: 238,727; N: 5,995,994 (MGA94 Zone 56) | surface elevation: 28 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP07 /				SM	**TOPSOIL: SILTY SAND**: fine to medium grained, dark grey, with rootlets, organic fines and charcoal.	D	L	X		**TOPSOIL**
								SM			MD			HP 70 kPa
								SC	**SILTY SAND**: fine to medium grained, pale grey, with rootlets, organic fines and charcoal.		D	X		**TOPSOIL / COLLUVIUM**
									CLAYEY SAND: fine to medium grained, pale brown, low plasticity clay, trace fine to medium grained gravel (highly weathered sandstone), with tree roots.		VD			**RESIDUAL SOIL**
					27.0	0.5								HP 250 kPa
									SANDSTONE: fine to medium grained, pale grey-brown, highly to extremely weathered, very low strength, some interbedded silt.					**WEATHERED ROCK**
					26.5	1.0								DCP Refusal
				TP07 / 1.8-1.9	26.0	1.5								
									Test pit TP07 terminated at 1.7 m Target depth					
					25.5	2.0								
					25.0	2.5								
					24.5	3.0								
					24.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP08***
sheet:	1 of 1
project no.	***754-CBRGE301356***
client:	***Eurobodalla Shire Council***
date excavated:	***16 Aug 2022***
principal:	***NSW Public Works Advisory***
date completed:	***16 Aug 2022***
project:	***Brou Landfill CL022, Geotechnical Investigation***
logged by:	***PP***
location:	***1 Brou Lake Road, Dalmeny NSW 2546***
checked by:	***IO***

position: E: 238,733; N: 5,996,044 (MGA94 Zone 56) | surface elevation: 26 m (AHD) | pit orientation: | DCP id.: FYSH-DCP-01

equipment type: Sumitomo 8t Excavator | excavation method: 350mm Bucket | excavation dimensions: 2.5 m long 0.5 m wide

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	DCP (blows/100 mm) 2 4 6 8 10	soil origin, structure and additional observations
E	N		Not Encountered	TP08 / 0.4-0.5	25.0	0.5		SM	**TOPSOIL: SILTY SAND**: fine to medium grained, pale brown, trace rootlets.	D	MD	X		**TOPSOIL**
								ML	**Sandy SILT**: low liquid limit, pale grey-brown, fine to coarse grained sand, trace rootlets.	<Wp	H			HP 50 kPa **RESIDUAL SOIL** HP 150 kPa
									SANDSTONE: extremely weathered, very low strength, crumbles under hand pressure to Clayey Sand: medium to coarse grained, pale grey-brown, some highly weathered sandstone.	D	VD			**EXTREMELY WEATHERED MATERIAL**
					24.5	1.0								DCP Refusal
				TP08 / 1.4-1.5	24.0	1.5			**SANDSTONE**: medium to coarse grained, pale grey-brown, highly weathered, low strength, occasional silt laminations.		H			**WEATHERED ROCK**
					23.5	2.0			Test pit TP08 terminated at 1.9 m Target depth					
					23.0	2.5								
					22.5	3.0								
					22.0	3.5								

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method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

soil group symbol & material description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

SOIL DESCRIPTION EXPLANATION SHEET

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disaggregated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with AS 1726:2017 as shown in the table on Sheet 2.

PARTICLE SIZE DEFINITIONS

Components	Subdivision	Size (mm)
Boulders Cobbles		>200 63 - 200
Gravel	Coarse Medium Fine	19 - 63 6.7 - 19 2.36 - 6.7
Sand	Coarse Medium Fine	0.6 - 2.36 0.210 - 0.6 0.075 - 0.21
Silt Clay		0.002 – 0.075 < 0.002

MOISTURE CONDITION

Coarse Grained Soil

Dry (D)	Non-cohesive and free-running
Moist (M)	Soil feels cool, darked in colour. Soil tends to stick together.
Wet (W)	As for moist, with free water forming when handled.

Fine Grained Soil

Moist, dry of plastic limit ($w<W_P$)	Hard and friable or powdery
Moist, near plastic limit ($w\approx W_P$)	Can be moulded at a moisture content approximately equal to the plastic limit.
Moist, wet of plastic limit ($w>W_P$)	Soils usually weakened and free water forms on hands when handling.
Wet, near liquid limit ($w\approx W_L$)	Near liquid limit.
Wet, wet of liquid limit ($w>W_L$)	Wet of liquid limit.

CONSISTENCY OF COHESIVE SOILS

Term (Abbreviation)	Indicative undrained shear strength s_u (kPa)	Field guide
Very Soft (VS)	<12	Soil exudes between fingers when squeezed in hand.
Soft (S)	12 – 25	Soil can be moulded by light finger pressure.
Firm (F)	25 – 50	Soil can be moulded by strong finger pressure.
Stiff (St)	50 – 100	Soil cannot be moulded by fingers.
Very Stiff (VSt)	100 – 200	Soil can be indented by thumb nail.
Hard (H)	>200	Soil can be indented with difficulty by thumb nail.
Friable (Fb)	–	Soil can be easily crumbled or broken into small pieces by hand.

RELATIVE DENSITY OF NON-COHESIVE SOILS

Term (Abbreviation)	Density index (%)
Very Loose (VL)	Less than 15
Loose (L)	15 – 35
Medium Dense (MD)	35 – 65
Dense (D)	65 – 85
Very Dense (VD)	Greater than 85

MINOR COMPONENTS

Term	Assessment Guide	Proportion of minor component in:
Trace	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: Fines - <5%, Accessory coarse fraction - <15% Fine grained soils: sand/gravel <15%
With	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: Fines - 5 to 12%, Accessory coarse fraction – 15 to 30% Fine grained soils: sand/gravel 15 to 30%

SOIL STRUCTURE AND CEMENTATION

Zoning		Cementation	
Layer	Zone is continuous across exposure or sample.	Weakly cemented	Easily disaggregated by hand in air or water.
Lense	Discontinuous layer of different material, with lenticular shape.	Moderately cemented	Effort is required to disaggregate the soil by hand in air or water.
Pocket	Irregular inclusion of different material.		

GEOLOGICAL ORIGIN

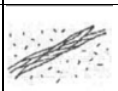
Residual soil	Structure and fabric of parent rock not visible.
Extremely weathered material	Structure and/or fabric of parent rock is visible.
Alluvial soil	Deposited by streams and rivers.
Estuarine soil	Deposited in coastal estuaries, including sediments carried by inflowing rivers and streams, or tidal currents.
Marine soil	Deposited in a marine environment
Lacustrine soil	Deposited in freshwater lakes
Aeolian soil	Carried and deposited by wind
Colluvial soil	Deposited on slopes (transported downslope by gravity, with or without assistance of water).
Topsoil	Mantle of surface or near surface material, often defined by high levels of organic material.
Fill	Any material which has been placed by anthropogenic processes. Fill may be significantly more variable between tested locations than naturally occurring soils.

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 63 mm and basing fractions on estimated mass)							GROUP SYMBOL	SOIL NAME
COARSE GRAINED SOIL More than 65% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVEL More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVEL (Fines less than 5%)	Wide range in grain size and substantial amounts of all intermediate particle sizes, not enough fines to bind coarse grains, no dry strength.			GW	GRAVEL
				Predominantly one size or a range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength.			GP	GRAVEL
			GRAVEL with FINES (Fines greater than 12%)	'Dirty' materials with excess of non-plastic fines (for identification procedures see ML below).			GM	Silty GRAVEL
				'Dirty' materials with excess of plastic fines (for identification procedures see CL below).			GC	Clayey GRAVEL
		SAND More than half of coarse fraction is smaller than 2.36	CLEAN SAND (Fines less than 5%)	Wide range in grain sizes and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength.			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength.			SP	SAND
			SAND with FINES (Fines greater than 12%r)	'Dirty' materials with excess of non-plastic fines (for identification procedures see ML below).			SM	Silty SAND
				'Dirty' materials with excess of plastic fines (for identification procedures see CL below).			SC	Clayey SAND
FINE GRAINED SOIL More than 35% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm					
		SILT & CLAY Liquid limit less	DRY STRENGTH	DILATANCY	TOUGHNESS			
			None to low	Slow to rapid	Low		ML	SILT
			Medium to high	None to slow	Medium		CL, CI	CLAY
			Low to medium	Slow	Low		OL	Organic SILT
		SILT & CLAY Liquid limit	Low to medium	None to slow	Low to medium		MH	SILT
			High to very high	None	High		CH	CLAY
			Medium to high	None to very slow	Low to medium		OH	Organic CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				PT	Peat

● Low plasticity – Liquid Limit W_L less than 35%. ● Medium plasticity –W_L between 35% and 50%. ● High plasticity – W_L greater than 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
Parting	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (e g. bedding). May be open or closed.	
Fissure	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. May include desiccation cracks.	
Sheared Seam	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
Sheared Surface	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect	

TERM	DEFINITION	DIAGRAM
Softened Zone	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere	
Tube	Tubular cavity. May occur singly or as one of a large number of separate or interconnected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter. Origins include root holes, animal burrows, tunnel erosion.	
Tube cast	An infilled tube. The infill may be uncemented or weakly cemented soil or have rock properties.	
Infilled Seam	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open defects.	

ROCK DESCRIPTION EXPLANATION SHEET

The descriptive terms used by Tetra Tech Coffey are given below. They are broadly consistent with Australian Standard AS1726:2017.

DEFINITIONS: Rock material, defect, structure and rock mass are defined as follows:

Rock material	In engineering terms rock material is any naturally occurring aggregate of minerals and/or organic materials that cannot be disaggregated by hand in air or water without prior soaking. Rock material is intact rock that is bounded by defects. Material which can be disaggregated or remoulded should be described as a soil.
Defect	Discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength.
Structure	Nature and configuration of the different defects within the rock mass and their relationship with each other.
Rock mass	It is the entirety of the system formed by all of the rock material and all of the defects. That is, it is a body of material which is not effectively homogeneous.

MATERIAL DESCRIPTIVE TERMS:

Rock name	Simple rock names are used rather than precise geological classification.
Particle size	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
Fabric	When grains show an alignment, a preferred orientation or a layering (e.g. bedding or lamination for sedimentary rocks, and foliation or cleavage for metamorphic rocks) the terms used are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on strength properties.
Distinct	Layering or fabric is easily visible. Rock may break more easily parallel to the fabric.

CLASSIFICATION OF MATERIAL WEATHERING

Term	Abbreviation	Definition
Residual Soil	**RS**	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible. Soil has not been significantly transported.
Extremely Weathered	**XW**	Material is weathered to such an extent that it has soil properties, i.e. it either disaggregates or can be remoulded in water. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered[1]	**HW**	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of weathering products in pores.
Moderately Weathered[1]	**MW**	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is no longer recognisable. Little or no change of strength from fresh rock.
Slightly Weathered	**SW**	Rock is partially discoloured with staining or bleaching adjacent to defects, but shows little or no change of strength from fresh rock.
Fresh	**FR**	Rock shows no sign of decomposition of individual minerals or colour changes.

Notes on Weathering:

1. The term 'Distinctly Weathered' (DW) may be used where it is not practicable (or it is judged that there is no advantage in making such a distinction) to distinguish between 'Highly Weathered' and 'Moderately Weathered'. 'Distinctly Weathered' is defined as follows: 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'.
2. Where physical and chemical changes of the rock material are caused by hot gases or liquids at depth (process called alteration) the term 'altered' may be substituted for 'weathering' to give the abbreviations XA, HA, MA, SA and DA.

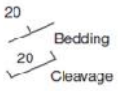
ROCK MATERIAL STRENGTH TERMS

Term (Abbreviation)	Guide to Strength: Point Load Strength Index, $I_{s(50)}$ (MPa)	Guide to Strength: Field Assessment
Very Low (VL)	0.03 - 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand; pieces up to 30mm thick can be broken by finger pressure.
Low (L)	0.1 - 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium (M)	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High (H)	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High (VH)	3 to 10	Hand specimen breaks after more than one blow; rock rings under hammer.
Extremely High (EH)	More than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes on Rock Material Strength:

1. Material with strength less than 'Very Low' should be described using soil characteristics.
2. The method of measuring the $I_{S(50)}$ should be in accordance with AS 4133.4.2.
3. The rock strength should be determined perpendicular to any anisotropy in the rock. High strength anisotropic rocks may readily break parallel to the planar anisotropy.
4. Although AS1726:2017 provides a basis for rock strength terms based on Unconfined Compressive Strength (UCS), the ratio between UCS and $I_{S(50)}$ may vary from less than 10 to over 30 depending on the rock type and overall strength. The UCS/$I_{S(50)}$ strength ratio should be determined for each rock material.
5. The rock strength classification using $I_{S(50)}$ above should be considered indicative only. The rock strength classified in accordance with AS1726:2017 may be higher or lower if UCS results are available.

COMMON ROCK DEFECT TYPES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.			 (Note 2)
Joint	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.			 (Note 2)
Sheared Zone/Seam (Note 3)	Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.			
Crushed Seam (Note 3)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams up to 1mm thick may be described as veneer or coating on a joint surface.			
Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects, and face sketches and sections show the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones/seams, sheared surfaces and crushed seams are generally faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

DEFECT ROUGHNESS TERMS

Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Smooth	Smooth to touch. Few or no surface irregularities.
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.

DEFECT COATING TERMS

Clean	No visible coating.
Stained	No visible coating but surfaces are discoloured.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy.
Coating	A visible coating up to 1mm thick. Thicker soil material should be described using appropriate defect terms (e g. infilled seam). Thicker rock strength material should be described as a vein.

DIMENSION OF DEFECTS

Spacing, length, openness and thickness

The spacing, length, aperture (openness), and seam thickness should generally be described directly in millimetres or metres.

Block Shape

Where it is considered significant, block shape (e.g. tabular, prismatic, columnar) should be described using the terms in Table 23 of AS 1726:2017.

APPENDIX D: DYNAMIC CONE PENETROMETER RESULTS

TETRA TECH COFFEY

Job No: 754-CBRGE301356

Dynamic Cone Penetrometer Test

Client:	**Eurobodalla Shire Council**	Office:	**Canberra**
Principal:	**NSW Public Works**	Date Tested:	**16/08/2022**
Project:	**Brou Landfill Expansion, Geotechnical Investigation**	By:	**P. Pfitzner**
Test Location:	**Phase 2 Development Area - Refer to Site Plan**	Checked:	**I. Ortega**

Test Method: AS 1289.6.3.2-1997(R2013) ☑ AS 1289.6.3.3-1997(R2013) ☐ RTA Test Method T161 ☐ NZS 4402.6.5.2 (1988) ☐

Test No:	DCP01	Test No:	DCP02	Test No:	DCP03	Test No:	DCP04
Test Location:	TP01	Test Location:	TP02	Test Location:	TP03	Test Location:	TP04
Starting Depth (m):	0	Starting Depth (m):	0	Starting Depth (m):	0	Starting Depth (m):	0
Depth (m)	**Blows**	**Depth (m)**	**Blows**	**Depth (m)**	**Blows**	**Depth (m)**	**Blows**
0.10	5	0.10	3	0.10	11	0.10	5
0.20	6	0.20	3	0.20	7	0.20	6
0.30	14	0.30	5	0.30	5	0.30	11
0.40	18	0.40	5	0.40	5	0.40	9
0.50	10	0.50	5	0.50	10	0.50	9
0.60	9	0.60	8	0.60	11	0.60	8
0.70	3	0.70	9	0.70	120	0.70	7
0.80	8	0.80	13	0.80	12	0.80	9
0.90	7	0.90	11	0.90	17	0.90	16
1.00	4	1.00	6	1.00	10	1.00	13
1.10	19	1.10	23	1.10	Refusal at	1.10	11
1.20	20	1.20	Refusal at 1.05m	1.20	Hammer bounce	1.20	11
1.30	Refusal at 1.18m	1.30		1.30		1.30	11
1.40	Hammer bounce	1.40		1.40		1.40	12
1.50		1.50		1.50		1.50	12
1.60		1.60		1.60		1.60	12
1.70		1.70		1.70		1.70	11
1.80		1.80		1.80		1.80	Refusal at 1.65m
1.90		1.90		1.90		1.90	Hammer bounce
2.00		2.00		2.00		2.00	
2.10		2.10		2.10		2.10	
2.20		2.20		2.20		2.20	
2.30		2.30		2.30		2.30	
2.40		2.40		2.40		2.40	
2.50		2.50		2.50		2.50	
2.60		2.60		2.60		2.60	
2.70		2.70		2.70		2.70	
2.80		2.80		2.80		2.80	
2.90		2.90		2.90		2.90	
3.00		3.00		3.00		3.00	

Test Method	Drop Weight	Drop Height	Cone/Blunt tip	DCP Id
NZS 4402.6.5.2 (1988) Determinaton of the penetration resistance of a soil	9 kg	510 mm	Cone	FYSH-DCP01

Note 1. Dynamic Cone Penetrometer testing is typically restricted to depths less than 3m.

Note 2. Testing should stop if the cone penetrometer resistance exceeds 8 blows per 20mm to avoid tip damage.

Note 3. Perth penetrometer testing should stop if the blow count exceeds 30 blows per 300mm to avoid damage to equipment.

TETRA TECH COFFEY

Job No: 754-CBRGE301356

Dynamic Cone Penetrometer Test

Sheet 2 of 2

Client:	**Eurobodalla Shire Council**	Office:	**Canberra**
Principal:	**NSW Public Works**	Date Tested:	**16/08/2022**
Project:	**Brou Landfill Expansion, Geotechnical Investigation**	By:	**P. Pfitzner**
Test Location:	**Phase 2 Development Area - Refer to Site Plan**	Checked:	**I. Ortega**

Test Method: AS 1289.6.3.2-1997(R2013) ☑ AS 1289.6.3.3-1997(R2013) ☐ RTA Test Method T161 ☐ NZS 4402.6.5.2 (1988) ☐

Test No:	DCP05	Test No:	DCP06	Test No:	DCP07	Test No:	DCP08
Test Location:	TP05	Test Location:	TP06	Test Location:	TP07	Test Location:	TP08
Starting Depth (m):	0	Starting Depth (m):	0	Starting Depth (m):	0	Starting Depth (m):	0
Depth (m)	**Blows**	**Depth (m)**	**Blows**	**Depth (m)**	**Blows**	**Depth (m)**	**Blows**
0.10	9	0.10	1	0.10	17	0.10	13
0.20	5	0.20	10	0.20	11	0.20	14
0.30	6	0.30	10	0.30	8	0.30	12
0.40	7	0.40	10	0.40	8	0.40	12
0.50	12	0.50	12	0.50	9	0.50	8
0.60	13	0.60	11	0.60	8	0.60	10
0.70	13	0.70	10	0.70	10	0.70	13
0.80	8	0.80	8	0.80	12	0.80	10
0.90	8	0.90	12	0.90	10	0.90	12
1.00	20	1.00	16	1.00	15	1.00	28
1.10	Refusal at	1.10	17	1.10	16	1.10	Refusal at 0.98m
1.20		1.20	20	1.20	5	1.20	
1.30		1.30	15	1.30	Refusal at 1.12m	1.30	
1.40		1.40	Refusal at 1.25m	1.40	Hammer bounce	1.40	
1.50		1.50	Hammer bounce	1.50		1.50	
1.60		1.60		1.60		1.60	
1.70		1.70		1.70		1.70	
1.80		1.80		1.80		1.80	
1.90		1.90		1.90		1.90	
2.00		2.00		2.00		2.00	
2.10		2.10		2.10		2.10	
2.20		2.20		2.20		2.20	
2.30		2.30		2.30		2.30	
2.40		2.40		2.40		2.40	
2.50		2.50		2.50		2.50	
2.60		2.60		2.60		2.60	
2.70		2.70		2.70		2.70	
2.80		2.80		2.80		2.80	
2.90		2.90		2.90		2.90	
3.00		3.00		3.00		3.00	

Test Method	Drop Weight	Drop Height	Cone/Blunt tip	DCP Id
NZS 4402.6.5.2 (1988) Determinaton of the penetration resistance of a soil	9 kg	510 mm	Cone	FYSH-DCP01

Note 1. Dynamic Cone Penetrometer testing is typically restricted to depths less than 3m.

Note 2. Testing should stop if the cone penetrometer resistance exceeds 8 blows per 20mm to avoid tip damage.

Note 3. Perth penetrometer testing should stop if the blow count exceeds 30 blows per 300mm to avoid damage to equipment.

APPENDIX E: LABORATORY RESULTS

Canberra Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Mildura Street
Fyshwick ACT 2609

Phone: +61 2 8876 0550

Material Test Report

Report No: ASM:CANB22W01570
Issue No: 1

Client: Tetra Tech Coffey Pty Ltd (Canberra)
16 Mildura Street
Fyshwick ACT 2609

Principal:
Project No.: TESTCANB00418AA
Project Name: 301356 - Bron Landfill G.I.
Lot No.: **TRN:**

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 and proficiency testing scheme providers reports.

Approved Signatory: Jason McGurgan
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 16/09/2022

Material Details

Location	Bron Lake, NSW		
Source	Insitu	**Sampled From**	
Description	Subgrade	**Specification**	AS Grading -19mm
Sampling Method	Submitted by client*		

Sample Details

Sample ID	CANB22S-04044	CANB22S-04045	CANB22S-04046	CANB22S-04047	CANB22S-04048
Field Sample ID	00001	00002	00003	00004	00005
Date Sampled	17/08/2022	17/08/2022	16/08/2022	17/08/2022	16/08/2022
Date Submitted:	7/09/2022	7/09/2022	7/09/2022	7/09/2022	7/09/2022
Sample Location:	BH06	BH07	BH10	BH11	BH12
	1.5 - 2.0m	0.5 -1.0m	1.5 - 1.95m	0.5 - 1.0m	2.0 - 2.5m

Particle Size Distribution

Method:
AS 1289.3.6.1

Description:
Determination of the Particle Size Distribution of a Soil - Standard Method of Analysis by

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
19.0mm		
13.2mm	100	
9.5mm	98	
6.7mm	95	
4.75mm	93	
2.36mm	86	
1.18mm	78	
600µm	71	
425µm	69	
300µm	64	
150µm	58	
75µm	53	

Other Test Results

Description	Method	Results					Limits
Emerson Class Number	AS 1289.3.8.1	5	5	6	5	6	
Soil Description		Subgrade	Subgrade	Subgrade	Subgrade	Subgrade	
Type of Water		Potable	Potable	Potable	Potable	Potable	
Temperature of Water (°C)		17	17	17	17	17	
Date Tested		14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022	

Comments

*Results relate only to the items tested or sampled.

Canberra Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Mildura Street
Fyshwick ACT 2609

Phone: +61 2 8876 0550

Report No: ASM:CANB22W01570
Issue No: 1

Material Test Report

Client: Tetra Tech Coffey Pty Ltd (Canberra)
16 Mildura Street
Fyshwick ACT 2609

Principal:
Project No.: TESTCANB00418AA
Project Name: 301356 - Bron Landfill G.I.
Lot No.: **TRN:**

Approved Signatory: Jason McGurgan
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 16/09/2022

Material Details

Location	Bron Lake, NSW		
Source	Insitu	**Sampled From**	
Description	Subgrade	**Specification**	AS Grading -19mm
Sampling Method	Submitted by client*		

Sample Details

Sample ID	CANB22S-04044	CANB22S-04045	CANB22S-04046	CANB22S-04047	CANB22S-04048
Field Sample ID	00001	00002	00003	00004	00005
Date Sampled	17/08/2022	17/08/2022	16/08/2022	17/08/2022	16/08/2022
Date Submitted:	7/09/2022	7/09/2022	7/09/2022	7/09/2022	7/09/2022
Sample Location:	BH06	BH07	BH10	BH11	BH12
	1.5 - 2.0m	0.5 -1.0m	1.5 - 1.95m	0.5 - 1.0m	2.0 - 2.5m

Other Test Results

Description	Method	Results	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	7.0	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.2	48	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	24	
Date Tested		14/09/2022	

Comments

*Results relate only to the items tested or sampled.

Canberra Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Mildura Street
Fyshwick ACT 2609

Phone: +61 2 8876 0550

Report No: ASM:CANB22W01571
Issue No: 1

Material Test Report

Client: Tetra Tech Coffey Pty Ltd (Canberra)
16 Mildura Street
Fyshwick ACT 2609

Principal:
Project No.: TESTCANB00418AA
Project Name: 301356 - Bron Landfill G.I.
Lot No.: **TRN:**

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 and proficiency testing scheme providers reports.

Approved Signatory: Jason McGurgan
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 16/09/2022

Material Details

Location	Bron Lake, NSW		
Source	Insitu	**Sampled From**	
Description	Subgrade	**Specification**	AS Grading -9.5mm
Sampling Method	Submitted by client*		

Sample Details

Sample ID	CANB22S-04049	CANB22S-04050	CANB22S-04051	CANB22S-04052	CANB22S-04053
Field Sample ID	00006	00007	00008	00009	00010
Date Sampled	16/08/2022	16/08/2022	16/08/2022	16/08/2022	16/08/2022
Date Submitted:	7/09/2022	7/09/2022	7/09/2022	7/09/2022	7/09/2022
Sample Location:	TP02	TP04	TP04	TP05	TP08
	0.4 - 0.5m	0.2 - 0.3m	0.4 - 0.5m	0.9 - 1.0m	0.3 - 0.4m

Particle Size Distribution

Method:
AS 1289.3.6.1

Description:
Determination of the Particle Size Distribution of a Soil - Standard Method of Analysis by

Drying by:
Oven

Washed:
Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	99	
4.75mm	99	
2.36mm	98	
1.18mm	97	
600µm	94	
425µm	92	
300µm	87	
150µm	76	
75µm	63	

Other Test Results

Description	Method	Results					Limits
Emerson Class Number	AS 1289.3.8.1	5	5	5	6	5	
Soil Description		Subgrade	Subgrade	Subgrade	Subgrade	Subgrade	
Type of Water		Potable	Potable	Potable	Potable	Potable	
Temperature of Water (°C)		17	17	17	17	17	
Date Tested		14/09/2022	14/09/2022	14/09/2022	14/09/2022	14/09/2022	

Comments

*Results relate only to the items tested or sampled.

Canberra Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Mildura Street
Fyshwick ACT 2609

Phone: +61 2 8876 0550

Report No: ASM:CANB22W01571
Issue No: 1

Material Test Report

Client: Tetra Tech Coffey Pty Ltd (Canberra)
16 Mildura Street
Fyshwick ACT 2609

Principal:
Project No.: TESTCANB00418AA
Project Name: 301356 - Bron Landfill G.I.
Lot No.: **TRN:**

Approved Signatory: Jason McGurgan
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 16/09/2022

Material Details

Location	Bron Lake, NSW		
Source	Insitu	**Sampled From**	
Description	Subgrade	**Specification**	AS Grading -9.5mm
Sampling Method	Submitted by client*		

Sample Details

Sample ID	CANB22S-04049	CANB22S-04050	CANB22S-04051	CANB22S-04052	CANB22S-04053
Field Sample ID	00006	00007	00008	00009	00010
Date Sampled	16/08/2022	16/08/2022	16/08/2022	16/08/2022	16/08/2022
Date Submitted:	7/09/2022	7/09/2022	7/09/2022	7/09/2022	7/09/2022
Sample Location:	TP02	TP04	TP04	TP05	TP08
	0.4 - 0.5m	0.2 - 0.3m	0.4 - 0.5m	0.9 - 1.0m	0.3 - 0.4m

Other Test Results

Description	Method	Results	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.5	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.2	35	
Plastic Limit (%)	AS 1289.3.2.1	23	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		14/09/2022	

Comments

*Results relate only to the items tested or sampled.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

TETRA TECH COFFEY

Consigning Office: Canberra, ACT

Report Results to: Peter Pfitzner — Mobile: 0429 958 271 — Email: Peter.Pfitzner@Tetratech.com

Invoices to: Michael Carbone — Phone: 0422 350 209 — Email: michael.carbone@tetratech.com

Project No: 754-CBRGE301356 — Task No:

Project Name: Brou Lake Expansion GI — Laboratory: Eurofins

Sampler's Name: Peter Pfitzner, Terry Xu — Project Manager: Michael Carbone

Quote number (if different to current quoted prices):

Special Instructions:

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix (Soil...etc)	Container Type & Preservative*	T-A-T (specify)	Analysis Request Section	NOTES
	TP04_0.4-0.5	16/08/2022		SOIL	BAG	STD		
	TP04_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP08_0.4-0.5	16/08/2022		SOIL	BAG	STD		
	TP06_1.4-1.5	16/08/2022		SOIL	BAG	STD		
	TP06_0.4-0.5	16/08/2022		SOIL	BAG	STD		
	TP07_1.8-1.9	16/08/2022		SOIL	BAG	STD		
	TP08_1.4-1.5	16/08/2022		SOIL	BAG	STD		
	TP07_0.2-0.3	16/08/2022		SOIL	BAG	STD		
	TP05_0.2-0.3	16/08/2022		SOIL	BAG	STD		
	TP05_0.8-0.9	16/08/2022		SOIL	BAG	STD		
	TP03_0.2-0.3	16/08/2022		SOIL	BAG	STD		
	TP03_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP02_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP02_0.4-0.5	16/08/2022		SOIL	BAG	STD		
	TP01_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP01_0.4-0.5	16/08/2022		SOIL	BAG	STD		

RELINQUISHED BY

Name: — Date:

Coffey — Time:

Name: [redacted] — Date: →

Company: — Time:

RECEIVED BY

Name: A. Beach — Date: 23/8/22

Company: Eurofins ACT — Time: 10:00Am

Name: — Date:

Company: — Time:

Sample Receipt Advice: (Lab Use Only)

All Samples Recieved in Good Condition ☑

All Documentation is in Proper Order ☑

Samples Received Properly Chilled ☑ 11.1°C

Lab. Ref/Batch No. 916665

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

TETRA TECH COFFEY

Consigning Office: Canberra, ACT

Report Results to: Peter Pfitzner — Mobile: 0429 958 271 — Email: Peter.Pfitzner@Tetratech.com

Invoices to: Michael Carbone — Phone: 0422 350 209 — Email: michael.carbone@tetratech.com

Project No: 754-CBRGE301356 — Task No:

Project Name: Brou Lake Expansion GI — Laboratory: Eurofins

Sampler's Name: p p — Project Manager: Michael Carbone

Quote number (if different to current quoted prices):

Special Instructions:

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix (Soil...etc)	Container Type & Preservative*	T-A-T (specify)	Analysis Request Section	NOTES
	BH09_13.5-13.8	16/08/2022		SOIL	BAG	STD		
	BH10_2.0-2.5	16/08/2022		SOIL	BAG	STD		
	BH12_9.5-10.0	16/08/2022		SOIL	BAG	STD		
	BH10_9.5-9.8	16/08/2022		SOIL	BAG	STD		
	BH09_1.5-1.8	16/08/2022		SOIL	BAG	STD		
	BH10_4.0-4.3	16/08/2022		SOIL	BAG	STD		
	BH12_1.5-1.8	16/08/2022		SOIL	BAG	STD		
	BH12_5.0-5.5	16/08/2022		SOIL	BAG	STD		
	BH11_2.5-2.8	17/08/2022		SOIL	BAG	STD		
	BH7_2.0-2.3	17/08/2022		SOIL	BAG	STD		
	BH7_10-10.3	17/08/2022		SOIL	BAG	STD		
	BH8_3.5-3.8	17/08/2022		SOIL	BAG	STD		
	BH8_2.0-2.3	17/08/2022		SOIL	BAG	STD		
	BH6_2.5-2.8	17/08/2022		SOIL	BAG	STD		
	BH6_9.5-9.8	17/08/2022		SOIL	BAG	STD		
	BH2_0.5-0.8	18/08/2022		SOIL	BAG	STD		

RELINQUISHED BY

Name: Coffey — Date: — Time:

Name: — Date: — Company: — Time:

RECEIVED BY

Name: A. Beach, AB — Date: 23/8/22 — Company: Eurofins ACT — Time: 10.00AM

Name: — Date: — Company: — Time:

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

Sample Receipt Advice: (Lab Use Only)

- All Samples Recieved in Good Condition ☒
- All Documentation is in Proper Order ☑
- Samples Received Properly Chilled ☑

Lab. Ref/Batch No. 916665 11.1°C

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

TETRA TECH COFFEY

Consigning Office:	Canberra, ACT				
Report Results to:	Peter Pfitzner	Mobile:	0429 958 271	Email:	Peter.Pfitzner@Tetratech.com
Invoices to:	Michael Carbone	Phone:	0422 350 209	Email:	michael.carbone@tetratech.com

Project No:	754-CBRGE301356	Task No:	
Project Name:	Brou Lake Expansion GI	Laboratory:	Eurofins
Sampler's Name:	p p	Project Manager:	Michael Carbone
Quote number (if different to current quoted prices):			
Special Instructions:			

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix *(Soil...etc)*	Container Type & Preservative*	T-A-T *(specify)*
	BH1_0.5-0.8	18/08/2022		SOIL	BAG	STD
	BH3_1.5-2.0	18/08/2022		SOIL	BAG	STD
	BH3_3.0-3.5	18/08/2022		SOIL	BAG	STD
	BH4_1.5-2.0	18/08/2022		SOIL	BAG	STD
	BH5_0.5-0.8	18/08/2022		SOIL	BAG	STD
	BH11_14.0-14.3	17/08/2022		SOIL	BAG	STD

Analysis Request Section

NOTES

RELINQUISHED BY		RECEIVED BY	
Name:	Date:	Name: D. Beach	Date: 23/8/22
Coffey	Time:	Company: Eurofins ACT	Time: 10:00AM
Name:	Date:	Name:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: (Lab Use Only)

- All Samples Recieved in Good Condition ☑
- All Documentation is in Proper Order ☑
- Samples Received Properly Chilled ☑
- Lab. Ref/Batch No. 916665 11.1°C

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

TETRA TECH COFFEY

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Consigning Office:	Canberra, ACT				
Report Results to:	Peter Pfitzner	Mobile:	0429 958 271	Email:	Peter.Pfitzner@Tetratech.com
Invoices to:	Michael Carbone	Phone:	0422 350 209	Email:	michael.carbone@tetratech.com

Project No:	754-CBRGE301356	Task No:	
Project Name:	Brou Lake Expansion GI	Laboratory:	Eurofins
Sampler's Name:	Peter Pfitzner, Terry Xu	Project Manager:	Michael Carbone
Quote number (if different to current quoted prices):			
Special Instructions:			

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix (Soil...etc)	Container Type & Preservative*	T-A-T (specify)	Analysis Request Section: pH Field Screen (pHf and pHfox) - Acid sulfate Soils	NOTES
	TP04_0.4-0.5	16/08/2022		SOIL	BAG	STD	X	
	TP04_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP08_0.4-0.5	16/08/2022		SOIL	BAG	STD	X	
	TP06_1.4-1.5	16/08/2022		SOIL	BAG	STD	X	
	~~TP06_0.4-0.5~~	16/08/2022		SOIL	BAG	STD		
	~~TP07_1.8-1.9~~	16/08/2022		SOIL	BAG	STD		
	TP08_1.4-1.5	16/08/2022		SOIL	BAG	STD		
	TP07_0.2-0.3	16/08/2022		SOIL	BAG	STD	X	
	TP05_0.2-0.3	16/08/2022		SOIL	BAG	STD	X	
	TP05_0.8-0.9	16/08/2022		SOIL	BAG	STD		Rename to TP05_0.9-1.0
	TP03_0.2-0.3	16/08/2022		SOIL	BAG	STD	X	
	TP03_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP02_0.9-1.0	16/08/2022		SOIL	BAG	STD		
	TP02_0.4-0.5	16/08/2022		SOIL	BAG	STD	X	
	TP01_0.9-1.0	16/08/2022		SOIL	BAG	STD	X	
	~~TP01_0.4-0.5~~	16/08/2022		SOIL	BAG	STD		

RELINQUISHED BY		RECEIVED BY	
Name:	Date:	Name: A-Beach	Date: 6/9/22
Coffey	Time:	Company: Eurofins ACT	Time: 2:00PM
Name:	Date:	Name:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: (Lab Use Only)

- All Samples Recieved in Good Condition ☑
- All Documentation is in Proper Order ☑
- Samples Received Properly Chilled ☑
- Lab. Ref/Batch No. 916665

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

TETRA TECH COFFEY

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Consigning Office:	Canberra, ACT				
Report Results to:	Peter Pfitzner	Mobile:	0429 958 271	Email:	Peter.Pfitzner@Tetratech.com
Invoices to:	Michael Carbone	Phone:	0422 350 209	Email:	michael.carbone@tetratech.com

Project No:	754-CBRGE301356	Task No:	
Project Name:	Brou Lake Expansion GI	Laboratory:	Eurofins
Sampler's Name:	Terry Xu	Project Manager:	Michael Carbone
Quote number (if different to current quoted prices):			
Special Instructions:			

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix (Soil...etc)	Container Type & Preservative*	T-A-T (specify)	Analysis Request Section: pH Field Screen (pHf and pHfox) - Acid sulfate Soils	NOTES
	BH09_13.5-13.8	16/08/2022		SOIL	BAG	STD	X	
	BH10_2.0-2.5	16/08/2022		SOIL	BAG	STD	X	
	BH12_9.5-10.0	16/08/2022		SOIL	BAG	STD	X	
	BH10_9.5-9.8	16/08/2022		SOIL	BAG	STD	X	
	BH09_1.5-1.8	16/08/2022		SOIL	BAG	STD		
	BH10_4.0-4.3	16/08/2022		SOIL	BAG	STD	X	
	BH12_1.5-1.8	16/08/2022		SOIL	BAG	STD		
	BH12_5.0-5.5	16/08/2022		SOIL	BAG	STD	X	
	BH11_2.5-2.8	17/08/2022		SOIL	BAG	STD	X	
	BH7_2.0-2.3	17/08/2022		SOIL	BAG	STD	X	
	BH7_10-10.3	17/08/2022		SOIL	BAG	STD		
	BH8_3.5-3.8	17/08/2022		SOIL	BAG	STD		
	BH8_2.0-2.3	17/08/2022		SOIL	BAG	STD	X	
	BH6_2.5-2.8	17/08/2022		SOIL	BAG	STD	X	
	BH6_9.5-9.8	17/08/2022		SOIL	BAG	STD		
	BH2_0.5-0.8	18/08/2022		SOIL	BAG	STD	X	

RELINQUISHED BY		RECEIVED BY	
Name: Coffey	Date: Time:	Name: A. Beach	Date: 6/9/22
		Company: Eurofins ALT	Time: 2:00PM
Name:	Date:	Name:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: (Lab Use Only)

- All Samples Recieved in Good Condition ☑
- All Documentation is in Proper Order ☑
- Samples Received Properly Chilled ☑
- Lab. Ref/Batch No. 916665

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

TETRA TECH COFFEY

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

Consigning Office:	Canberra, ACT				
Report Results to:	Peter Pfitzner	Mobile:	0429 958 271	Email:	Peter.Pfitzner@Tetratech.com
Invoices to:	Michael Carbone	Phone:	0422 350 209	Email:	michael.carbone@tetratech.com

Project No:	754-CBRGE301356	Task No:	
Project Name:	Brou Lake Expansion GI	Laboratory:	Eurofins
Sampler's Name:	Terry Xu	Project Manager:	Michael Carbone
Quote number (if different to current quoted prices):			
Special Instructions:			

Lab Batch Ref	Sample ID	Sample Date	Time	Matrix (Soil...etc)	Container Type & Preservative*	T-A-T (specify)	pH Field Screen (pHf and pHfox) - Acid sulfate Soils	NOTES
	BH1_0.5-0.8	18/08/2022		SOIL	BAG	STD	X	
	BH3_1.5-2.0	18/08/2022		SOIL	BAG	STD	X	
	BH3_3.0-3.5	18/08/2022		SOIL	BAG	STD	X	
	BH4_1.5-2.0	18/08/2022		SOIL	BAG	STD	X	
	BH5_0.5-0.8	18/08/2022		SOIL	BAG	STD	X	
	BH11_14.0-14.3	17/08/2022		SOIL	BAG	STD		

Analysis Request Section

RELINQUISHED BY		RECEIVED BY	
Name: Coffey	Date: Time:	Name: A Beach	Date: 6/9/22
		Company: Eurofins ACT	Time: 2:00PM
Name:	Date:	Name:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: (Lab Use Only)

- All Samples Recieved in Good Condition ☑
- All Documentation is in Proper Order ☑
- Samples Received Properly Chilled ☑
- Lab. Ref/Batch No. 916665

***Container Type & Preservation Codes:** **P** - Plastic, **G**- Glass Bottle, **J** - Glass Jar, **V**- Vial, **Z** - Ziplock bag, **N** - Nitric Acid Preserved, **C** - Hydrochloric Acid Preserved, **S** - Sulphuric Acid Preserved, **I** - Ice, **ST** - Sodium Thiosulfate, **NP** - No Preservative

eurofins | Environment Testing

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Eurofins Environment Testing Australia Pty Ltd

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Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
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VIC 3216
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NATA# 1261 Site# 1254

Sydney
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Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
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ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
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QLD 4172
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NATA# 1261 Site# 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd

ABN: 91 05 0159 898

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NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

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35 O'Rorke Road
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Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Sample Receipt Advice

Company name:	Tetra Tech Coffey Environment Pty Ltd ACT
Contact name:	Michael Carbone
Project name:	BROU LAKE EXPANSION GI
Project ID:	754-CBRGE301356
Turnaround time:	5 Day
Date/Time received	Sep 6, 2022 2:00 PM
Eurofins reference	916665

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	Sample Temperature of chilled sample on the batch as recorded by Eurofins Sample Receipt : 11.1 degrees Celsius.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
N/A	Sample containers for volatile analysis received with zero headspace.
X	Split sample sent to requested external lab.
X	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Samples TP-1_0.4-0.5, TP07_1.8-1.9, TP06_0.4-0.5 were missing, so analyses were cancelled for these samples. TP05_0.8-0.9 (as listed on COC) was labelled as TP05_0.9-1.0, in accordance with the bag. Samples were logged for analysis according to the COC received on the 06/09/22. In addition, no sample was received for BH12_1.5-1.8 upon original receipt, however, was missed in original logging. Therefore, this sample was logged and analysis cancelled in retrospect.

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Asim Khan on phone : or by email: AsimKhan@eurofins.com

Results will be delivered electronically via email to Michael Carbone - Michael.Carbone@coffey.com.

Note: A copy of these results will also be delivered to the general Tetra Tech Coffey Environment Pty Ltd ACT email address.

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

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Geelong
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NATA# 1261 Site# 1254

Sydney
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NATA# 1261 Site# 18217

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NATA# 1261 Site# 20794

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Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
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NATA# 2377 Site# 2370

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Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
Address: 16 Mildura Street
Fyshwick
ACT 2609

Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 916665
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 6, 2022 2:00 PM
Due: Sep 13, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	TP04_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051769			X
2	TP04_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051770		X	
3	TP08_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051771			X
4	TP06_1.4-1.5	Aug 16, 2022		Soil	R22-Au0051772			X
5	TP06_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051773	X		
6	TP07_1.8-1.9	Aug 16, 2022		Soil	R22-Au0051774	X		
7	TP08_1.4-1.5	Aug 16, 2022		Soil	R22-Au0051775		X	
8	TP07_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051776			X
9	TP05_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051777			X
10	TP05_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051778		X	
11	TP03_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051779			X
12	TP03_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051780		X	

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web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
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Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

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Tel: +61 2 6113 8091

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Murarrie
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Tel: +61 7 3902 4600
NATA# 1261 Site# 20794

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Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

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ABN: 91 05 0159 898

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Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
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35 O'Rorke Road
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Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
Address: 16 Mildura Street
Fyshwick
ACT 2609

Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 916665
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 6, 2022 2:00 PM
Due: Sep 13, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
13	TP02_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051781		X	
14	TP02_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051782			X
15	TP01_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051783			X
16	TP01_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051784	X		
17	BH09_13.5-13.8	Aug 16, 2022		Soil	R22-Au0051785			X
18	BH10_2.0-2.5	Aug 16, 2022		Soil	R22-Au0051786			X
19	BH12_9.5-10.0	Aug 16, 2022		Soil	R22-Au0051787			X
20	BH10_9.5-9.8	Aug 16, 2022		Soil	R22-Au0051788			X
21	BH09_1.5-1.8	Aug 16, 2022		Soil	R22-Au0051789		X	
22	BH10_4.0-4.3	Aug 16, 2022		Soil	R22-Au0051790			X
23	BH12_5.0-5.5	Aug 16, 2022		Soil	R22-Au0051792			X
24	BH11_2.5-2.8	Aug 16, 2022		Soil	R22-Au0051793			X
25	BH7_2.0-2.3	Aug 16, 2022		Soil	R22-Au0051794			X
26	BH7_10-10.3	Aug 16, 2022		Soil	R22-Au0051795		X	

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
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Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
Address: 16 Mildura Street
Fyshwick
ACT 2609

Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 916665
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 6, 2022 2:00 PM
Due: Sep 13, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
27	BH8_3.5-3.8	Aug 16, 2022		Soil	R22-Au0051796		X	
28	BH8_2.0-2.3	Aug 16, 2022		Soil	R22-Au0051797			X
29	BH6_2.5-2.8	Aug 16, 2022		Soil	R22-Au0051798			X
30	BH6_9.5-9.8	Aug 16, 2022		Soil	R22-Au0051799		X	
31	BH2_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051800			X
32	BH1_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051801			X
33	BH3_1.5-2.0	Aug 16, 2022		Soil	R22-Au0051802			X
34	BH3_3.0-3.5	Aug 16, 2022		Soil	R22-Au0051803			X
35	BH4_1.5-2.0	Aug 16, 2022		Soil	R22-Au0051804			X
36	BH5_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051805			X
37	BH11_14.0-14.3	Aug 16, 2022		Soil	R22-Au0051806		X	
38	BH12_1.5-1.8	Aug 16, 2022		Soil	R22-Se0010071	X		
Test Counts						4	10	24

Tetra Tech Coffey Environment Pty Ltd ACT
16 Mildura Street
Fyshwick
ACT 2609

Attention: **Michael Carbone**

Report **916665-S**
Project name BROU LAKE EXPANSION GI
Project ID 754-CBRGE301356
Received Date Sep 06, 2022

Client Sample ID			TP04_0.4-0.5	TP08_0.4-0.5	TP06_1.4-1.5	TP07_0.2-0.3
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051769	R22-Au0051771	R22-Au0051772	R22-Au0051776
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	5.8	6.3	5.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.7	4.9	4.8	4.3
Reaction Ratings*[S05]	0	-	3.0	3.0	3.0	3.0

Client Sample ID			TP05_0.2-0.3	TP03_0.2-0.3	TP02_0.4-0.5	TP01_0.9-1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051777	R22-Au0051779	R22-Au0051782	R22-Au0051783
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	5.8	5.9	5.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.1	4.5	4.2	4.5
Reaction Ratings*[S05]	0	-	4.0	3.0	3.0	2.0

Client Sample ID			BH09_13.5-13.8	BH10_2.0-2.5	BH12_9.5-10.0	BH10_9.5-9.8
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051785	R22-Au0051786	R22-Au0051787	R22-Au0051788
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.6	6.1	5.9	5.4
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.8	4.5	6.3	4.7
Reaction Ratings*[S05]	0	-	4.0	4.0	4.0	4.0

Client Sample ID			BH10_4.0-4.3	BH12_5.0-5.5	BH11_2.5-2.8	BH7_2.0-2.3
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051790	R22-Au0051792	R22-Au0051793	R22-Au0051794
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.4	5.3	4.6	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.2	4.0	4.0	4.2
Reaction Ratings*[S05]	0	-	4.0	3.0	4.0	4.0

Client Sample ID			BH8_2.0-2.3	BH6_2.5-2.8	BH2_0.5-0.8	BH1_0.5-0.8
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051797	R22-Au0051798	R22-Au0051800	R22-Au0051801
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.4	4.7	5.3	5.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.0	4.0	3.8	4.0
Reaction Ratings*[S05]	0	-	4.0	3.0	3.0	3.0

Client Sample ID			BH3_1.5-2.0	BH3_3.0-3.5	BH4_1.5-2.0	BH5_0.5-0.8
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			R22-Au0051802	R22-Au0051803	R22-Au0051804	R22-Au0051805
Date Sampled			Aug 16, 2022	Aug 16, 2022	Aug 16, 2022	Aug 16, 2022
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.8	5.7	5.1	6.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.7	3.6	4.5	3.9
Reaction Ratings*[S05]	0	-	3.0	4.0	4.0	4.0

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
Acid Sulfate Soils Field pH Test	Brisbane	Sep 07, 2022	7 Days

- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests

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Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
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Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 916665
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 6, 2022 2:00 PM
Due: Sep 13, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	TP04_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051769			X
2	TP04_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051770		X	
3	TP08_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051771			X
4	TP06_1.4-1.5	Aug 16, 2022		Soil	R22-Au0051772			X
5	TP06_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051773	X		
6	TP07_1.8-1.9	Aug 16, 2022		Soil	R22-Au0051774	X		
7	TP08_1.4-1.5	Aug 16, 2022		Soil	R22-Au0051775		X	
8	TP07_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051776			X
9	TP05_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051777			X
10	TP05_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051778		X	
11	TP03_0.2-0.3	Aug 16, 2022		Soil	R22-Au0051779			X
12	TP03_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051780		X	

Date Reported:Sep 08, 2022

Date Reported:Sep 08, 2022

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Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 916665
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 6, 2022 2:00 PM
Due: Sep 13, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
13	TP02_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051781		X	
14	TP02_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051782			X
15	TP01_0.9-1.0	Aug 16, 2022		Soil	R22-Au0051783			X
16	TP01_0.4-0.5	Aug 16, 2022		Soil	R22-Au0051784	X		
17	BH09_13.5-13.8	Aug 16, 2022		Soil	R22-Au0051785			X
18	BH10_2.0-2.5	Aug 16, 2022		Soil	R22-Au0051786			X
19	BH12_9.5-10.0	Aug 16, 2022		Soil	R22-Au0051787			X
20	BH10_9.5-9.8	Aug 16, 2022		Soil	R22-Au0051788			X
21	BH09_1.5-1.8	Aug 16, 2022		Soil	R22-Au0051789		X	
22	BH10_4.0-4.3	Aug 16, 2022		Soil	R22-Au0051790			X
23	BH12_5.0-5.5	Aug 16, 2022		Soil	R22-Au0051792			X
24	BH11_2.5-2.8	Aug 16, 2022		Soil	R22-Au0051793			X
25	BH7_2.0-2.3	Aug 16, 2022		Soil	R22-Au0051794			X
26	BH7_10-10.3	Aug 16, 2022		Soil	R22-Au0051795		X	

Date Reported:Sep 08, 2022

Date Reported:Sep 08, 2022

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Sample Detail						CANCELLED	HOLD	Acid Sulfate Soils Field pH Test
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	
Brisbane Laboratory - NATA # 1261 Site # 20794								X
27	BH8_3.5-3.8	Aug 16, 2022		Soil	R22-Au0051796		X	
28	BH8_2.0-2.3	Aug 16, 2022		Soil	R22-Au0051797			X
29	BH6_2.5-2.8	Aug 16, 2022		Soil	R22-Au0051798			X
30	BH6_9.5-9.8	Aug 16, 2022		Soil	R22-Au0051799		X	
31	BH2_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051800			X
32	BH1_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051801			X
33	BH3_1.5-2.0	Aug 16, 2022		Soil	R22-Au0051802			X
34	BH3_3.0-3.5	Aug 16, 2022		Soil	R22-Au0051803			X
35	BH4_1.5-2.0	Aug 16, 2022		Soil	R22-Au0051804			X
36	BH5_0.5-0.8	Aug 16, 2022		Soil	R22-Au0051805			X
37	BH11_14.0-14.3	Aug 16, 2022		Soil	R22-Au0051806		X	
38	BH12_1.5-1.8	Aug 16, 2022		Soil	R22-Se0010071	X		
Test Counts						4	10	24

Date Reported:Sep 08, 2022

Date Reported:Sep 08, 2022

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.

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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	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	R22-Au0051785	CP	pH Units	5.6	5.6	pass	20%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	R22-Au0051790	CP	pH Units	5.4	5.5	pass	20%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	R22-Au0051804	CP	pH Units	5.1	5.1	pass	20%	Pass	

Comments

Sample Integrity

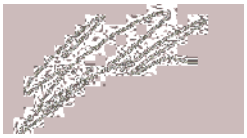
Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted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

Qualifier Codes/Comments

Code	Description
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Asim Khan — Analytical Services Manager



Glenn Jackson
General 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 or please click here.

Do not click on links or open attachments unless you recognise the sender and are certain that the content is safe.

Hi Asim

Please can we have additional testing for the following four samples (see table below) from the attached batch of results.

Please analyse the four samples for chromium reducible sulphur (CRS) analysis.

Sample ID	TP05_0.2-0.3	BH3_1.5-2.0	BH3_3.0-3.5	BH5_0.5-0.8
Sample code	R22-Au0051777	R22-Au0051802	R22-Au0051803	R22-Au0051805

922482

BSSE127 DH010 BSSE126 DH SEO10 BSSE126 DH010 BSSE126 DH010

If you have any questions please let me know.

Regards,

Michael Carbone, BAppSc (Hons) | Senior Associate | ACT Practice Lead
Direct **+61 2 6124 5621** | Business **+61 2 6124 5600** | Mobile **+61 422 350 209** | michael.carbone@tetratech.com

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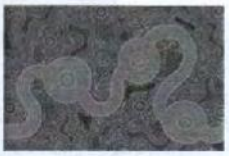

I acknowledge the Ngunnawal and Ngambri peoples on whose country I live and work. I pay my respects to their Elders past, present, emerging and future. Tetra Tech Coffey recognises Aboriginal and Torres Strait Islanders as the first peoples of Australia, and we respect their cultural heritage, traditional knowledge and customs associated with their ancestral lands and waters. Through this acknowledgement we commit to ongoing learning and understanding on our journey to reconciliation.
Artist: Chloe Little

From: AsimKhan@eurofins.com <AsimKhan@eurofins.com>
Sent: Thursday, 8 September 2022 11:20 AM
To: Carbone, Michael <Michael.Carbone@tetratech.com>
Cc: Pfitzner, Peter <Peter.Pfitzner@tetratech.com>
Subject: Eurofins Test Results, Invoice - Report 916665 : Site BROU LAKE EXPANSION GI (754-CBRGE301356)

Please find attached results and invoice for your project in the subject header.

Kind regards,

eurofins | Environment Testing

www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

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Sample Receipt Advice

Company name:	Tetra Tech Coffey Environment Pty Ltd ACT
Contact name:	Michael Carbone
Project name:	BROU LAKE EXPANSION GI
Project ID:	754-CBRGE301356
Turnaround time:	5 Day
Date/Time received	Sep 12, 2022 11:27 AM
Eurofins reference	922482

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	Sample Temperature of chilled sample on the batch as recorded by Eurofins Sample Receipt : 11.1 degrees Celsius.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
X	Split sample sent to requested external lab.
X	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Asim Khan on phone : or by email: AsimKhan@eurofins.com

Results will be delivered electronically via email to Michael Carbone - Michael.Carbone@coffey.com.

Note: A copy of these results will also be delivered to the general Tetra Tech Coffey Environment Pty Ltd ACT email address.

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

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IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
Address: 16 Mildura Street
Fyshwick
ACT 2609

Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 922482
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 12, 2022 11:27 AM
Due: Sep 19, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP05_0.2-0.3	Aug 16, 2022		Soil	R22-Se0023674	X	X
2	BH3_1.5-2.0	Aug 16, 2022		Soil	R22-Se0023675	X	X
3	BH3_3.0-3.5	Aug 16, 2022		Soil	R22-Se0023676	X	X
4	BH5_0.5-0.8	Aug 16, 2022		Soil	R22-Se0023677	X	X
Test Counts						4	4

Tetra Tech Coffey Environment Pty Ltd ACT
16 Mildura Street
Fyshwick
ACT 2609

Attention: **Michael Carbone**

Report **922482-S**
Project name BROU LAKE EXPANSION GI
Project ID 754-CBRGE301356
Received Date Sep 12, 2022

Client Sample ID			**TP05_0.2-0.3**	**BH3_1.5-2.0**	**BH3_3.0-3.5**	**BH5_0.5-0.8**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**R22-Se0023674**	**R22-Se0023675**	**R22-Se0023676**	**R22-Se0023677**
Date Sampled			**Aug 16, 2022**	**Aug 16, 2022**	**Aug 16, 2022**	**Aug 16, 2022**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL (NLM-3.1)	0.1	pH Units	4.4	4.5	4.6	4.8
Titratable Actual Acidity (NLM-3.2)	2	mol H+/t	37	52	39	35
Titratable Actual Acidity (NLM-3.2)	0.003	% pyrite S	0.060	0.084	0.062	0.057
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.005	% S	< 0.005	< 0.005	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0	2.0
HCl Extractable Sulfur	0.005	% S	< 0.005	< 0.005	N/A	N/A
Net Acid soluble sulfur (SNAS) NLM-4.1	0.02	% S	< 0.02	< 0.02	N/A	N/A
Net Acid soluble sulfur (a-SNAS) NLM-4.1	10	mol H+/t	< 10	< 10	N/A	N/A
Net Acid soluble sulfur (s-SNAS) NLM-4.1[S02]	0.02	% S	< 0.02	< 0.02	N/A	N/A
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	N/A	N/A	N/A	N/A
Acid Neutralising Capacity - (a-ANCbt) (NLM-5.2)	2	mol H+/t	N/A	N/A	N/A	N/A
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)[S03]	0.02	% S	N/A	N/A	N/A	N/A
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
CRS Suite - Net Acidity - NASSG (Including ANC)	0.02	% S	0.06	0.08	0.06	0.06
CRS Suite - Net Acidity - NASSG (Including ANC)	10	mol H+/t	37	52	39	35
CRS Suite - Liming Rate - NASSG (Including ANC)[S01]	1	kg CaCO3/t	2.8	3.9	2.9	2.7
Extraneous Material						
<2mm Fraction	0.005	g	62	60	45	33
>2mm Fraction	0.005	g	3.3	7.8	22	6.0
Analysed Material	0.1	%	95	88	67	85
Extraneous Material	0.1	%	5.0	12	33	15
% Moisture	1	%	7.6	17	11	13

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
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Sep 14, 2022	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	Sep 12, 2022	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Sep 12, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

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Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Tetra Tech Coffey Environment Pty Ltd ACT
Address: 16 Mildura Street
Fyshwick
ACT 2609

Project Name: BROU LAKE EXPANSION GI
Project ID: 754-CBRGE301356

Order No.:
Report #: 922482
Phone: +61 2 6124 5600
Fax: +61 2 6260 7211

Received: Sep 12, 2022 11:27 AM
Due: Sep 19, 2022
Priority: 5 Day
Contact Name: Michael Carbone

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP05_0.2-0.3	Aug 16, 2022		Soil	R22-Se0023674	X	X
2	BH3_1.5-2.0	Aug 16, 2022		Soil	R22-Se0023675	X	X
3	BH3_3.0-3.5	Aug 16, 2022		Soil	R22-Se0023676	X	X
4	BH5_0.5-0.8	Aug 16, 2022		Soil	R22-Se0023677	X	X
Test Counts						4	4

Date Reported:Sep 15, 2022

Date Reported:Sep 15, 2022

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
LCS - % Recovery									
Chromium Suite									
pH-KCL (NLM-3.1)			%	96			80-120	Pass	
Titratable Actual Acidity (NLM-3.2)			%	100			80-120	Pass	
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)			%	98			80-120	Pass	
HCl Extractable Sulfur			%	101			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL (NLM-3.1)	S22-Se0019876	NCP	pH Units	6.3	6.4	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	S22-Se0019876	NCP	mol H+/t	< 2	< 2	<1	20%	Pass	
Titratable Actual Acidity (NLM-3.2)	S22-Se0019876	NCP	% pyrite S	< 0.003	< 0.003	<1	30%	Pass	
Chromium Reducible Sulfur (s-SCr) (NLM-2.1)	S22-Se0019876	NCP	% S	< 0.005	< 0.005	<1	20%	Pass	
Chromium Reducible Sulfur (a-SCr) (NLM-2.1)	S22-Se0019876	NCP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	S22-Se0019876	NCP	% S	N/A	N/A	N/A	30%	Pass	
HCl Extractable Sulfur	S22-Se0019876	NCP	% S	N/A	N/A	N/A	20%	Pass	
Net Acid soluble sulfur (SNAS) NLM-4.1	S22-Se0019876	NCP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (a-SNAS) NLM-4.1	S22-Se0019876	NCP	mol H+/t	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur (s-SNAS) NLM-4.1	S22-Se0019876	NCP	% S	N/A	N/A	N/A	30%	Pass	
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	S22-Se0019876	NCP	% CaCO3	N/A	N/A	N/A	20%	Pass	
Acid Neutralising Capacity - (s-ANCbt) (NLM-5.2)	S22-Se0019876	NCP	% S	N/A	N/A	N/A	30%	Pass	
ANC Fineness Factor	S22-Se0019876	NCP	factor	1.5	1.5	<1	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	S22-Se0019876	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
CRS Suite - Net Acidity - NASSG (Including ANC)	S22-Se0019876	NCP	mol H+/t	< 10	< 10	<1	30%	Pass	
CRS Suite - Liming Rate - NASSG (Including ANC)	S22-Se0019876	NCP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B22-Se0023454	NCP	%	50	48	3.6	30%	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	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised by:

Asim Khan	Analytical Services Manager
Jonathon Angell	Senior Analyst-Sample Properties

Glenn Jackson
General 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 or please click here.