REPORT TO

HEALTH INFRASTRUCTURE

ON

PRELIMINARY SALINITY ASSESSMENT

FOR

PROPOSED SOIL CONSERVATION WORKS

AT

LOT 2 DP1281576, PRINCES HIGHWAY, MORUYA, NSW

Date: 14 December 2022

Ref: E33942PL2rpt4Rev1-SAL

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E33942PL2rpt4-SAL	Final Report	8 December 2022
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Executive Summary

Health Infrastructure ('the client') commissioned JK Environments (JKE) to undertake a preliminary salinity assessment for the proposed soil conservation works at Lot 2 DB1281576, Princes Highway, Moruya, NSW (the site). The site location is shown on Figure 1 and the assessment was confined to the site boundaries as shown on Figure 2 attached in the appendices.

JKE has previously undertaken preliminary investigations for the site including a desktop preliminary site investigation (Desktop PSI) and a PSI with intrusive investigation (Project Ref: E33942PL). A brief summary of the previous investigation findings is presented in Section 2.

The primary aim of the assessment was to characterise the broad scale dryland salinity conditions at the site in the context of the proposed development works. The assessment objectives were to:

- Assess the current site conditions via a site walkover inspection;
- Assess the soil and groundwater salinity conditions via implementation of a preliminary sampling and analysis program; and
- Assess if a salinity management plan (SMP) is required for the proposed development.

The scope of work included the following:

- Review site information including topography, soils maps, salinity risk maps, regional geology and hydro-geology in the vicinity of the site;
- A walkover site inspection to identify obvious visual indicators of dryland salinity or potential problem areas;
- Design and implementation of a field sampling and laboratory analysis program;
- Interpretation of the analytical results based on established assessment criteria;
- Preparation of a report presenting the results of the assessment; and
- Assess the need for a site specific SMP for the proposed development.

The investigation identified the following salinity conditions at the site:

- The pH results indicate the soils are classed as optimal to very strongly acidic with regards to plant growth;
- The soils are generally classed as non-saline. There was only one sample found to be slightly saline;
- The ESP% values indicate the soils are classed as non-sodic to highly sodic;
- The soils are mildly to moderately aggressive towards buried concrete, based on the acidic pH;
- The soils are not aggressive towards buried steel;
- The groundwater is non-aggressive towards buried concrete; and
- The groundwater is non-aggressive towards buried steel.

Based on the results of this investigation, JKE is of the opinion that a salinity management plan is not required for the proposed development. The soils are largely non-saline and JKE therefore consider that there is no requirement to manage any associated salinity issues within the soils.

The aggressivity results of the soils and groundwater outlined in this report should be reviewed and incorporated into the design of the proposed development by the project team (civil, structural and landscaping).

In the event that the proposed development includes excavation, crushing and re-use of excavated bedrock as fill on site as part of the development, we recommend that the salinity/aggressivity conditions within the bedrock be checked so that the findings can be considered in the context of the earthworks and the built form of the development.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of this report.

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ABBREVIATIONS

Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Below Ground Level	**BGL**
Borehole	**BH**
Cation Exchange Capacity	**CEC**
Calcium	**Ca**
Cement, Concrete and Aggregates Australia	**CCAA**
Chain of Custody	**COC**
Damp Proof Course	**DPC**
Department of Land and Water Conservation	**DLWC**
Dissolved Oxygen	**DO**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
Local Government Authority	**LGA**
Map Grid of Australia	**MGA**
Magnesium	**Mg**
National Association of Testing Authorities	**NATA**
Potassium	**K**
Polyvinyl Chloride	**PVC**
Practical Quantitation Limit	**PQL**
Redox Potential	**Eh**
Review of Environmental Factors	**REF**
Secretary's Environmental Assessment Requirements	**SEARs**
Site Assessment Criteria	**SAC**
Standard Penetration Test	**SPT**
Standard Sampling Procedure	**SSP**
Standing Water Level	**SWL**
Standard Sampling Procedure	**SSP**
State Significant Development Application	**SSDA**
Sodium	**Na**
Western Sydney Regional Organisation of Councils	**WSROC**

Units

deci Siemens per Metre	**dS/m**
Electrical Conductivity	**EC**
Exchangeable Sodium Percentage (Sodicity)	**ESP%**
Litres	**L**
Metres	**m**
Metres Below Ground Level	**mBGL**
Millivolts	**mV**
Millilitres	**ml**
Milliequivalents	**meq**
Milligrams per Litre	**mg/L**
Milligrams per Kilogram	**mg/kg**
ohm Centimetres	**ohm.cm**

ABBREVIATIONS

Parts Per Million	**ppm**
micro Siemens per Centimetre	**µS/cm**

1 INTRODUCTION

Health Infrastructure ('the client') commissioned JK Environments (JKE) to undertake a preliminary salinity assessment for the proposed soil conservation works at Lot 2 DB1281576, Princes Highway, Moruya, NSW (the site). The site location is shown on Figure 1 and the assessment was confined to the site boundaries as shown on Figure 2 attached in the appendices.

This report supports a Review of Environmental Factors (REF) prepared for Health Infrastructure NSW pursuant to part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the undertaking of soil conservation works and the construction of a new road at Lot 2 DP 1281576, Princes Highway, Moruya.

JKE has previously undertaken preliminary investigations for the site including a desktop preliminary site investigation (Desktop PSI) and a PSI with intrusive investigation (Project Ref: E33942PL). A brief summary of the previous investigation findings is presented in Section 2.

Background information on salinity is included in the appendices.

1.1 The Site

The site of the soil conservation works, and ancillary road works is located on the Princes Highway in the NSW south coast town of Moruya. The site is legally described as Lot 2 DP 1281576 and is a large vacant greenfield site. The soil conservation works will facilitate the ongoing management of the greenfield lot. To the west of the site is Moruya TAFE, and to the north is a small residential subdivision called Mynora Estate. An aerial figure of the site is shown on the following **Plate 1**.

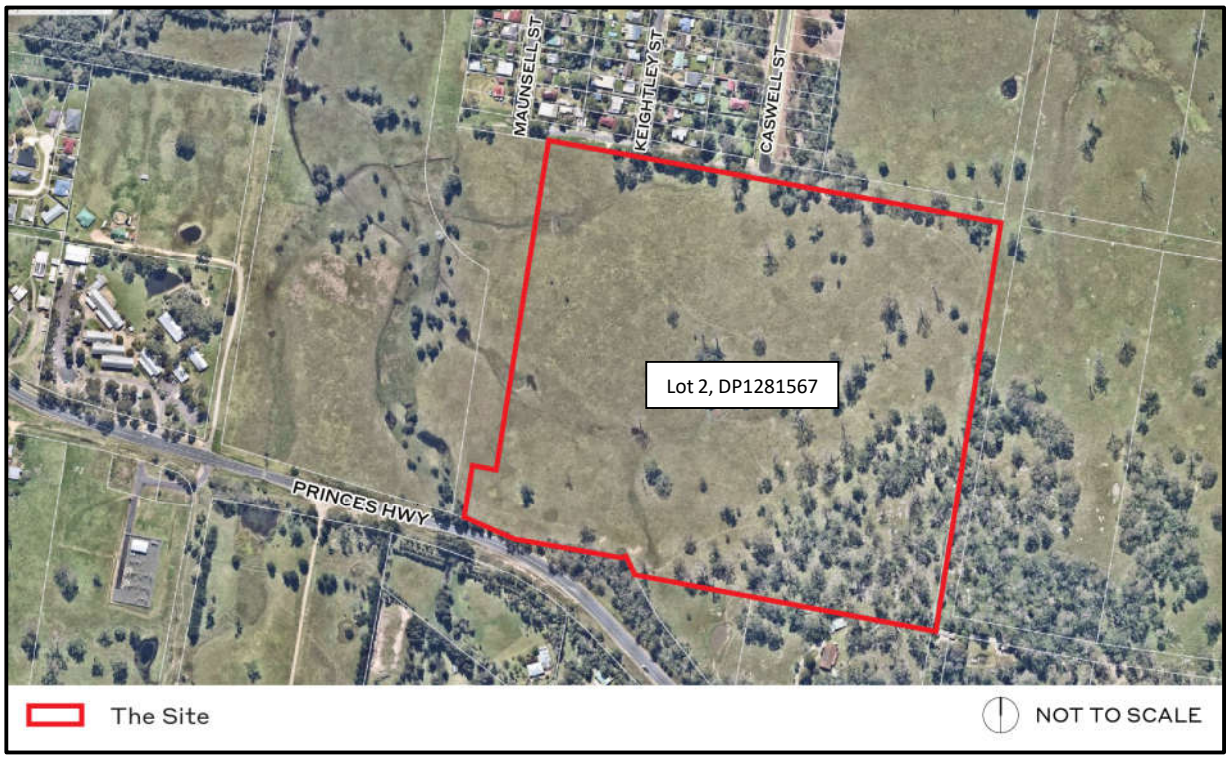


Plate 1: Propose site location.

1.2 Proposed Development Details

The works proposed under the REF include the following:

- Construction of three erosion and sediment basins, ranging between 507m^2 and 990m^2 in area.
- Construction of an ancillary road into the site to facilitate construction access into the site.

JKE understand from the civil plans that excavation for the sediment basins will be required to a maximum depth of approximately 2.5m below the existing ground level. A further detailed description of the proposed works is contained in the REF report prepared by Ethos Urban.

1.3 Aim and Objectives

The primary aim of the assessment was to characterise the broad scale dryland salinity conditions at the site in the context of the proposed development works. The assessment objectives were to:

- Assess the current site conditions via a site walkover inspection;
- Assess the soil and groundwater salinity conditions via implementation of a preliminary sampling and analysis program; and
- Assess if a salinity management plan (SMP) is required for the proposed development.

1.4 Scope of Work

The assessment was undertaken generally in accordance with a JKE proposal (Ref: EP55665PL) of 17 December 2021 and written acceptance from the client of 21 December 2021. The scope of work included the following:

- Review site information including topography, soils maps, salinity risk maps, regional geology and hydro-geology in the vicinity of the site;
- A walkover site inspection to identify obvious visual indicators of dryland salinity or potential problem areas;
- Design and implementation of a field sampling and laboratory analysis program;
- Interpretation of the analytical results based on established assessment criteria;
- Preparation of a report presenting the results of the assessment; and
- Assess the need for a site specific SMP for the proposed development.

The assessment was designed and the report was prepared with reference to regulations/guidelines outlined in the table below. Individual guidelines/documents are also referenced within the text of the report.

Table 1-1: Guidelines

Guidelines/Regulations/Documents
Site Investigations for Urban Salinity (2002)[1]
Salinity Code of Practice (2004)[2]
Managing Urban Stormwater – Soil and Construction (4th ed.) (2004)[3]
Salinity Potential in Western Sydney Map (2002)[4]
Piling – Design and Installation AS2159-2009 (2009)[5]
Industry Guide T56: Residential Slabs and Footings in Saline Environments (2018)[6]

[1] Department of Land and Water Conservation (DLWC), (2002). *Site Investigations for Urban Salinity,* (referred to as DLWC 2002)

[2] Western Sydney Regional Organisation of Councils (WSROC) and Department of Infrastructure, Planning and Natural Resources (DIPNR), (2003 amended 2004). *Western Sydney Salinity Code of Practice* (referred to as Salinity Code of Practice)

[3] NSW Government/Landcom, (2004). *Managing Urban Stormwater – Soil and Construction*, (4th ed.) (referred to as Blue Book)

[4] DIPNR, (2002). *1:100,000 Map – Salinity Potential in Western Sydney*, (referred to as Salinity Potential Map)

[5] Standards Australia, (2009). *Piling – Design and Installation, AS2159-2009* (referred to as AS2159-2009)

[6] Cement, Concrete and Aggregates Australia (CCAA), (2018). Industry Guide *T56: Residential Slabs and Footings in Saline Environments* (referred to as CCAA 2018)

2 SITE INFORMATION

2.1 JKE Desktop PSI

The Desktop PSI included a review of site information, including background and site history information and a site walkover inspection. Soil sampling was not undertaken.

Based on the information reviewed and a weight of evidence assessment of the site history documentation, and site observations made by JKE, it was considered that the site has been historically used for grazing purposes since at least 1961 and it was presumed to have been of similar use before this time. The immediate surrounds appeared to have been used for similar purposes, with the exception of the low-density residential properties to the north and south of the site. There were no historical structures on site and the site inspection and aerial photographs did not identify evidence of filling.

2.2 JKE Intrusive PSI

The scope of the Intrusive PSI included sampling of the soil on site to obtain preliminary data on the potential for soil contamination. The boreholes drilled and samples for the Intrusive PSI generally encountered shallow topsoil and residual (natural) soil overlying shallow granite bedrock.

2.3 Site Identification

Table 2-1: Site Identification

Site Address:	Princes Highway, Moruya, NSW
Lot & Deposited Plan:	Lot 2 in DP1281576
Current Land Use:	Vacant/Grazing
Proposed Land Use:	Soil Conservation Works (Ancillary Roads and Sediment Basins)
Local Government Authority (LGA):	Eurobodalla Shire Council
Site Area (m^2) (approx.)	22 hectares (220,000m^2)
RL (AHD in m) (approx.):	7-40
Geographical Location (MGA56) (approx. centre of site):	E: 237804.255 N: 6020784.595

2.4 Site Location and Regional Setting

The site is located in a predominantly residential and rural area of Moruya and is bound by Princes Highway to the south and partially by Albert Street to the north. Racecourse Creek is located approximately 550m to the north-west of the site.

2.5 Topography

The site is located within an area of undulating regional topography. The site itself comprises two hill peaks in the north-east and south-east corners of the site. The south-east hill slopes down towards the north and west at a gradient of between approximately 7° to 11°. The north-east hill slopes down towards the north, west and south at a gradient of between approximately 3° to 7°.

There are two tributaries (creek lines) that extend westward through the site (see Figure 2) and flow towards the low-lying areas, further west of the site. These appeared to flow towards more significant tributaries of Racecourse Creek, beyond the western site boundary.

2.6 Site Inspection

A walkover inspection of the site was undertaken by JKE on 11 July 2022. The inspection was limited to accessible areas of the site and was focussed on assessing the site conditions relevant to salinity-related factors only.

At the time of the inspection, the site was vacant and utilised for grazing of a small herd of cattle. The majority of the site was grassed, with some large native eucalypt trees across the eastern and southern portions of the site. Granite bedrock outcropping was visible at the highest points of the hills, with large boulders also visible at the surface mid-way down the hill slopes/spurs.

Surface water runoff is presumed to follow in sympathy with the topography and the varying slopes of the site, then generally tending towards the west along the creek lines. A stormwater drain located on Albert Street to the north of the site appeared to drain onto the site and meetup with the northern-most creek line, as shown on Figure 2. From the observation during the site walkover, the creek lines were found to support various forms of freshwater ecology such as fish, frogs and aquatic plants, as well as native plant life. Grass coverage was very good with larger trees scattered across the site all appearing to be in good condition. No visible indications of saline conditions (such as scalding) were observed.

2.7 Surrounding Land Use

During the site inspection, JKE observed the following land uses in the immediate surrounds:

- North – Braemar Drive and low-density residential properties;
- South – Princes Highway and low-density residential properties
- East – Vacant/grazing land; and
- West – Vacant/grazing land.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology and Soils

Regional geological information was reviewed for the Desktop PSI. The information indicated that the site is underlain by Moruya Tonalite of the Moruya Suite, which typically consists of tonalite, granodiorite, biotite, granite, adamellite, diorite and gabbro. The Moruya 1:25,000 Quaternary Geology Sheet indicated that most of the site is underlain by bedrock of the Moruya Supersuite. However, along to the creek lines adjacent to the western site boundary, Quaternary aged alluvial and colluvial fan soils are mapped. These soils comprise *"fluvial sand, silt, gravel, clay"*.

The Atlas of Australian Soils information presented in the Desktop PSI report indicates that the site is underlain by 'Dermsol' soils which are characterised by naturally acidic soils.

3.2 Salinity Hazard Map

The site is not located within the Salinity Potential Map and is not indicated on the Eurobodalla Shire Council Local Environmental Plan 2012 as an area of potential salinity risk.

3.3 Hydrogeology

There was a total of 44 registered bores within the report buffer of 2,000m. The nearest registered bore was located approximately 418m from the site. This was utilised for domestic/stock purposes. The bores were generally registered for a mixture of monitoring, domestic and domestic stock purposes. Use of groundwater is not proposed as part of the development. The majority of the registered bores are located in the low-lying land to the west of the site.

3.4 Receiving Water Bodies and Surface Water Run-off

Several small dams were located along the creek lines and these appeared relatively full during the inspection due to the recent rain event. The upper sections of the creek lines on site were not expected to permanently hold water. The site location and regional topography indicates that water from the creek lines on site would flow towards the west, linking up with other tributaries of Racecourse Creek.

4 SAMPLING AND ANALYSIS PLAN

4.1 Soil Sampling Rationale

The investigation included soil sampling from 44 locations placed on a regular grid pattern as shown on Figure 2. This density is equivalent to approximately two sampling points per hectare (the area of the site is approximately 22 hectares) and meets the requirements for an 'initial site investigation' recommended in the DLWC 2002 document for 'moderately intensive construction'. The density was considered adequate to identify large areas of salinity impacted soils at the site.

Soil sampling for this assessment was to a maximum depth of approximately 1.1m below existing ground level (BGL). This was considered adequate to provide an indication of saline soil conditions on site in the context of the proposed development, particularly considering the relatively shallow bedrock conditions that were known to exist at the site.

4.2 Soil Sampling Methods

Fieldwork for this investigation was undertaken between 11 and 15 July 2022. Sampling locations were set out using a hand-held GPS unit. Locations were marked using wooden pegs. The sample locations were drilled using hand equipment.

Soil samples were collected from the soil profiles encountered during the investigation based on distinct change in lithology or field observations. All samples were recorded on the borehole logs attached in the appendices.

Samples were placed in plastic bags and sealed using twist ties. Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date.

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Field sampling protocols adopted for this assessment are summarised in the appendices.

4.3 Groundwater Sampling Rationale

The assessment included sampling from three groundwater monitoring wells that were previously installed at (as shown on Figure 2). The wells were positioned for site coverage in the context of the proposed development and were considered adequate to provide a snapshot of the groundwater conditions at the site.

4.4 Monitoring Well Installation

The monitoring well construction details are documented on appropriate borehole logs (BH1/MW1, BH18/MW18 and BH27/MW27) presented in the appendices. The wells were installed to a maximum depth of approximately 5.8mBGL. The wells were generally constructed as follows:

- 50mm diameter Class 18 PVC (machine slotted screen) was installed in the lower section of the well to intersect groundwater;
- 50mm diameter Class 18 PVC casing was installed in the upper section of the well (screw fixed);
- A 2mm sand filter pack was used around the screen section for groundwater infiltration;
- A hydrated bentonite seal/plug was used on top of the sand pack to seal the well; and
- A gatic cover was installed at the surface with a concrete plug to limit the inflow of surface water.

The surface RLs for the monitoring wells were obtained from the GPS data during installation. A detailed survey of the well heads was outside the scope of the assessment.

4.5 Monitoring Well Development and Groundwater Sampling

The monitoring wells were developed to the extent possible using a dedicated disposable polyethylene bailer on 11 July 2022. Groundwater samples were obtained from the monitoring wells using a dedicated disposable polyethylene bailer on 15 July 2022.

The pH, temperature, electrical conductivity (EC), dissolved oxygen (DO) and redox potential (Eh) were monitored during sampling using calibrated field instruments. It is noted that there was insufficient well volume in MW18 to undertake field measurements prior to sampling. The sampling data sheets and field calibration information are attached in the appendices. The samples were preserved in accordance with the requirements detailed in AS/NZS 5667.1-1998[7] and placed in an insulated container with ice.

On completion of the fieldwork, the samples were delivered in an insulated sample container to a NATA registered laboratory for analysis under standard chain of custody procedures.

4.6 Laboratory Analysis

Samples were analysed by Envirolab Services Pty Ltd (NATA accreditation number 2901). Reference should be made to the laboratory reports (Ref: 300717 and 300599) attached in the appendices for further details of the analytical methods.

4.7 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 4-1: Analytical Schedule

Analyte	Topsoil Samples	Natural Subsoil Soil Samples	Natural Bedrock Samples	Groundwater Samples
pH	25	19	0	3
Electrical Conductivity (EC)	25	19	0	3

[7] Standards Australia, (1998). *Water Quality – Part 1: Sampling, Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples,* (AS/NZS 5667.1:1998)

Resistivity	25	19	0	-
EC extract (ECe) (determined by texture)	25	19	0	-
Sulphate	25	19	0	3
Chloride	25	19	0	3
Cation Exchange Capacity (CEC)	3	3	0	-

5 SITE ASSESSMENT CRITERIA (SAC)

5.1 Soil Salinity and Plant Growth

The electrical conductivity (EC) of a 1:5 soil:water extract is commonly used as an indicator of soil salinity conditions as the reading is directly related to the electrolyte (salt) concentration of the extract. In order to compare the laboratory data with published salinity classes, the results are converted to equivalent saturated paste (ECe) using texture adjustment values presented in DLWC 2002.

The following table provides a summary of plant response with reference to salinity:

Table 5-1: Plant Response to Soil Salinity

ECe (dS/m)	Salinity Class	Plant Response[1]
<2	Non-saline	Salinity effects mostly negligible
2-4	Slightly saline	Yields of very sensitive crops may be affected
4-8	Moderately saline	Yield of many crops affected
8-16	Very saline	Only tolerant crops yield satisfactorily
>16	Highly saline	Only a few very tolerant crops yield satisfactorily

Note:

1 - Plant Response to Salinity Class has been adopted from DLWC 2002

5.2 Soil pH and Plant Growth

Soil pH is a measure of the acidity or alkalinity of the soils and values have been assessed as an indicator of soil fertility with respect to plant growth. The optimal pH for plant growth is between 5.5 and 7. Beyond this range, effective revegetation of exposed soil following disturbance is increasingly difficult and the potential for erosion is considered to increase.

Highly alkaline soils are commonly associated with saline and sodic soil conditions and can limit the ability of plants to take up water and nutrients. Highly acidic soils exhibit aluminium toxicity toward plants and can limit the ability of plants to take up other essential nutrients including molybdenum.

Interpretation of soil pH with respect to plant growth is undertaken using the ratings published in Bruce and Rayment (1982)[8] presented below:

Table 5-2: Plant Response to Soil pH

pH	Rating
<4.5	Extremely acidic
4.5-5.0	Very strongly acidic

[8] Bruce, R.C. and Rayment, G.E., (1982). *Analytical Methods and Interpretations used by the Agricultural Chemistry Branch for Soil and Land Use Surveys,* (referred to as Bruce and Rayment 1982)

pH	Rating
5.1-5.5	Strongly acidic
5.6 – 7.3	Optimal plant growth
7.4-7.8	Mildly alkaline
7.9-8.4	Moderately alkaline
8.5-9.0	Strongly alkaline
>9.1	Very strongly alkaline

5.3 Cation Exchange Capacity (CEC) in Soil

The ability of soils to attract, retain and exchange cations (positively charged ions) is estimated by the calculated CEC value. CEC represents the major controlling factor in stability of clay soil structure, nutrient availability for plant growth, soil pH and the reaction of the soil to chemical applications (fertilisers, conditioners etc.).

High CEC soils have a greater capacity to retain nutrients, however, deficient soils require greater applications of nutrients to correct imbalances. Low CEC soils have a reduced capacity to retain nutrients and may result in leaching of nutrients from the soil in the event of excess nutrient applications.

Metson (1961)[9] developed a set of ratings for effective CEC and the most abundant cations. These are summarised below (values are in meq/100g):

Table 5-3: CEC Rating

Rating	eCEC	Exch Na	Exch K	Exch Ca	Exch Mg
Very low	<6	0-0.1	0-0.2	0-2	0-0.3
Low	6-12	0.1-0.3	0.2-0.3	2-5	0.3-1
Moderate	12-25	0.3-0.7	0.3-0.7	5-10	1-3
High	25-40	0.7-2	0.7-2	10-20	3-8
Very high	>40	>2	>2	>20	>8

5.3.1 Ratio of Exchangeable Calcium to Magnesium

To maintain soil structure there should be a ratio of around 4:1 to 6:1 calcium to magnesium for a balanced soil (Eckert 1987)[10]. At ratios of less than 4:1 calcium is considered to be deficient, whilst at ratios of greater than 6:1 are considered to be magnesium deficient.

[9] Metson, A.J, (1961). *Methods of Chemical Analysis for Soil Survey Samples* (referred to as Metson 1961)

[10] Eckert, D.J, (1987). *Soil Test Interpretation: Basic Cation Saturation Ratios and Sufficiency Levels* (referred to as Eckert 1987)

5.4 Exchangeable Sodium Percentage or Sodicity (ESP%)

Exchangeable sodium is an important soil stability and salinity parameter. Excessive exchangeable sodium leads to unstable soils, increased runoff, potential salinity, dispersivity and water logging problems.

Normally the sodium content is expressed as a percentage of the CEC as other cations counteract the negative effects of sodium (known as ESP% and termed sodicity). The effect of the exchangeable sodium (exchangeable sodium percentage, ESP) varies with other soil factors such as the type of clay, the relative quantity of magnesium and the quantity of organic matter. However, Charman & Murphy (2000)[11] indicate that a soil is generally considered sodic if the ESP exceeds 6% and extremely sodic if the ESP exceeds 15%.

5.5 Groundwater Salinity

EC values in groundwater are dependent on numerous factors and can vary with changes in temperature and pH conditions. Suttar (1990)[12] has classed water into different types based on EC values as outlined in the table below.

Table 5-4: EC Ranges in Water

Water Type	EC (µS/cm)
Deionised Water	0.5 – 3
Pure Rainwater	<15
Freshwater Rivers	0 – 800
Marginal River Water	800 – 1600
Brackish Water	1600 – 4800
Saline Water	>4800
Seawater	51,500
Industrial Waters	100 – 10,000

5.6 Recommendations for Concrete Slabs and Footings in Saline Soils

In the absence of endorsed recommendations for buildings in saline environments, reference is made to the CCAA 2018. The guide provides recommendations on the minimum concrete grade/strength required for slabs and footings in saline soils. Reference should be made to the CCAA 2018 publication for further information:

[11] Charman, P.E.V and Murphy, B.W (eds), (2000). *Soils: Their Management and Properties,* (referred to as Charman and Murphy 2000)

[12] Suttar, S., (1990). *Ribbons of Blue Handbook, Scitech*, Victoria (referred to as Suttar 1990)

Table 5-5: Minimum Concrete Grade for Slabs and Footings in Saline Soils

ECe (dS/m)	Salinity Class	Concrete Grade[1]
<2	Non-saline	N20
2-4	Slightly saline	N20
4-8	Moderately saline	N25
8-16	Very saline	N32
>16	Highly saline	≥N40

Note:

1 - Concrete Grade for Salinity Class has been adopted from CCAA 2018

5.7 Recommendations for Durability with Reference to AS2159-2009

In designing for durability, reference should be made to the requirements listed in the AS2159-2009. The exposure classification for concrete and steel piles and foundations is outlined in the following tables.

Table 5-6: Exposure Classification for Concrete Piles

Exposure Conditions				Exposure Classification	
Sulphate (expressed as SO_4)		pH	Chlorides in Groundwater (ppm)	Soil Conditions A[1]	Soil Conditions B[2]
In Soil (ppm)	In Groundwater (ppm)				
<5,000	<1,000	>5.5	<6,000	Mild	Non-aggressive
5,000-10,000	1,000-3,000	4.5-5.5	6,000-12,000	Moderate	Mild
10,000-20,000	3,000-10,000	4-4.5	12,000-30,000	Severe	Moderate
>20,000	>10,000	<4	>30,000	Very severe	Severe

Notes:

1 - High permeability soils (eg sands and gravels) which are in groundwater

2 – Low permeability soils (eg silts and clays) or all soils above groundwater

Table 5-7: Exposure Classification for Steel Piles

Exposure Conditions				Exposure Classifications	
pH	Chlorides		Resistivity (ohm.cm)	Soil Conditions A[1]	Soil Conditions B[2]
	In Soil (ppm)	In Groundwater (ppm)			
>5	<5,000	<1,000	>5,000	Non-aggressive	Non-aggressive
4-5	5,000-20,000	1,000-10,000	2,000-5,000	Mild	Non-aggressive
3-4	20,000-50,000	10,000-20,000	1,000-2,000	Moderate	Mild
<3	>50,000	>20,000	<1,000	Severe	Moderate

Notes:

1 - High permeability soils (eg sands and gravels) which are in groundwater

2 – Low permeability soils (eg silts and clays) or all soils above groundwater

6 INVESTIGATION RESULTS

6.1 Subsurface Conditions

A summary of the subsurface conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 6-1: Summary of Subsurface Conditions

Profile	Description (metres below ground level - mBGL)
Fill	Topsoil was encountered at the surface in all boreholes with the exception of BH133 and BH144 extended to depths of approximately 0.2m to 0.6m below ground level (BGL). The topsoil typically comprised silty sandy clay with inclusions of ash, roots and root fibres. JKE note that the description of 'topsoil' for soil profiles deeper than 0.4m BGL includes a root affected zone and deeper soil of the same profile. 'Fill' was logged in BH133 at the surface and extended to a depth of approximately 0.2m BGL. The fill comprised silty sandy clay with inclusions of brick fragments, ash and root fibres. Based on the site observations, it was considered that this 'fill' was likely a layer of disturbed soil that had been impacted by during previous use of the area, rather than being imported fill.
Natural Soil (primarily subsoil)	Natural silty sandy clay and silty clay soils were encountered at the surface (BH144) or beneath the topsoil in all boreholes with the exception of BH131 and extended to depths of approximately 0.5m to 1.0mBGL. Most boreholes were terminated in this material.
Bedrock	Inferred granite bedrock was encountered beneath the natural clay in a number of boreholes at depths of between 0.5m to 0.8mBGL. The bedrock was unable to be confirmed due to the use of hand tools.
Groundwater	Groundwater seepage was encountered in a large number of boreholes at the top of the natural clay soil profile, this was believed to be due to saturation of the topsoil due to recent rain events in the area. Standing water was measured within BH03, BH128, BH135, BH137, BH148, BH150, BH151 and BH171 at depths of between approximately 0.3m BGL and 0.8m BGL upon completion of augering.

6.2 Laboratory Results

A summary of the results is presented below.

Table 6-2: Summary of Laboratory Results

Analyte	Results
EC & ECe	The EC results ranged from 40µS/m to 360µS/m. The ECe results ranged from <2dS/m to 2.9dS/m.
Resistivity	Resistivity values were calculated based on the raw EC values. The resistivity values for the soil samples ranged from 2,778ohm.cm to 25,000ohm.cm. We note that JKE calculated the resistivity values based on the raw EC data and these results are presented in Table B.

Analyte	Results
	Envirolab reported the resistivity values in different units (ohm.m) and also rounded the values, hence the discrepancy when comparing the Envirolab data to the results presented in Table B.
pH	The results of the analysis ranged from 4.3 to 6.5.
CEC	The results of the analysis ranged from: • CEC – <1meq/100g to 9.1meq/100g; • Exchangeable Na – <0.1meq/100g to 1.4meq/100g; • Exchangeable K – <0.1meq/100g to 0.1meq/100g; • Exchangeable Ca – 0.6meq/100g to 5.3meq/100g; and • Exchangeable Mg – 0.2meq/100g to 6.7meq/100g.
Sulphate	The results ranged from 10mg/kg to 240mg/kg.
Chloride	The results ranged from <10mg/kg to 68mg/kg.
Groundwater	The results of the analysis ranged from: • pH – 7.1 to 7.3; • EC – 250µS/cm to 450µS/cm; • Chloride - 19mg/L to 61mg/L; and • Sulphate - 5mg/L to 15mg/L.

Note:

Na – Sodium, K – Potassium, Ca – Calcium, Mg – Magnesium

7 RESULTS INTERPRETATION

The laboratory results are compared to the relevant SAC in the attached report tables. Interpretation of the results against the SAC is provided in the following table.

Table 7-1: Interpretation of Laboratory Results

Parameter	Notes
Soil Salinity and Plant Growth	The majority of the ECe results were <2dS/m and were non-saline. One result of 2.9dS/m in BH151 (0-0.1m) was in the slightly saline category.
Soil pH and Plant Growth	The soil pH results ranged from 4.3 to 6.5 and are classed as very strongly acidic to optimal for plant growth. The majority of the surficial soils were generally within the strongly acidic range for plant growth. The acidic conditions were generally consistent across profile depths. The proposed excavations will generally expose acidic soils and may require treatment with lime or gypsum in order to make the soils suitable for plant growth.
CEC in Soil	The CEC values ranged from <1meq/100g to 9.1meq/100g in the very low to low range. The majority of the samples were within the very low to low range which is typical of the soil formation encountered at the site and are generally indicative of the low levels of organic matter within the soils.
Ratio of Calcium to Magnesium	The results indicate that the soils generally have more calcium than magnesium with the exception of the sample BH172 (0.6-0.8m) which indicated less calcium than magnesium. The CEC of the soil is generally very low to low. Lime and gypsum can be used to stabilise the soil which will improve soil structure for both engineering and fertility purposes.
ESP%	The ESP% values of the samples ranged from 1.2% to 15.4%. The majority of the ESP results were below the 5% threshold and were classed as non-sodic. Values from sample BH154 (0-0.1m) and BH172 (0.6-0.8m) were classed as sodic and highly sodic respectively.
Groundwater Salinity	The laboratory results indicate that the groundwater is non-saline and within the 'freshwater rivers' water type.
Concrete Slabs and Footings in Saline Soils (CCAA 2018)	The proposed earthworks are anticipated to expose soils generally classed as non-saline to slightly saline. The CCAA 2018 recommended concrete grade for slabs and footings in non-saline to slightly saline soils is N20. Reference should also be made to AS2159-2009 for minimum concrete strengths and reinforcement cover for concrete piles/foundations.
Soil Conditions for Exposure Classification (AS2159-2009)	The boreholes drilled for the investigation have indicated that the subsurface conditions at the site generally comprise of low permeability soils (i.e. silts and clays). Based on this, the exposure classification outlined under 'Soil Conditions B' has been adopted for the assessment.
Exposure Classification for Concrete Piles/Foundations (AS2159-2009)	The soil pH and sulphate results indicate that the soils are mildly to moderately aggressive towards buried concrete. The aggressivity is associated with the acidic pH, rather than with sulphate. The groundwater pH, sulphate and chloride results indicate that the groundwater is non-aggressive towards buried concrete.

Parameter	Notes
	The results should be assessed by the project design team as applicable for the proposed development.
Exposure Classification for Steel Piles/Foundations (AS2159-2009)	The soil resistivity, pH and chloride results indicate that the soils are non-aggressive towards buried steel. The groundwater pH and chloride results indicate that the groundwater is non-aggressive towards buried steel. The results should be assessed by the project design team as applicable for the proposed development.

8 CONCLUSIONS AND RECOMMENDATIONS

The investigation identified the following salinity conditions at the site:

- The pH results indicate the soils are classed as optimal to very strongly acidic with regards to plant growth;
- The soils are generally classed as non-saline. There was only one sample found to be slightly saline;
- The ESP% values indicate the soils are classed as non-sodic to highly sodic;
- The soils are mildly to moderately aggressive towards buried concrete, based on the acidic pH;
- The soils are not aggressive towards buried steel;
- The groundwater is non-aggressive towards buried concrete; and
- The groundwater is non-aggressive towards buried steel.

Based on the results of this investigation, JKE is of the opinion that a SMP is not required for the proposed development. The soils are largely non-saline and JKE therefore consider that there is no requirement to manage any associated salinity issues within the soils.

The aggressivity results of the soils and groundwater outlined in this report should be reviewed and incorporated into the design of the proposed development by the project team (civil, structural and landscaping).

In the event that the proposed development includes excavation, crushing and re-use of excavated bedrock as fill on site as part of the development, we recommend that the salinity/aggressivity conditions within the bedrock be checked so that the findings can be considered in the context of the earthworks and the built form of the development.

JKE consider that the report objectives outlined in Section 1.3 have been addressed.

9 LIMITATIONS

The report limitations are outlined below:

- Salinity is a natural phenomenon and can change over time, based on site conditions and climatic variations. Changes to existing drainage patters can also impact the salinity at the site. The results outlined in this report are a snap shot of conditions present at the time of the investigation and is bound to change over time;
- JKE accepts no responsibility for any unidentified salinity issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report was produced based on information gathered as part of previous investigations associated with other proposed developments at the site;
- JKE accepts no responsibility for non-compliance of salinity management recommends outlined in this report;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential salinity sources or may have been impacted by adverse salinity conditions, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or land use. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a salinity viewpoint, and vice versa;
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report is the property of JKE. JKE has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty

expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report;

- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of JKE; and
- Any third party who seeks to rely on this report without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater salinity concentrations may also vary over time through migration and accumulation of salts, importation of materials, construction and landscaping. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of salinity, the likely impact on the proposed development and appropriate management measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations
The assessment is designed to identify major salinity risks at the site. Implementing the management recommends can minimise the risks. No assessment can identify all risks as salinity is a natural phenomenon which can change over time. Even a rigorous professional assessment may not detect all potential salinity impacts on a site. Salinity may be present in areas that were not surveyed or sampled, or may accumulate in areas which showed no signs of salinity when sampled.

Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

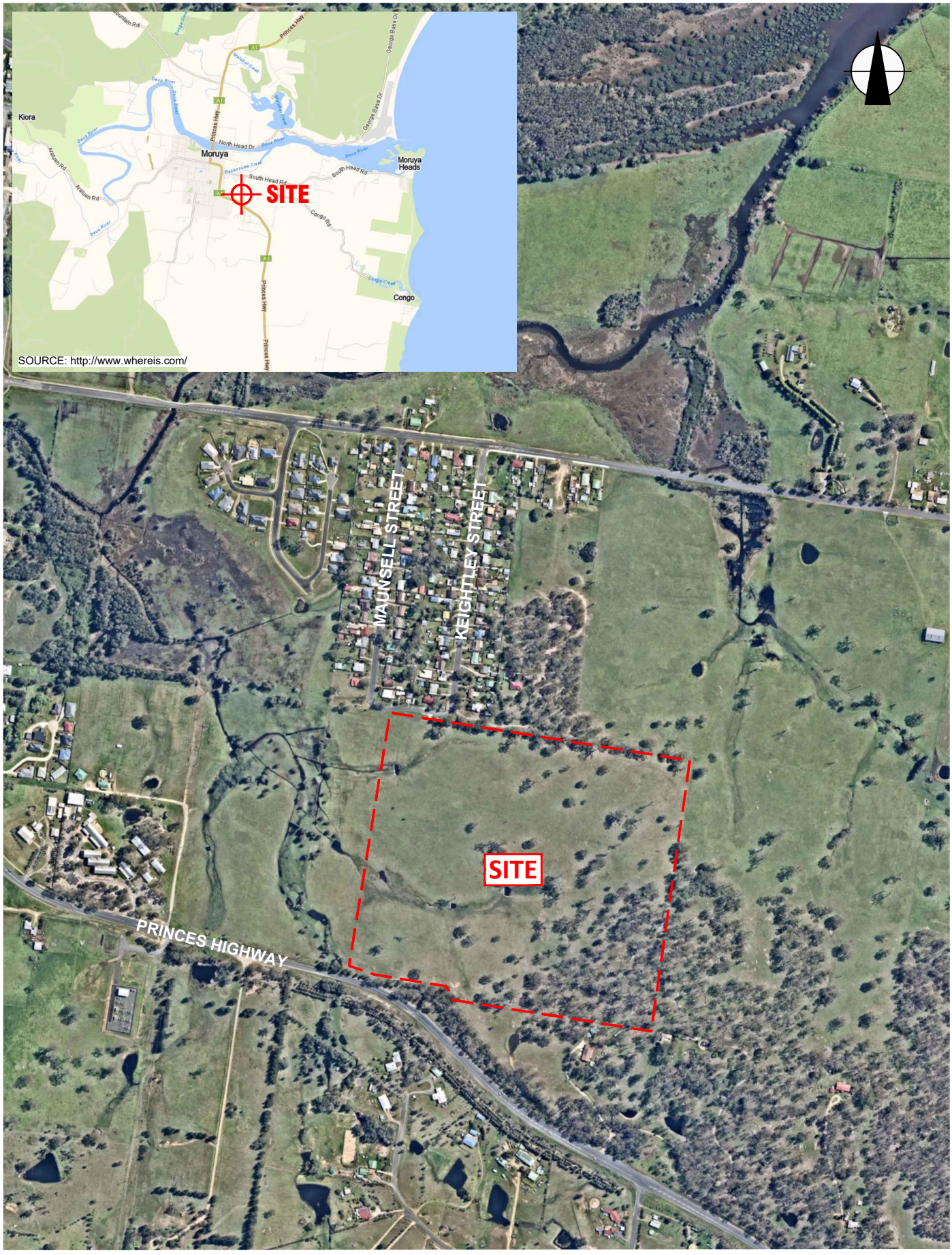
Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site management or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Report Figures



AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title: **SALINITY SITE LOCATION PLAN**

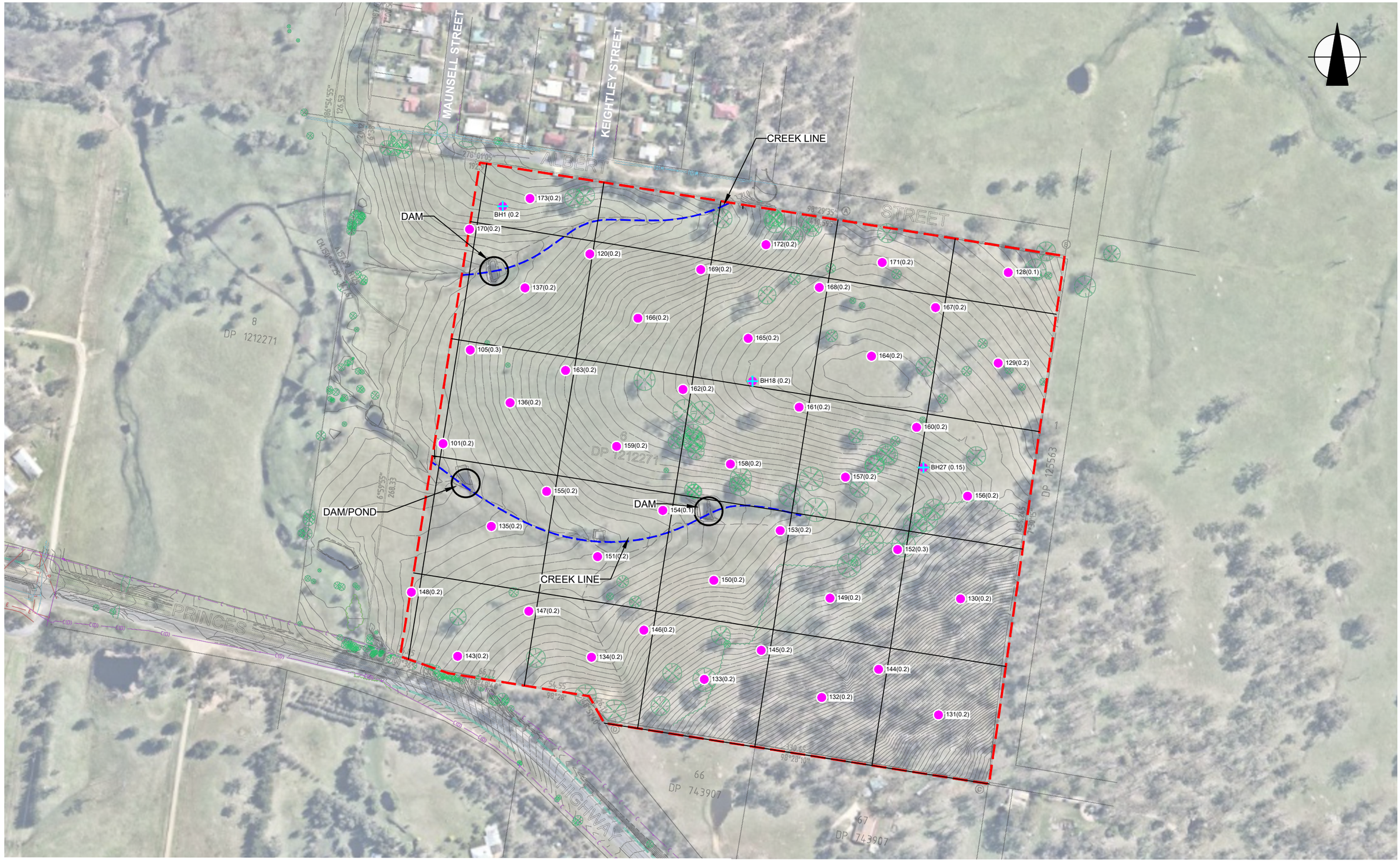
Location: LOT 2, DP1281576, PRINCES HIGHWAY, MORUYA, NSW

Project No: E33942PL

Figure No: 1.Sal

JKEnvironments

PLOT DATE: 17/08/2022 4:07:44 PM DWG FILE: S:\5 EIS\5C EIS JOBS\33000'S\E33942PL MORUYA\CAD\2022\E33942PL.DWG



LEGEND

APPROXIMATE SITE BOUNDARY	
BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
BH/MW(Fill Depth)	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 30 60 90 120 150

SCALE 1:3000 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **SALINITY SAMPLE LOCATION PLAN**

Location: LOT 2, DP1281576, PRINCES HIGHWAY, MORUYA, NSW

Project No: E33942PL

Figure No: 2a.Sal

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Appendix B: Laboratory Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS FOR SALINITY TABLES

Abbreviations used in the Tables:

Ca	Calcium
CEC	Cation Exchange Capacity
DO	Dissolved Oxygen
EC	Electrical Conductivity
ECe	Extract Electrical Conductivity
Eh	Redox Potential
ESP	Exchangeable Sodium Percentage (Each Na/CEC)
K	Potassium
Mg	Magnesium
Na	Sodium
SWL	Standing Water Level

Units used in the Tables

°C	Degrees Celsius
dS/m	deciSiemens per metre
m	meters
meq/100g	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mV	millivolts
ohm.cm	ohm centimetre
µS/cm	microSiemens per centimetre

Notes on Specific Tables

SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe

- The salinity Class has been adopted from 'Site Investigations for Urban Salinity' DLWC 2002.
- The chart function assumes an ECe value of 1.9 for values that are less than the practical quatitation limit.

SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS

- The resistivity values have been calculated on the laboratory EC values.
- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C])
- Table 6.5.2 [A] of Australian Standard 2159-2009 recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water

SUMMARY OF SOIL LABORATORY RESULTS - pH

- The pH Classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Tables 6.4.2 [C] & 6.5.2 [C])
- Table 6.5.2 [A] of Australian Standard 2159-2009 recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water

SUMMARY OF SOIL LABORATORY RESULTS - SULFATE & CHLORIDES

- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C])
- The chart function assumes an concentration of 0.5mg/kg for values that are less than the practical quatitation li

SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

- The Sodicity rating has been adopted from the publication 'Site Investigations for Urban Salinity' DLWC 2002.

SUMMARY OF GROUNDWATER LABORATORY RESULTS

- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C]) .
- Table 6.4.2 [A] recommends using a Mild Exposure Classification for Concrete Piles in Fresh Water - Treat as in Soil Condition 'A'.
- Table 6.5.2 [A] recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water.

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TABLE A
SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	ECe (dS/m)	Salinity Class
BH101	0.35-0.5	Silty Sandy Clay	76	<2	NON SALINE
BH101	0.35-0.5	LAB DUPLICATE	77	<2	NON SALINE
BH105	0-0.1	Silty Sandy Clay	110	<2	NON SALINE
BH120	0.3-0.5	Topsoil: Silty Sandy Clay	110	<2	NON SALINE
BH128	0.3-0.5	Silty Sandy Clay	58	<2	NON SALINE
BH129	0-0.1	Topsoil: Silty Sandy Clay	82	<2	NON SALINE
BH130	0.4-0.6	Silty Sandy Clay	120	<2	NON SALINE
BH131	0-0.1	Topsoil: Silty Clay	160	<2	NON SALINE
BH132	0.3-0.5	Topsoil: Silty Sandy Clay	85	<2	NON SALINE
BH133	0.2-0.4	Silty Sandy Clay	63	<2	NON SALINE
BH133	0.2-0.4	LAB DUPLICATE	56	<2	NON SALINE
BH134	0.3-0.5	Silty Sandy Clay	80	<2	NON SALINE
BH134	0.3-0.5	LAB DUPLICATE	84	<2	NON SALINE
BH135	0.3-0.5	Topsoil: Silty Sandy Clay	110	<2	NON SALINE
BH136	0-0.1	Silty Sandy Clay	110	<2	NON SALINE
BH137	0.4-0.6	Silty Sandy Clay	40	<2	NON SALINE
BH143	0-0.1	Topsoil: Silty Sandy Clay	94	<2	NON SALINE
BH144	0.6-0.8	Silty Clayey Sand	180	<2	NON SALINE
BH145	0.6-0.8	Silty Sandy Clay	160	<2	NON SALINE
BH146	0.4-0.6	Topsoil: Silty Sandy Clay	230	<2	NON SALINE
BH147	0-0.1	Topsoil: Silty Sandy Clay	110	<2	NON SALINE
BH148	0-0.1	Topsoil: Silty Sandy Clay	98	<2	NON SALINE
BH149	0-0.1	Topsoil: Silty Sandy Clay	160	<2	NON SALINE
BH150	0-0.1	Topsoil: Silty Sandy Clay	130	<2	NON SALINE
BH151	0-0.1	Topsoil: Silty Sandy Clay	360	2.9	SLIGHTLY SALINE
BH152	0-0.1	Topsoil: Silty Sandy Clay	160	<2	NON SALINE
BH153	0-0.1	Topsoil: Silty Sandy Clay	84	<2	NON SALINE
BH153	0-0.1	LAB DUPLICATE	83	<2	NON SALINE
BH154	0-0.1	Topsoil: Silty Sandy Clay	96	<2	NON SALINE
BH155	0.6-0.9	Topsoil: Silty Sandy Clay	42	<2	NON SALINE
BH156	0.6-0.8	Topsoil: Silty Sandy Clay	45	<2	NON SALINE
BH157	0.3-0.5	Topsoil: Silty Sandy Clay	85	<2	NON SALINE
BH158	0.5-0.7	Topsoil: Silty Sandy Clay	60	<2	NON SALINE
BH159	0-0.1	Silty Sandy Clay	70	<2	NON SALINE
BH160	0.5-0.7	Topsoil: Silty Sandy Clay	55	<2	NON SALINE
BH161	0.6-0.8	Topsoil: Silty Sandy Clay	42	<2	NON SALINE
BH162	0.3-0.6	Topsoil: Silty Sandy Clay	51	<2	NON SALINE
BH163	0-0.1	Silty Sandy Clay	67	<2	NON SALINE
BH164	0-0.1	Silty Clay	78	<2	NON SALINE
BH165	0-0.1	Silty Clay	83	<2	NON SALINE
BH165	0-0.1	LAB DUPLICATE	88	<2	NON SALINE
BH166	0-0.1	Silty Clay	95	<2	NON SALINE
BH167	0-0.1	Silty Clay	62	<2	NON SALINE
BH168	0-0.1	Topsoil: Silty Sandy Clay	83	<2	NON SALINE
BH169	0-0.1	Topsoil: Silty Sandy Clay	77	<2	NON SALINE
BH170	0.5-0.7	Silty Sandy Clay	110	<2	NON SALINE
BH171	0.4-0.6	Silty Clay	81	<2	NON SALINE
BH172	0.6-0.8	Silty Clay	110	<2	NON SALINE
BH173	0-0.1	Topsoil: Silty Sandy Clay	94	<2	NON SALINE
Total Number of Samples			49	49	-
Minimum Value			40	<PQL	-
Maximum Value			360	2.9	-

ECe Values (dS/m)	Salinity Class
<2	NON SALINE
2 to 4	SLIGHTLY SALINE
4 to 8	MODERATELY SALINE
8 to 16	VERY SALINE
>16	HIGHLY SALINE

TABLE B
SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	Resistivity (ohm.cm)	Classification Condition B
BH101	0.35-0.5	Silty Sandy Clay	76	13,158	Non Aggressive
BH101	0.35-0.5	LAB DUPLICATE	77	12,987	Non Aggressive
BH105	0-0.1	Silty Sandy Clay	110	9,091	Non Aggressive
BH120	0.3-0.5	Topsoil: Silty Sandy Clay	110	9,091	Non Aggressive
BH128	0.3-0.5	Silty Sandy Clay	58	17,241	Non Aggressive
BH129	0-0.1	Topsoil: Silty Sandy Clay	82	12,195	Non Aggressive
BH130	0.4-0.6	Silty Sandy Clay	120	8,333	Non Aggressive
BH131	0-0.1	Topsoil: Silty Clay	160	6,250	Non Aggressive
BH132	0.3-0.5	Topsoil: Silty Sandy Clay	85	11,765	Non Aggressive
BH133	0.2-0.4	Silty Sandy Clay	63	15,873	Non Aggressive
BH133	0.2-0.4	LAB DUPLICATE	56	17,857	Non Aggressive
BH134	0.3-0.5	Silty Sandy Clay	80	12,500	Non Aggressive
BH134	0.3-0.5	LAB DUPLICATE	84	11,905	Non Aggressive
BH135	0.3-0.5	Topsoil: Silty Sandy Clay	110	9,091	Non Aggressive
BH136	0-0.1	Silty Sandy Clay	110	9,091	Non Aggressive
BH137	0.4-0.6	Silty Sandy Clay	40	25,000	Non Aggressive
BH143	0-0.1	Topsoil: Silty Sandy Clay	94	10,638	Non Aggressive
BH144	0.6-0.8	Silty Clayey Sand	180	5,556	Non Aggressive
BH145	0.6-0.8	Silty Sandy Clay	160	6,250	Non Aggressive
BH146	0.4-0.6	Topsoil: Silty Sandy Clay	230	4,348	Non Aggressive
BH147	0-0.1	Topsoil: Silty Sandy Clay	110	9,091	Non Aggressive
BH148	0-0.1	Topsoil: Silty Sandy Clay	98	10,204	Non Aggressive
BH149	0-0.1	Topsoil: Silty Sandy Clay	160	6,250	Non Aggressive
BH150	0-0.1	Topsoil: Silty Sandy Clay	130	7,692	Non Aggressive
BH151	0-0.1	Topsoil: Silty Sandy Clay	360	2,778	Non Aggressive
BH152	0-0.1	Topsoil: Silty Sandy Clay	160	6,250	Non Aggressive
BH153	0-0.1	Topsoil: Silty Sandy Clay	84	11,905	Non Aggressive
BH153	0-0.1	LAB DUPLICATE	83	12,048	Non Aggressive
BH154	0-0.1	Topsoil: Silty Sandy Clay	96	10,417	Non Aggressive
BH155	0.6-0.9	Topsoil: Silty Sandy Clay	42	23,810	Non Aggressive
BH156	0.6-0.8	Topsoil: Silty Sandy Clay	45	22,222	Non Aggressive
BH157	0.3-0.5	Topsoil: Silty Sandy Clay	85	11,765	Non Aggressive
BH158	0.5-0.7	Topsoil: Silty Sandy Clay	60	16,667	Non Aggressive
BH159	0-0.1	Silty Sandy Clay	70	14,286	Non Aggressive
BH160	0.5-0.7	Topsoil: Silty Sandy Clay	55	18,182	Non Aggressive
BH161	0.6-0.8	Topsoil: Silty Sandy Clay	42	23,810	Non Aggressive
BH162	0.3-0.6	Topsoil: Silty Sandy Clay	51	19,608	Non Aggressive
BH163	0-0.1	Silty Sandy Clay	67	14,925	Non Aggressive
BH164	0-0.1	Silty Clay	78	12,821	Non Aggressive
BH165	0-0.1	Silty Clay	83	12,048	Non Aggressive
BH165	0-0.1	LAB DUPLICATE	88	11,364	Non Aggressive
BH166	0-0.1	Silty Clay	95	10,526	Non Aggressive
BH167	0-0.1	Silty Clay	62	16,129	Non Aggressive
BH168	0-0.1	Topsoil: Silty Sandy Clay	83	12,048	Non Aggressive
BH169	0-0.1	Topsoil: Silty Sandy Clay	77	12,987	Non Aggressive
BH170	0.5-0.7	Silty Sandy Clay	110	9,091	Non Aggressive
BH171	0.4-0.6	Silty Clay	81	12,346	Non Aggressive
BH172	0.6-0.8	Silty Clay	110	9,091	Non Aggressive
BH173	0-0.1	Topsoil: Silty Sandy Clay	94	10,638	Non Aggressive
Total Number of Samples			49	49	-
Minimum Value			40	2,778	-
Maximum Value			360	25,000	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

Resistivity Values (ohm.cm)	Classification for Steel Piles
>5,000	Non-Aggressive
2,000 - 5,000	Non-Aggressive
1,000 - 2,000	Mildly Aggressive
<1,000	Moderately Aggressive

TABLE C
SUMMARY OF SOIL LABORATORY RESULTS - pH

Borehole Number	Sample Depth (m)	Sample Description	pH	Classification for Concrete Piles Condition B	Classification for Steel Piles Condition B
BH101	0.35-0.5	Silty Sandy Clay	5.9	Non-Aggressive	Non-Aggressive
BH101	0.35-0.5	LAB DUPLICATE	5.7	Non-Aggressive	Non-Aggressive
BH105	0-0.1	Silty Sandy Clay	5.7	Non-Aggressive	Non-Aggressive
BH120	0.3-0.5	Topsoil: Silty Sandy Clay	5.5	Mildly Aggressive	Non-Aggressive
BH128	0.3-0.5	Silty Sandy Clay	5	Mildly Aggressive	Non-Aggressive
BH129	0-0.1	Topsoil: Silty Sandy Clay	5.3	Mildly Aggressive	Non-Aggressive
BH130	0.4-0.6	Silty Sandy Clay	5.7	Non-Aggressive	Non-Aggressive
BH131	0-0.1	Topsoil: Silty Clay	6.1	Non-Aggressive	Non-Aggressive
BH132	0.3-0.5	Topsoil: Silty Sandy Clay	5.5	Mildly Aggressive	Non-Aggressive
BH133	0.2-0.4	Silty Sandy Clay	6.1	Non-Aggressive	Non-Aggressive
BH133	0.2-0.4	LAB DUPLICATE	6.1	Non-Aggressive	Non-Aggressive
BH134	0.3-0.5	Silty Sandy Clay	6.4	Non-Aggressive	Non-Aggressive
BH134	0.3-0.5	LAB DUPLICATE	6.4	Non-Aggressive	Non-Aggressive
BH135	0.3-0.5	Topsoil: Silty Sandy Clay	5.3	Mildly Aggressive	Non-Aggressive
BH136	0-0.1	Silty Sandy Clay	4.8	Mildly Aggressive	Non-Aggressive
BH137	0.4-0.6	Silty Sandy Clay	5.4	Mildly Aggressive	Non-Aggressive
BH143	0-0.1	Topsoil: Silty Sandy Clay	5	Mildly Aggressive	Non-Aggressive
BH144	0.6-0.8	Silty Clayey Sand	5.4	Mildly Aggressive	Non-Aggressive
BH145	0.6-0.8	Silty Sandy Clay	5.6	Non-Aggressive	Non-Aggressive
BH146	0.4-0.6	Topsoil: Silty Sandy Clay	5.5	Mildly Aggressive	Non-Aggressive
BH147	0-0.1	Topsoil: Silty Sandy Clay	4.8	Mildly Aggressive	Non-Aggressive
BH148	0-0.1	Topsoil: Silty Sandy Clay	4.8	Mildly Aggressive	Non-Aggressive
BH149	0-0.1	Topsoil: Silty Sandy Clay	5.1	Mildly Aggressive	Non-Aggressive
BH150	0-0.1	Topsoil: Silty Sandy Clay	5.2	Mildly Aggressive	Non-Aggressive
BH151	0-0.1	Topsoil: Silty Sandy Clay	5	Mildly Aggressive	Non-Aggressive
BH152	0-0.1	Topsoil: Silty Sandy Clay	5.1	Mildly Aggressive	Non-Aggressive
BH153	0-0.1	Topsoil: Silty Sandy Clay	4.6	Mildly Aggressive	Non-Aggressive
BH153	0-0.1	LAB DUPLICATE	4.6	Mildly Aggressive	Non-Aggressive
BH154	0-0.1	Topsoil: Silty Sandy Clay	4.6	Mildly Aggressive	Non-Aggressive
BH155	0.6-0.9	Topsoil: Silty Sandy Clay	6.5	Non-Aggressive	Non-Aggressive
BH156	0.6-0.8	Topsoil: Silty Sandy Clay	6.1	Non-Aggressive	Non-Aggressive
BH157	0.3-0.5	Topsoil: Silty Sandy Clay	4.6	Mildly Aggressive	Non-Aggressive
BH158	0.5-0.7	Topsoil: Silty Sandy Clay	5.1	Mildly Aggressive	Non-Aggressive
BH159	0-0.1	Silty Sandy Clay	5.1	Mildly Aggressive	Non-Aggressive
BH160	0.5-0.7	Topsoil: Silty Sandy Clay	5.4	Mildly Aggressive	Non-Aggressive
BH161	0.6-0.8	Topsoil: Silty Sandy Clay	4.6	Mildly Aggressive	Non-Aggressive
BH162	0.3-0.6	Topsoil: Silty Sandy Clay	4.6	Mildly Aggressive	Non-Aggressive
BH163	0-0.1	Silty Sandy Clay	5.4	Mildly Aggressive	Non-Aggressive
BH164	0-0.1	Silty Clay	5.5	Mildly Aggressive	Non-Aggressive
BH165	0-0.1	Silty Clay	5.4	Mildly Aggressive	Non-Aggressive
BH165	0-0.1	LAB DUPLICATE	5.4	Mildly Aggressive	Non-Aggressive
BH166	0-0.1	Silty Clay	5.3	Mildly Aggressive	Non-Aggressive
BH167	0-0.1	Silty Clay	5.4	Mildly Aggressive	Non-Aggressive
BH168	0-0.1	Topsoil: Silty Sandy Clay	5.3	Mildly Aggressive	Non-Aggressive
BH169	0-0.1	Topsoil: Silty Sandy Clay	5	Mildly Aggressive	Non-Aggressive
BH170	0.5-0.7	Silty Sandy Clay	4.5	Moderately Aggressive	Non-Aggressive
BH171	0.4-0.6	Silty Clay	4.5	Moderately Aggressive	Non-Aggressive
BH172	0.6-0.8	Silty Clay	4.3	Moderately Aggressive	Non-Aggressive
BH173	0-0.1	Topsoil: Silty Sandy Clay	5.2	Mildly Aggressive	Non-Aggressive
Total Number of Samples			49	-	-
Minimum Value			4.3	-	-
Maximum Value			6.5	-	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

	Classification for Concrete Piles
>5.5	Non-Aggressive
4.5 - 5.5	Mildly Aggressive
4 - 4.5	Moderately Aggressive
<4	Severely Aggressive

pH Value	Classification for Steel Piles
>5	Non-Aggressive
4.0 - 5.0	Non-Aggressive
3.0 - 4.0	Mildly Aggressive
<3	Moderately Aggressive

TABLE D
SUMMARY OF SOIL LABORATORY RESULTS - SULPHATE & CHLORIDES

Borehole Number	Sample Depth (m)	Sample Description	Chloride (mg/kg)	Sulphate (mg/kg)	Classification for Concrete Piles Sulfate - Condition B	Classification for Steel Piles Chloride - Condition B
BH101	0.35-0.5	Silty Sandy Clay	10	24	Non-Aggressive	Non-Aggressive
BH101	0.35-0.5	LAB DUPLICATE	10	21	Non-Aggressive	Non-Aggressive
BH105	0-0.1	Silty Sandy Clay	<10	64	Non-Aggressive	Non-Aggressive
BH120	0.3-0.5	Topsoil: Silty Sandy Clay	67	29	Non-Aggressive	Non-Aggressive
BH128	0.3-0.5	Silty Sandy Clay	20	27	Non-Aggressive	Non-Aggressive
BH129	0-0.1	Topsoil: Silty Sandy Clay	<10	51	Non-Aggressive	Non-Aggressive
BH130	0.4-0.6	Silty Sandy Clay	<10	33	Non-Aggressive	Non-Aggressive
BH131	0-0.1	Topsoil: Silty Clay	<10	70	Non-Aggressive	Non-Aggressive
BH132	0.3-0.5	Topsoil: Silty Sandy Clay	10	48	Non-Aggressive	Non-Aggressive
BH133	0.2-0.4	Silty Sandy Clay	<10	24	Non-Aggressive	Non-Aggressive
BH133	0.2-0.4	LAB DUPLICATE	<10	22	Non-Aggressive	Non-Aggressive
BH134	0.3-0.5	Silty Sandy Clay	10	20	Non-Aggressive	Non-Aggressive
BH134	0.3-0.5	LAB DUPLICATE	10	20	Non-Aggressive	Non-Aggressive
BH135	0.3-0.5	Topsoil: Silty Sandy Clay	20	47	Non-Aggressive	Non-Aggressive
BH136	0-0.1	Silty Sandy Clay	<10	85	Non-Aggressive	Non-Aggressive
BH137	0.4-0.6	Silty Sandy Clay	<10	20	Non-Aggressive	Non-Aggressive
BH143	0-0.1	Topsoil: Silty Sandy Clay	<10	71	Non-Aggressive	Non-Aggressive
BH144	0.6-0.8	Silty Clayey Sand	10	110	Non-Aggressive	Non-Aggressive
BH145	0.6-0.8	Silty Sandy Clay	<10	53	Non-Aggressive	Non-Aggressive
BH146	0.4-0.6	Topsoil: Silty Sandy Clay	40	72	Non-Aggressive	Non-Aggressive
BH147	0-0.1	Topsoil: Silty Sandy Clay	<10	80	Non-Aggressive	Non-Aggressive
BH148	0-0.1	Topsoil: Silty Sandy Clay	<10	80	Non-Aggressive	Non-Aggressive
BH149	0-0.1	Topsoil: Silty Sandy Clay	<10	93	Non-Aggressive	Non-Aggressive
BH150	0-0.1	Topsoil: Silty Sandy Clay	<10	89	Non-Aggressive	Non-Aggressive
BH151	0-0.1	Topsoil: Silty Sandy Clay	60	240	Non-Aggressive	Non-Aggressive
BH152	0-0.1	Topsoil: Silty Sandy Clay	<10	110	Non-Aggressive	Non-Aggressive
BH153	0-0.1	Topsoil: Silty Sandy Clay	<10	65	Non-Aggressive	Non-Aggressive
BH153	0-0.1	LAB DUPLICATE	<10	67	Non-Aggressive	Non-Aggressive
BH154	0-0.1	Topsoil: Silty Sandy Clay	<10	84	Non-Aggressive	Non-Aggressive
BH155	0.6-0.9	Topsoil: Silty Sandy Clay	<10	10	Non-Aggressive	Non-Aggressive
BH156	0.6-0.8	Topsoil: Silty Sandy Clay	<10	20	Non-Aggressive	Non-Aggressive
BH157	0.3-0.5	Topsoil: Silty Sandy Clay	21	21	Non-Aggressive	Non-Aggressive
BH158	0.5-0.7	Topsoil: Silty Sandy Clay	38	23	Non-Aggressive	Non-Aggressive
BH159	0-0.1	Silty Sandy Clay	<10	40	Non-Aggressive	Non-Aggressive
BH160	0.5-0.7	Topsoil: Silty Sandy Clay	<10	20	Non-Aggressive	Non-Aggressive
BH161	0.6-0.8	Topsoil: Silty Sandy Clay	<10	10	Non-Aggressive	Non-Aggressive
BH162	0.3-0.6	Topsoil: Silty Sandy Clay	10	20	Non-Aggressive	Non-Aggressive
BH163	0-0.1	Silty Sandy Clay	<10	35	Non-Aggressive	Non-Aggressive
BH164	0-0.1	Silty Clay	<10	38	Non-Aggressive	Non-Aggressive
BH165	0-0.1	Silty Clay	<10	50	Non-Aggressive	Non-Aggressive
BH165	0-0.1	LAB DUPLICATE	<10	49	Non-Aggressive	Non-Aggressive
BH166	0-0.1	Silty Clay	<10	49	Non-Aggressive	Non-Aggressive
BH167	0-0.1	Silty Clay	<10	32	Non-Aggressive	Non-Aggressive
BH168	0-0.1	Topsoil: Silty Sandy Clay	<10	50	Non-Aggressive	Non-Aggressive
BH169	0-0.1	Topsoil: Silty Sandy Clay	<10	49	Non-Aggressive	Non-Aggressive
BH170	0.5-0.7	Silty Sandy Clay	68	58	Non-Aggressive	Non-Aggressive
BH171	0.4-0.6	Silty Clay	20	80	Non-Aggressive	Non-Aggressive
BH172	0.6-0.8	Silty Clay	20	50	Non-Aggressive	Non-Aggressive
BH173	0-0.1	Topsoil: Silty Sandy Clay	<10	60	Non-Aggressive	Non-Aggressive
Total Number of Samples			49	49	-	-
Minimum Value			<PQL	10	-	-
Maximum Value			68	240	-	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

Sulfate Values	Classification for Concrete Piles
<5,000	Non-Aggressive
5,000 - 10,000	Mildly Aggressive
10,000 - 20,000	Moderately Aggressive
>20,000	Severely Aggressive

Chloride Values	Classification for Steel Piles
<5,000	Non-Aggressive
5,000 - 20,000	Non-Aggressive
20,000 - 50,000	Mildly Aggressive
>50,000	Moderately Aggressive

TABLE E
SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

Borehole Number	Sample Depth (m)	Sample Description	Exchangeable Ca	Exchangeable K	Exchangeable Mg	Exchangeable Na	CEC	ESP	Ca:Mg
			(meq/100g)					%	
BH105	0-0.1	Silty Sandy Clay	1.5	<0.1	0.7	<0.1	2.3	4.3%	2.14:1
BH105	0-0.1	LAB DUPLICATE	1.5	<0.1	0.7	<0.1	2.3	4.3%	2.14:1
BH130	0.4-0.6	Silty Sandy Clay	4	0.1	3.7	0.2	8.1	2.5%	20.0:1
BH131	0-0.1	Topsoil: Silty Clay	5.3	0.1	1.6	<0.1	7.1	1.4%	3.31:1
BH135	0.3-0.5	Topsoil: Silty Sandy Clay	5.1	0.1	4.9	0.5	11	4.5%	1.04:1
BH154	0-0.1	Topsoil: Silty Sandy Clay	0.6	<0.1	0.2	<0.1	<1	10.0%	3.0:1
BH172	0.6-0.8	Silty Clay	0.9	<0.1	6.7	1.4	9.1	15.4%	0.13:1
Total Number of Samples			7	7	7	7	7	7	7
Minimum Value			0.60	<PQL	0.20	<PQL	<PQL	1.4%	0.13:1
Maximum Value			5.30	0.10	6.70	1.40	9.1	15.4%	20.0:1

ESP Value	Sodicity Rating
< 5%	Non-Sodic
5% to 15%	Sodic
> 15%	Highly Sodic

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TABLE F
SUMMARY OF GROUNDWATER LABORATORY RESULTS

Sample Reference	Field Measurements						Laboratory Results				Classification for Concrete Piles Soil Condition B	Classification for Steel Piles Soil Condition B
	SWL (m)	pH	EC (µS/cm)	Temp (°C)	Eh (mV)	DO (mg/L)	pH	EC (µS/cm)	Sulfate (mg/L)	Chloride (mg/L)		
MW1	5.4	6.1	236	14.5	185.9	4.3	7.3	450	8	61	Non-Aggressive	Non-Aggressive
MW18	5.49	-	-	-	-	-	7.3	270	15	43	Non-Aggressive	Non-Aggressive
MW27	5	6.7	253	15.7	115.1	4.4	7.1	250	5	19	Non-Aggressive	Non-Aggressive
Total Number of Samples	3	3	3	3	3	3	3	3	3	3	-	-
Minimum Value	5	6.1	236	14.5	115.1	4.3	7.1	250	5	19	-	-
Maximum Value	5.49	6.7	253	15.7	185.9	4.4	7.3	450	15	61	-	-

Exposure Classification for Concrete Piles

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts and clays) or all soils above groundwater.

pH	Sulfate (mg/L)	Chloride (mg/L)	Classification B
> 5.5	<1,000	<6,000	Non-Aggressive
4.5 - 5.5	1,000 - 3,000	6,000 - 12,000	Mildly Aggressive
4.0 - 4.5	3,000 - 10,000	12,000 - 30,000	Moderately Aggressive
< 4	>10,000	>30,000	Severely Aggressive

Exposure Classification for Steel Piles

Classification is also based on Soil condition 'B' - low permeability soils (e.g. silts and clays) or all soils above groundwater.

pH	Chloride (mg/L)	Classification B
> 5	<1,000	Non-Aggressive
4.0 - 5.0	1,000 - 10,000	Non-Aggressive
3.0 - 4.0	10,000 - 20,000	Mildly Aggressive
<3	>20,000	Moderately Aggressive

Appendix C: Background on Salinity

Background on Salinity

A. General Information on Salinity

Salinity is the accumulation and concentration of salt at or near the ground surface or within surface water bodies. Salt is naturally present in the landscape through deposition of salt from the ocean in coastal areas and through weathering of bedrock that contains salt, accumulated during deposition of original sediments in a prehistoric marine environment. The salts are commonly soluble chlorides, sulphates or carbonates of sodium and magnesium.

In Sydney, salinity issues are typically associated with the Wianamatta Group shales and their derived soil landscapes. The natural vegetation of western Sydney is dominated by large isolated trees with deep root systems that remove subsurface moisture. Slow rates of percolation through the relatively impermeable clay soil and uptake of a large proportion of rainfall by the trees results in limited recharge of the groundwater system by rainfall. The depth to groundwater has developed a natural equilibrium and there is little tendency for salt contained in the groundwater or subsoils to rise to the surface.

B. Salinity and Urban Development

Salinity becomes a problem in urban areas when changes in the land use result in changes to the way water moves through the environment. This can result in vegetation die-back, decrease in water quality and damage to urban infrastructure.

Removal of deep rooted tree species during development and replacement with urban infrastructure, houses and industrial developments reduces the mechanism for the removal of subsurface moisture.

The development of urban salinity is commonly associated with changes in the hydrological cycle through the environment (rainfall, surface run-off, water infiltration and groundwater system). An increase in the quantity of water reaching the groundwater table as a result of vegetation clearance, irrigation of parklands, leaking water infrastructure and changes in drainage patterns, can cause a relatively rapid rise in the groundwater table. Earthworks that include excavation of natural soil profiles and exposure of more saline subsurface soils or shale bedrock may also result in an increase in salt concentrations at the ground surface.

Construction of roads, pipelines and buildings commonly results in removal of topsoil leading to exposure of the subsoils and interception of surficial and shallow subsurface drainage. In addition, over-irrigation of urban gardens, leaking water infrastructure and concentrated drainage patterns can result in increased water movement through the subsoil to the groundwater system leading to a relatively rapid rise in the groundwater table.

A rise in groundwater levels and impediments to subsurface drainage patterns can transport salt formerly stored in the bedrock to the surficial soil profile. This may result in salt encrustation of exposed soils, building foundations, roads, drainage infrastructure and corrosion of metal, concrete and other building materials. Increasing salt concentrations in surficial soils (and consequently in surface waters) may also result in die-off

of the existing vegetation, further reducing the hydrological load on the groundwater system and resulting in further groundwater table rises.

C. Potential Salinity Impacts on Urban Development

Some of the adverse impacts that can arise from saline conditions include:

- Salt scalds caused by a rise in the subsoil moisture content that mobilises salt to the ground surface;
- Salt scalds caused by modification of former drainage patterns which leads to the day lighting of subsurface seepage (either perched water or groundwater) in areas lower in the catchment, either at breaks in the slope or within drainage lines;
- A rise in groundwater table or accumulation of salt rich seepage leading to corrosion of subsurface facilities including concrete structures, metal pipework, cables, foundations, underground services, etc;
- Rising damp, where salt rich moisture is drawn into building and pavement materials by capillary action leading to deterioration of brick, mortar and concrete;
- Structural cracking, damage or building collapse which may occur as a result of shifting and or sinking foundations;
- Plant die-back associated with a rise in groundwater table level that mobilises excess salt to the plant root zone; and
- Subsurface water discharge and subsequent pollution of streams and drainage channels.

D. Soils and Groundwater Planning Strategy in Western Sydney

The aim of the DLWC 2002 document is to provide a framework for the sustainable development and management of new developments in the western region of Sydney. In relation to salinity management, the development should be designed and constructed such that there is no significant increase in the water table level and no adverse salinity impacts.

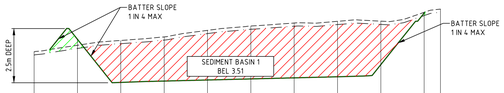
The proposed development controls that relate to soils and groundwater issues are summarised below:

1. A water management strategy should be prepared to address the following:
    - Reduction of potable water usage onsite;
    - Development of best practice measures for stormwater reuse for open space irrigation;
    - Reduction of potable water demand;
    - Reduction of adverse impacts on local groundwater regimes;
    - Reduction of change in local flow regimes; and
    - Preparation of water maintenance and a monitoring management system.
2. A salinity management plan should be prepared that includes a groundwater management strategy related to:
    - Adoption of small landscaped areas to reduce irrigation requirements;
    - Use of native and other low water requirement plants;
    - Use of mulch cover (not in drainage lines);
    - Use of low flow watering facilities for landscaped areas;
    - Implementation of a tree planting program, especially in high recharge areas, of native, deep rooted, large growing species to assist retention of the groundwater at existing levels;

- Retention of existing native tree cover where possible; and
- Not permitting infiltration pits or tanks to disperse surface water.

3. An assessment of soil and rock conditions at the site, including erosion, expansive and dispersive soil conditions, and plant growth potential should be undertaken.
4. Use of the Blue Book (2004) as a guide to prepare soil and water management plans. The approved plan and subsequent works are to be supervised by appropriately qualified experienced personnel.

Appendix D: Proposed Civil Plans

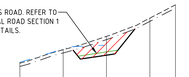


DATUM 1.5

SC01										
DESIGN SURFACE		5.511	3.523	3.595	3.634	3.683	3.733	3.782	4.345	6.723
BULK EARTHWORKS SURFACE		5.511	3.523	3.595	3.634	3.683	3.733	3.782	4.345	6.723
GRANITE SURFACE - XW (EXTREMELY WEATHERED)										
GRANITE SURFACE - DW (DISTINCTLY WEATHERED)										
STRIPPED 150mm SURFACE	4.785	5.988	5.310	5.475	5.774	5.976	6.114	6.192	6.300	6.607	6.755
EXISTING SURFACE	4.935	5.238	5.460	5.625	5.924	6.126	6.264	6.342	6.350	6.757	6.905
CHAINAGES	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	93.753

1 in 500 HORIZONTAL
1 in 100 VERTICAL

SC01 LONGITUDINAL SECTION

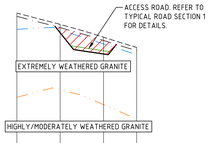


DATUM 9.4

SC02					
DESIGN SURFACE				12.693	
BULK EARTHWORKS SURFACE				11.743	
GRANITE SURFACE - XW (EXTREMELY WEATHERED)	11.693	12.275			
GRANITE SURFACE - DW (DISTINCTLY WEATHERED)					
STRIPPED 150mm SURFACE	11.423	12.043	12.660	13.501	14.175
EXISTING SURFACE	11.573	12.193	12.810	13.651	14.265
CHAINAGES	0.000	10.000	20.000	30.000	35.911

1 in 500 HORIZONTAL
1 in 100 VERTICAL

SC02 LONGITUDINAL SECTION

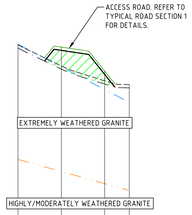


DATUM 14.4

SC03					
DESIGN SURFACE			20.543	19.564	
BULK EARTHWORKS SURFACE			20.393	19.414	
GRANITE SURFACE - XW (EXTREMELY WEATHERED)	20.560		20.527	19.879	19.385
GRANITE SURFACE - DW (DISTINCTLY WEATHERED)	17.433		17.761	17.076	16.414
STRIPPED 150mm SURFACE	21.152		20.630	20.039	19.566
EXISTING SURFACE	21.302		20.780	20.189	19.716
CHAINAGES	0.000		10.000	20.000	27.647

1 in 500 HORIZONTAL
1 in 100 VERTICAL

SC03 LONGITUDINAL SECTION



DATUM 1.5

SC04				
DESIGN SURFACE		10.156	9.467	
BULK EARTHWORKS SURFACE		10.006	8.897	
GRANITE SURFACE - XW (EXTREMELY WEATHERED)	10.283	9.243	8.199	
GRANITE SURFACE - DW (DISTINCTLY WEATHERED)	6.972	6.414	3.856	
STRIPPED 150mm SURFACE	10.193	9.141	8.452	8.275
EXISTING SURFACE	10.263	9.291	8.602	8.425
CHAINAGES	0.000	10.000	20.000	25.663

1 in 500 HORIZONTAL
1 in 100 VERTICAL

SC04 LONGITUDINAL SECTION

LEGEND

FILL FROM STRIPPED SURFACE TO UNDERSIDE OF BULK EARTHWORKS LEVELS

CUT FROM STRIPPED SURFACE TO UNDERSIDE OF BULK EARTHWORKS LEVELS

NOTES

1. EXISTING SURFACE LEVELS ARE INTERPOLATED FROM INFORMATION SUPPLIED BY 'LTS' PTY LTD REFERENCE 51266 001DT ISSUE 1 DATED 23/02/21
2. GRANITE SURFACE LEVELS INTERPOLATED FROM BOREHOLE LOGS SUPPLIED BY 'JKGEOTECHNICS' PTY LTD REF: 33942LTrpt2 DATED: 21ST MAY 2021

Rev	Description	Date	By	App
B	ISSUED FOR REF SUBMISSION	06.12.22	DH	SN
A	ISSUED FOR REF SUBMISSION	30.11.22	DH	SN

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NSW GOVERNMENT Health Infrastructure

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Project Name: SOIL CONSERVATION WORKS
PRINCES HWY, MORUYA NSW 2537

Drawing Title: BULK EARTHWORKS SITE SECTIONS

REF SUBMISSION

Designed	AM	Approved	
Drawn	DH	Date	NOV. 2022
Scale	AS SHOWN	Project Ref	
Date	NOV. 2022	Drawing No	ERH-HI-CV-DWG-DD-01-PW-0521
Sheet	A1	Rev	B

North

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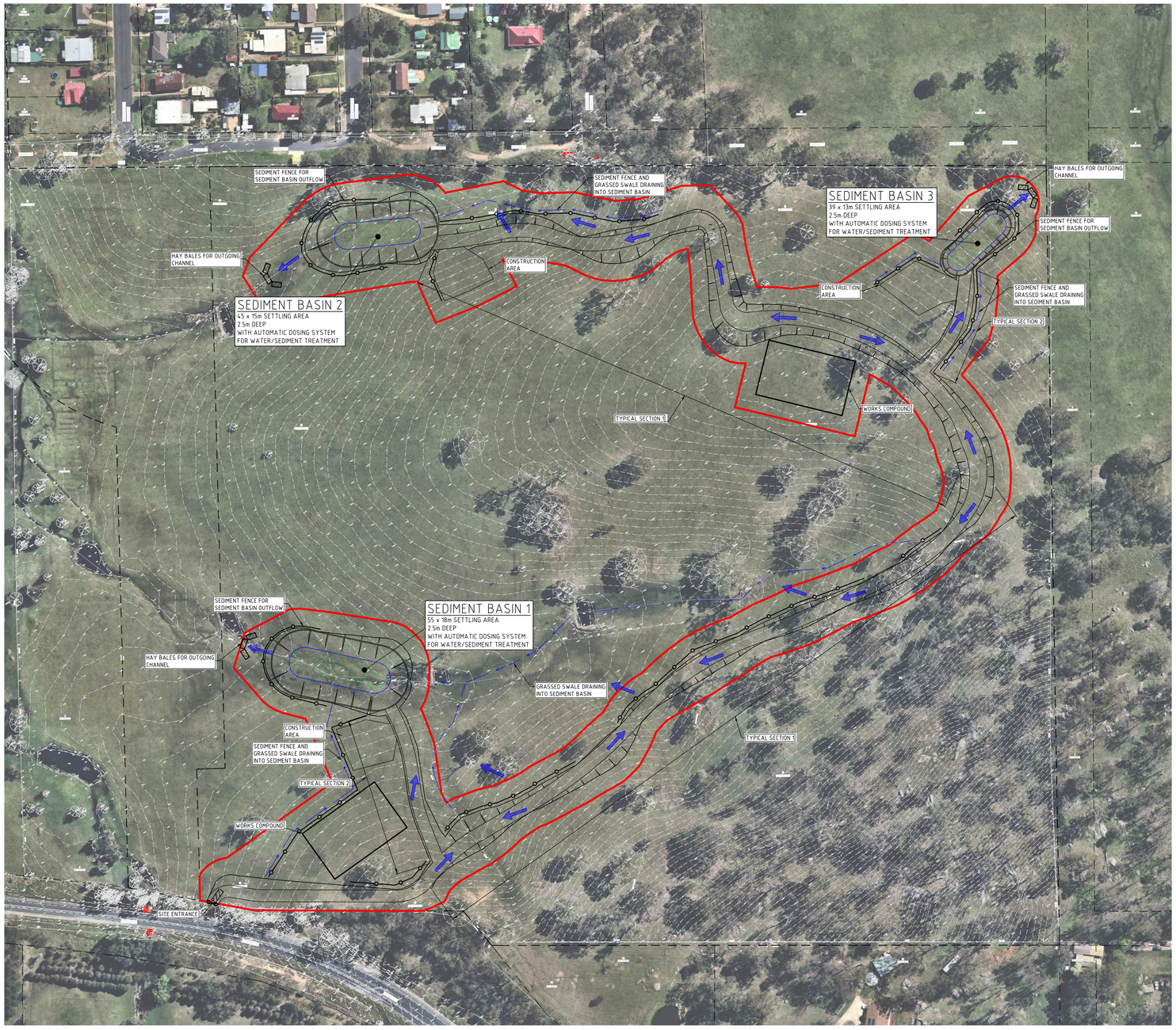
Plotted: 06.12.22 at 2:37 PM By: Dovsky Herrera



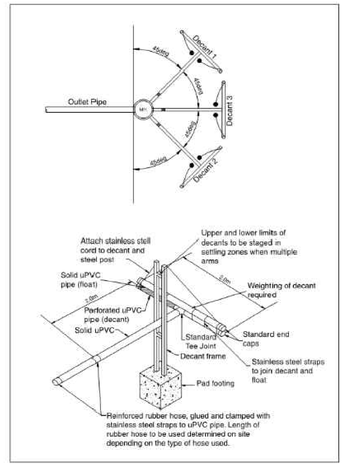


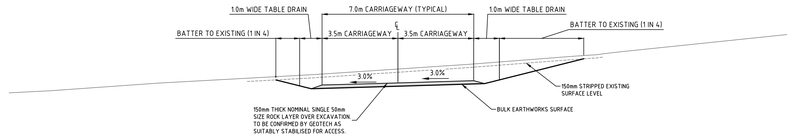
Figure B29 – Auckland-type floating decant system for Type A basins

DECANT SYSTEM TYPICAL DETAIL (EMPTYING FOR HIGH LEVEL)

N.T.S

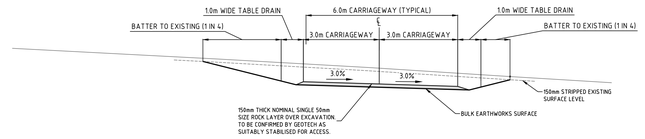
LEGEND

- EXISTING SURFACE CONTOUR
- EARLY WORKS DESIGN CONTOUR
- LOT BOUNDARY
- SEDIMENT BASIN SETTLING AREA
- BATTER
- TEMPORARY SHAKER RAMP FOR ENTRY/EXIT
- OVERLAND FLOW
- HAY BALES
- SEDIMENT FENCE
- SWALE DRAIN
- WORKS EXTENT (TOTAL AREA: 6.5Ha)
- WORKS COMPOUND



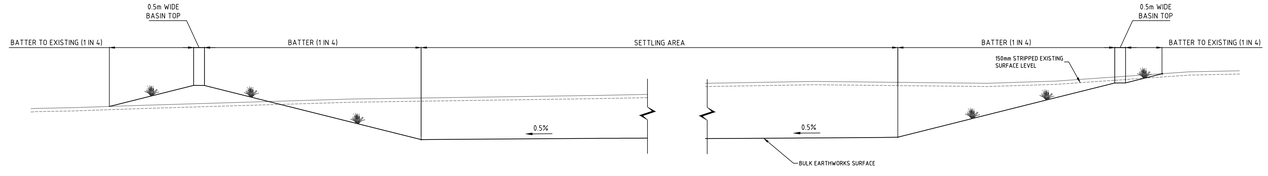
TYPICAL ROAD SECTION 1

N.T.S



TYPICAL ROAD SECTION 2

N.T.S



SEDIMENT BASIN TYPICAL SECTION

N.T.S

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Rev	Description	Date	By	App
B	ISSUED FOR REF SUBMISSION	06.12.22	DH	SN
A	ISSUED FOR REF SUBMISSION	30.11.22	DH	SN

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Project Name: SOIL CONSERVATION WORKS PRINCES HWY, MORUYA NSW 2537

Drawing Title: SITE WORKS PLAN

REF SUBMISSION

Designed	AM	Approved	North
Drawn	DH	SN	Date NOV. 2022
Scale	1:1000		
Date	NOV. 2022	Project Ref	Drawing No Rev
Sheet	A0	ERH-HI-CV-DWG-DD-01-PW-0530	B

Plotted: 06.12.22 at 4:06 PM By: Dunjay Herrera

Appendix E: Borehole Logs

JKGeotechnics

BOREHOLE LOG

Borehole No.
BH1
1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6 DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: 33942LT **Method:** SPIRAL AUGER **R.L. Surface:** ~7.7 m

Date: 13/4/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** W.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION									-	TOPSOIL: Silty sandy clay, low plasticity, brown, trace of root fibres.	w<PL			GRASS COVER
									CI	Silty sandy CLAY: medium plasticity, brown and orange brown, fine to medium grained sand, trace of fine grained quartz gravel and root fibres.	w~PL	St	120 110	RESIDUAL
					N = 43 9,20,23	7	1		-	Extremely Weathered granite: silty clayey SAND, fine to coarse grained, brown and light grey, trace of fine grained quartz gravel.	XW	D		HP ON DISTURBED WMP SAMPLE MORUYA TONALITE
					N=SPT 10/ 50mm REFUSAL	6	2							
						5	3							
					N=SPT 5/ 20mm REFUSAL	4	4							
						3	5							
						2	6			END OF BOREHOLE AT 6.00 m				GROUNDWATER MONITORING WELL INSTALLED TO 5.8m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.8m TO 5.8m. CASING 0.1m TO 2.8m. 2mm SAND BACKFILL 3m TO 5.8m. BENTONITE SEAL 2m TO 3m. BACKFILLED WITH CUTTINGS TO SURFACE COMPLETED WITH A CONCRETED GATIC COVER
						1								

JKGeotechnics

BOREHOLE LOG

Borehole No.
BH18
1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6 DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: 33942LT **Method:** SPIRAL AUGER **R.L. Surface:** ~19.3 m

Date: 14/4/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** W.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION									-	TOPSOIL: Silty sandy clay, low plasticity, brown, fine to coarse grained sands, trace of root fibres.	w~PL			GRASS COVER
						19			CL		w<PL			RESIDUAL
					N=SPT 20/ 100mm REFUSAL				-	Silty sandy CLAY: low plasticity, brown and grey, fine to coarse grained sand, trace of fine grained quartz gravel and root fibres.	XW	D		MORUYA TONALITE VERY LOW 'TC' BIT RESISTANCE
							1			Extremely Weathered GRANITE: Clayey gravelly SAND, fine to coarse grained, fine grained quartz gravel, light grey, brown and orange brown.				
						18								
					N > 15 12,15/ 150mm REFUSAL		2							
						17								
					N=SPT 5/ 20mm REFUSAL		3							
						16								GROUNDWATER MONITORING WELL INSTALLED TO 5.8m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.8m TO 5.8m. CASING 0.1m TO 2.8m. 2mm SAND BACKFILL 3m TO 5.8m. BENTONITE SEAL 2m TO 3m. BACKFILLED WITH CUTTINGS TO SURFACE COMPLETED WITH A CONCRETED GATIC COVER
							4							
					N=SPT 6/ 20mm REFUSAL	15								
							5							VERY LOW RESISTANCE WITH LOW BANDS (POSSIBLY LESS WEATHERED CORE STONES)
						14								
							6			GRANITE: medium to coarse grained quartz gravel and sand, orange brown, white grey and dark grey.	DW	M		MODERATE RESISTANCE
						13				END OF BOREHOLE AT 6.00 m				

JKGeotechnics

BOREHOLE LOG

Borehole No.
BH27
1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6 DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: 33942LT **Method:** SPIRAL AUGER **R.L. Surface:** ~17.3 m

Date: 15/4/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** W.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										TOPSOIL: Silty sandy clay, low plasticity, brown, fine to coarse grained sand, trace of root fibres.	w~PL			GRASS COVER
						17			CI		w>PL			RESIDUAL
					N > 20 12,20/ 150mm REFUSAL				-	Silty sandy CLAY: medium plasticity, brown and grey, fine to coarse grained sand, with fine grained quartz gravel, trace of root fibres.	XW	D		MORUYA TONALITE
							1			Extremely Weathered granite: clayey SAND, fine to coarse grained, light grey, brown and orange brown, trace of fine grained quartz gravel.				VERY LOW 'TC' BIT RESISTANCE
					N = 44 13,21,23	16								
							2							
						15								
					N=SPT 11/ 100mm REFUSAL		3							
						14								
							4							
					N=SPT 5/ 50mm REFUSAL	13								
							5			GRANITE: medium to coarse grained, grey and red brown.	DW	L - M		LOW RESISTANCE WITH MODERATE BANDS
						12								
							6							GROUNDWATER MONITORING WELL INSTALLED TO 5.8m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.8m TO 5.8m. CASING 0.1m TO 2.8m. 2mm SAND BACKFILL 3m TO 5.8m. BENTONITE SEAL 2m TO 3m. BACKFILLED WITH CUTTINGS TO SURFACE COMPLETED WITH A CONCRETED GATIC COVER
										END OF BOREHOLE AT 6.00 m				
						11								

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 101 **1/1**

SDUP101: 0-0.1m

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 9.1kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w<PL			SCREEN: 10.2kg 0.1-0.35m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.65m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 102 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 10.2kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w<PL			SCREEN: 10.6kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 103 1/1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 8.2kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w>PL			SCREEN: 11.0kg 0.1-0.4m NO FCF RESIDUAL
▼										END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 104 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 8.8kg 0-0.1m NO FCF
									CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w<PL			SCREEN: 11.1kg 0.1-0.3m NO FCF
							0.5			END OF BOREHOLE AT 0.55m				RESIDUAL HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 105 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■	■	■		0			TOPSOIL:Silty sandy clay, low to medium plasticity,brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 10.2kg 0-0.1m NO FCF
	■			■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w<PL			SCREEN: 11.4kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 128 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 11.4kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			SCREEN: 11.8kg 0.1-0.3m NO FCF RESIDUAL
▼										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 129 **1/1**

SDUP109: 0-0.1m

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 8.6kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			SCREEN: 12.2kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 130 **1/1**

SDUP108: 0-0.1m

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■	■	■		0			TOPSOIL: Silty clay, low to medium plasticity, brown, trace of sand, and root fibres.	w≈PL			GRASS COVER SCREEN: 9.5kg 0-0.1m NO FCF
	■		■	■	■		0.5		CI-CH	Silty CLAY: medium to high plasticity, brown mottled orange brown, trace of sand.	w≈PL			SCREEN: 10.2kg 0.1-0.4m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 131 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■	■	■		0			TOPSOIL: Silty sandy clay,m low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
										END OF BOREHOLE AT 0.2m				SCREEN: 6.2kg 0-0.1m NO FCF
							0.5							SCREEN: 8.5kg 0.1-0.2m NO FCF
														HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 132 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■	■	■		0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER SCREEN: 9.4kg 0-0.1m NO FCF
	■			■					CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w<PL			SCREEN: 11.3kg 0.1-0.3m NO FCF RESIDUAL
							0.5			END OF BOREHOLE AT 0.5m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 133 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■	■	■		0			FILL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of brick fragments, ash and root fibres.	w<PL			GRASS COVER
	■		■		■				CI-CH	Silty sandy CLAY: medium tom high plasticity, orange brown mottled brown, fine to coarse grained sand.	w<PL			SCREEN: 8.4kg 0-0.1m NO FCF
	■						0.5			END OF BOREHOLE AT 0.5m				SCREEN: 9.7kg 0.1-0.2m NO FCF
														RESIDUAL
														HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 134 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 10.3kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium tom high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			SCREEN: 9.9kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 135 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
▼							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 10.3kg 0-0.1m NO FCF
							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			SCREEN: 11.3kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 136 **1/1**

SDUP107: 0-0.1m

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, brown, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER SCREEN: 9.6kg 0-0.1m NO FCF
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			SCREEN: 10.9kg 0.1-0.3m NO FCF RESIDUAL
										END OF BOREHOLE AT 0.8m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 137 **1/1**

SDUP106: 0-0.1m

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty clayey sand, fine to coarse grained, brown, trace of ash and root fibres.	M			GRASS COVER SCREEN: 9.7kg 0-0.1m NO FCF
▶							0.5		SC	Silty clayey SAND: fine to coarse grained, light brown.	M			SCREEN: 10.6kg 0.1-0.4m NO FCF ALLUVIAL
▼											W			
							1			END OF BOREHOLE AT 1.0m				
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 143 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand, trace of quartz gravel.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 144 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0		CL-CI	Silty sandy CLAY: low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER RESIDUAL
				■			0.5			as above, but without roots.				
										END OF BOREHOLE AT 0.8m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 145 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled brown, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 146 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 147 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 148 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 11/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, grey, fine to coarse grained sand.	w>PL			RESIDUAL
▼							1			END OF BOREHOLE AT 1.0m				
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 149 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled orange brown, fine to coarse grained sand.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.7m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 150 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
▶							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled brown, fine to coarse grained sand.	w>PL			RESIDUAL
▼				■			1			END OF BOREHOLE AT 1.0m				
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 151 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
▼				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w>PL			GRASS COVER
▶				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled red brown, fine to coarse grained sand.	w>PL			RESIDUAL
										END OF BOREHOLE AT 0.7m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 152 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, light grey, fine to coarse grained sand, trace of quartz gravel.	w≈PL			RESIDUAL
				■			1			END OF BOREHOLE AT 1.1m				
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 153 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER - SALINITY **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
▶							0.5		CI-CH	Silty sandy CLAY: medium tom high plasticity, light grey mottled brown, fine to coarse grained sand.	w≈PL			RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 154 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibers.	w≈PL			GRASS COVER
▶				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, light grey mottled brown, fine to coarse grained sand.	w≈PL			RESIDUAL
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 155 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 14/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** A.M./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to medium grained sand, trace of root fibres.	w≈PL			GRASS COVER
▶							0.5		CI-CH	Silty CLAY: medium to high plasticity, light grey mottled orange brown, fine to coarse grained sand.	w≈PL			RESIDUAL
				■						END OF BOREHOLE AT 0.9m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 156 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 157 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
				■					CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown, fine to coarse grained sand.	w<PL			RESIDUAL
							0.5			END OF BOREHOLE AT 0.5m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 158 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■						END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 159 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, brown mottled grey.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.6m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 160 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey,m fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.7m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 161 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of ironstone gravel.	w≈PL			GRASS COVER
▶									CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled grey, fine to coarse grained sand.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 162 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of sandstone gravel.	w<PL			GRASS COVER
				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 163 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
▶				■					CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand, trace of ash.	w≈PL			RESIDUAL
							0.5							
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 164 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
										END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 165 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand, trace of root fibres.	w<PL			RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 166 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled orange brown, fine to coarse grained sand.	w<PL			RESIDUAL
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 167 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.7m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 168 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 169 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 11/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
							0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, brown mottled orange brown, fine to coarse grained sand.	w<PL			RESIDUAL
				■						END OF BOREHOLE AT 0.9m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 170 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 13/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.7m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 171 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
▼				■			0.5		CI-CH	Silty sandy CLAY: medium to high plasticity, grey mottled orange brown, fine to coarse grained sand.	w>PL			RESIDUAL
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 172 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, fine to coarse grained sand, trace of root fibres.	w<PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown mottled grey, fine to coarse grained sand.	w<PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 173 **1/1**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED EUROBODALLA HEALTH SERVICE

Location: LOT 6, DP1212271, PRINCES HIGHWAY, MORUYA, NSW

Job No.: E33942PL **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 11/7/22 **Datum:** -

Plant Type: - **Logged/Checked by:** E.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION				■			0			TOPSOIL: Silty sandy clay, low to medium plasticity, grey, fine to coarse grained sand, trace of root fibres.	w≈PL			GRASS COVER
									CI-CH	Silty sandy CLAY: medium to high plasticity, orange brown, fine to coarse grained sand.	w≈PL			RESIDUAL
				■			0.5							
										END OF BOREHOLE AT 0.8m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the

structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

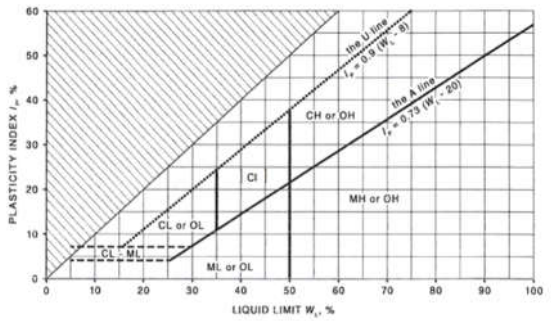
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
	PFAS	Soil sample taken over depth indicated, for analysis of Per- and Polyfluoroalkyl Substances.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL $w \approx$ PL w < PL $w \approx$ LL w > LL	Moisture content estimated to be greater than plastic limit. Moisture content estimated to be approximately equal to plastic limit. Moisture content estimated to be less than plastic limit. Moisture content estimated to be near liquid limit. Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D M W	DRY – runs freely through fingers. MOIST – does not run freely but no free water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S F St VSt Hd Fr ( )	VERY SOFT – unconfined compressive strength ≤ 25kPa. SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa. FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa. STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa. VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa. HARD – unconfined compressive strength > 400kPa. FRIABLE – strength not attainable, soil crumbles. Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)	VL L MD D VD ( )	**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)** VERY LOOSE ≤ 15 / 0 – 4 LOOSE > 15 and ≤ 35 / 4 – 10 MEDIUM DENSE > 35 and ≤ 65 / 10 – 30 DENSE > 65 and ≤ 85 / 30 – 50 VERY DENSE > 85 / > 50 Bracketed symbol indicates estimated density based on ease of drilling or other assessment.

Log Column	Symbol	Definition
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

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, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	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 deposition of weathering products in pores.
Moderately Weathered		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 not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints 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.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. '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'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has 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 Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	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 Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Appendix F: Laboratory Reports & COC Documents

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CERTIFICATE OF ANALYSIS 300717

Client Details

Client	JK Environments
Attention	Harry Leonard
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E33942PL, Moruya**
Number of Samples	87 Soil
Date samples received	18/07/2022
Date completed instructions received	20/07/2022

Analysis Details

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

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

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

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	27/07/2022
Date of Issue	27/07/2022

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Results Approved By
Hannah Nguyen, Metals Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		300717-2	300717-3	300717-5	300717-7	300717-8
Your Reference	UNITS	BH101	BH105	BH120	BH128	BH129
Depth		0.35-0.5	0-0.1	0.3-0.5	0.3-0.5	0-0.1
Date Sampled		12/07/2022	12/07/2022	13/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.9	5.7	5.5	5.0	5.3
Chloride, Cl 1:5 soil:water	mg/kg	10	<10	67	20	<10
Sulphate, SO4 1:5 soil:water	mg/kg	24	64	29	27	51
Resistivity in soil*	ohm m	130	89	93	170	120

Misc Inorg - Soil						
Our Reference		300717-11	300717-12	300717-14	300717-16	300717-18
Your Reference	UNITS	BH130	BH131	BH132	BH133	BH134
Depth		0.4-0.6	0-0.1	0.3-0.5	0.2-0.4	0.3-0.5
Date Sampled		14/07/2022	14/07/2022	14/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.7	6.1	5.5	6.1	6.4
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	10	<10	10
Sulphate, SO4 1:5 soil:water	mg/kg	33	70	48	24	20
Resistivity in soil*	ohm m	83	64	120	160	130

Misc Inorg - Soil						
Our Reference		300717-20	300717-21	300717-24	300717-25	300717-28
Your Reference	UNITS	BH135	BH136	BH137	BH143	BH144
Depth		0.3-0.5	0-0.1	0.4-0.6	0-0.1	0.6-0.8
Date Sampled		14/07/2022	13/07/2022	13/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.3	4.8	5.4	5.0	5.4
Chloride, Cl 1:5 soil:water	mg/kg	20	<10	<10	<10	10
Sulphate, SO4 1:5 soil:water	mg/kg	47	85	20	71	110
Resistivity in soil*	ohm m	94	94	250	110	54

Misc Inorg - Soil						
Our Reference		300717-30	300717-32	300717-33	300717-35	300717-37
Your Reference	UNITS	BH145	BH146	BH147	BH148	BH149
Depth		0.6-0.8	0.4-0.6	0-0.1	0-0.1	0-0.1
Date Sampled		14/07/2022	14/07/2022	14/07/2022	17/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.6	5.5	4.8	4.8	5.1
Chloride, Cl 1:5 soil:water	mg/kg	<10	40	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	53	72	80	80	93
Resistivity in soil*	ohm m	63	43	88	100	63

Misc Inorg - Soil						
Our Reference		300717-39	300717-41	300717-43	300717-45	300717-47
Your Reference	UNITS	BH150	BH151	BH152	BH153	BH154
Depth		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Date Sampled		14/07/2022	14/07/2022	13/07/2022	13/07/2022	13/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.2	5.0	5.1	4.6	4.6
Chloride, Cl 1:5 soil:water	mg/kg	<10	60	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	89	240	110	65	84
Resistivity in soil*	ohm m	78	28	62	120	100

Misc Inorg - Soil						
Our Reference		300717-50	300717-52	300717-54	300717-56	300717-57
Your Reference	UNITS	BH155	BH156	BH157	BH158	BH159
Depth		0.6-0.9	0.6-0.8	0.3-0.5	0.5-0.7	0-0.1
Date Sampled		14/07/2022	13/07/2022	13/07/2022	13/07/2022	13/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	6.5	6.1	4.6	5.1	5.1
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	21	38	<10
Sulphate, SO4 1:5 soil:water	mg/kg	10	20	21	23	40
Resistivity in soil*	ohm m	240	220	120	170	140

Misc Inorg - Soil						
Our Reference		300717-60	300717-62	300717-64	300717-65	300717-67
Your Reference	UNITS	BH160	BH161	BH162	BH163	BH164
Depth		0.5-0.7	0.6-0.8	0.3-0.6	0-0.1	0-0.1
Date Sampled		12/07/2022	12/07/2022	12/07/2022	13/07/2022	12/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.4	4.6	4.6	5.4	5.5
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	20	10	20	35	38
Resistivity in soil*	ohm m	180	240	200	150	130

Misc Inorg - Soil						
Our Reference		300717-69	300717-71	300717-73	300717-75	300717-77
Your Reference	UNITS	BH165	BH166	BH167	BH168	BH169
Depth		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Date Sampled		12/07/2022	12/07/2022	12/07/2022	12/07/2022	11/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	5.4	5.3	5.4	5.3	5.0
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	50	49	32	50	49
Resistivity in soil*	ohm m	120	110	160	120	130

Misc Inorg - Soil					
Our Reference		300717-80	300717-82	300717-84	300717-85
Your Reference	UNITS	BH170	BH171	BH172	BH173
Depth		0.5-0.7	0.4-0.6	0.6-0.8	0-0.1
Date Sampled		13/07/2022	12/07/2022	12/07/2022	12/07/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022
Date analysed	-	26/07/2022	26/07/2022	26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units	4.5	4.5	4.3	5.2
Chloride, Cl 1:5 soil:water	mg/kg	68	20	20	<10
Sulphate, SO4 1:5 soil:water	mg/kg	58	80	50	60
Resistivity in soil*	ohm m	92	120	94	110

Texture and Salinity*						
Our Reference		300717-2	300717-3	300717-5	300717-7	300717-8
Your Reference	UNITS	BH101	BH105	BH120	BH128	BH129
Depth		0.35-0.5	0-0.1	0.3-0.5	0.3-0.5	0-0.1
Date Sampled		12/07/2022	12/07/2022	13/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	76	110	110	58	82
Texture Value	-	8.5	9.0	8.0	8.0	9.0
Texture	-	LIGHT CLAY	CLAY LOAM	LIGHT MEDIUM CLAY	LIGHT MEDIUM CLAY	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-11	300717-12	300717-14	300717-16	300717-18
Your Reference	UNITS	BH130	BH131	BH132	BH133	BH134
Depth		0.4-0.6	0-0.1	0.3-0.5	0.2-0.4	0.3-0.5
Date Sampled		14/07/2022	14/07/2022	14/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	120	160	85	63	80
Texture Value	-	9.0	9.0	7.0	9.0	8.0
Texture	-	CLAY LOAM	CLAY LOAM	MEDIUM CLAY	CLAY LOAM	LIGHT MEDIUM CLAY
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-20	300717-21	300717-24	300717-25	300717-28
Your Reference	UNITS	BH135	BH136	BH137	BH143	BH144
Depth		0.3-0.5	0-0.1	0.4-0.6	0-0.1	0.6-0.8
Date Sampled		14/07/2022	13/07/2022	13/07/2022	14/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	110	110	40	94	180
Texture Value	-	7.0	9.0	14	9.0	9.0
Texture	-	MEDIUM CLAY	CLAY LOAM	SANDY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-30	300717-32	300717-33	300717-35	300717-37
Your Reference	UNITS	BH145	BH146	BH147	BH148	BH149
Depth		0.6-0.8	0.4-0.6	0-0.1	0-0.1	0-0.1
Date Sampled		14/07/2022	14/07/2022	14/07/2022	17/07/2022	14/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	160	230	110	98	160
Texture Value	-	8.0	7.0	9.0	9.0	9.0
Texture	-	LIGHT MEDIUM CLAY	MEDIUM CLAY	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-39	300717-41	300717-43	300717-45	300717-47
Your Reference	UNITS	BH150	BH151	BH152	BH153	BH154
Depth		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Date Sampled		14/07/2022	14/07/2022	13/07/2022	13/07/2022	13/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	130	360	160	84	96
Texture Value	-	9.0	8.0	9.0	9.0	9.0
Texture	-	CLAY LOAM	LIGHT MEDIUM CLAY	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	2.9	<2	<2	<2
Class	-	NON SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-50	300717-52	300717-54	300717-56	300717-57
Your Reference	UNITS	BH155	BH156	BH157	BH158	BH159
Depth		0.6-0.9	0.6-0.8	0.3-0.5	0.5-0.7	0-0.1
Date Sampled		14/07/2022	13/07/2022	13/07/2022	13/07/2022	13/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	42	45	85	60	70
Texture Value	-	8.0	8.0	7.0	7.0	9.0
Texture	-	LIGHT MEDIUM CLAY	LIGHT MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-60	300717-62	300717-64	300717-65	300717-67
Your Reference	UNITS	BH160	BH161	BH162	BH163	BH164
Depth		0.5-0.7	0.6-0.8	0.3-0.6	0-0.1	0-0.1
Date Sampled		12/07/2022	12/07/2022	12/07/2022	13/07/2022	12/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	55	42	51	67	78
Texture Value	-	9.0	14	7.0	9.0	9.0
Texture	-	CLAY LOAM	SANDY LOAM	MEDIUM CLAY	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		300717-69	300717-71	300717-73	300717-75	300717-77
Your Reference	UNITS	BH165	BH166	BH167	BH168	BH169
Depth		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Date Sampled		12/07/2022	12/07/2022	12/07/2022	12/07/2022	11/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	83	95	62	83	77
Texture Value	-	9.0	9.0	9.0	9.0	9.0
Texture	-	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*					
Our Reference		300717-80	300717-82	300717-84	300717-85
Your Reference	UNITS	BH170	BH171	BH172	BH173
Depth		0.5-0.7	0.4-0.6	0.6-0.8	0-0.1
Date Sampled		13/07/2022	12/07/2022	12/07/2022	12/07/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Date analysed	-	22/07/2022	22/07/2022	22/07/2022	22/07/2022
Electrical Conductivity 1:5 soil:water	µS/cm	110	81	110	94
Texture Value	-	7.0	8.0	8.0	9.0
Texture	-	MEDIUM CLAY	LIGHT MEDIUM CLAY	LIGHT MEDIUM CLAY	CLAY LOAM
ECe	dS/m	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE

CEC						
Our Reference		300717-3	300717-11	300717-12	300717-20	300717-47
Your Reference	UNITS	BH105	BH130	BH131	BH135	BH154
Depth		0-0.1	0.4-0.6	0-0.1	0.3-0.5	0-0.1
Date Sampled		12/07/2022	14/07/2022	14/07/2022	14/07/2022	13/07/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/07/2022	27/07/2022	27/07/2022	27/07/2022	27/07/2022
Date analysed	-	27/07/2022	27/07/2022	27/07/2022	27/07/2022	27/07/2022
Exchangeable Ca	meq/100g	1.5	4.0	5.3	5.1	0.6
Exchangeable K	meq/100g	<0.1	0.1	0.1	0.1	<0.1
Exchangeable Mg	meq/100g	0.7	3.7	1.6	4.9	0.2
Exchangeable Na	meq/100g	<0.1	0.2	<0.1	0.5	<0.1
Cation Exchange Capacity	meq/100g	2.3	8.1	7.1	11	<1

CEC		
Our Reference		300717-84
Your Reference	UNITS	BH172
Depth		0.6-0.8
Date Sampled		12/07/2022
Type of sample		Soil
Date prepared	-	27/07/2022
Date analysed	-	27/07/2022
Exchangeable Ca	meq/100g	0.9
Exchangeable K	meq/100g	<0.1
Exchangeable Mg	meq/100g	6.7
Exchangeable Na	meq/100g	1.4
Cation Exchange Capacity	meq/100g	9.1

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-123	Determined using a "Texture by Feel" method.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-OES analytical finish.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	300717-5
Date prepared	-			26/07/2022	2	26/07/2022	26/07/2022		26/07/2022	26/07/2022
Date analysed	-			26/07/2022	2	26/07/2022	26/07/2022		26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	2	5.9	5.7	3	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	10	10	0	102	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	24	21	13	92	84
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	2	130	130	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	300717-33
Date prepared	-			[NT]	16	26/07/2022	26/07/2022		26/07/2022	26/07/2022
Date analysed	-			[NT]	16	26/07/2022	26/07/2022		26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	16	6.1	6.1	0	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	16	<10	<10	0	99	81
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	16	24	22	9	90	#
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	16	160	180	12	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	300717-52
Date prepared	-			[NT]	18	26/07/2022	26/07/2022		26/07/2022	26/07/2022
Date analysed	-			[NT]	18	26/07/2022	26/07/2022		26/07/2022	26/07/2022
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	18	6.4	6.4	0	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	18	10	10	0	97	77
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	18	20	20	0	90	79
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	18	130	120	8	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	45	26/07/2022	26/07/2022		[NT]	[NT]
Date analysed	-			[NT]	45	26/07/2022	26/07/2022		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	45	4.6	4.6	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	45	<10	<10	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	45	65	67	3	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	45	120	120	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	69	26/07/2022	26/07/2022		[NT]	[NT]
Date analysed	-			[NT]	69	26/07/2022	26/07/2022		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	69	5.4	5.4	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	69	<10	<10	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	69	50	49	2	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	69	120	110	9	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			22/07/2022	2	22/07/2022	22/07/2022		22/07/2022	[NT]
Date analysed	-			22/07/2022	2	22/07/2022	22/07/2022		22/07/2022	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	2	76	77	1	97	[NT]
Texture Value	-		INORG-123	[NT]	2	8.5	8.5	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	16	22/07/2022	22/07/2022		22/07/2022	[NT]
Date analysed	-			[NT]	16	22/07/2022	22/07/2022		22/07/2022	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	16	63	56	12	96	[NT]
Texture Value	-		INORG-123	[NT]	16	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			[NT]	18	22/07/2022	22/07/2022		22/07/2022	[NT]
Date analysed	-			[NT]	18	22/07/2022	22/07/2022		22/07/2022	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	18	80	84	5	96	[NT]
Texture Value	-		INORG-123	[NT]	18	8.0	8.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	45	22/07/2022	22/07/2022		[NT]	[NT]
Date analysed	-			[NT]	45	22/07/2022	22/07/2022		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	45	84	83	1	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	45	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	69	22/07/2022	22/07/2022		[NT]	[NT]
Date analysed	-			[NT]	69	22/07/2022	22/07/2022		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	69	83	88	6	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	69	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	300717-11
Date prepared	-			27/07/2022	3	27/07/2022	27/07/2022		27/07/2022	27/07/2022
Date analysed	-			27/07/2022	3	27/07/2022	27/07/2022		27/07/2022	27/07/2022
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	3	1.5	1.5	0	92	123
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	3	<0.1	<0.1	0	98	110
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	3	0.7	0.7	0	95	121
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	3	<0.1	<0.1	0	112	119

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

MISC_INORG_DRY:# Percent recovery is not applicable due to the high concentration of the analyte/s in the sample/s. However an acceptable recovery was obtained for the LCS.

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

SAMPLE RECEIPT ADVICE

Client Details

Client	JK Environments
Attention	Harry Leonard

Sample Login Details

Your reference	E33942PL, Moruya
Envirolab Reference	300717
Date Sample Received	18/07/2022
Date Instructions Received	20/07/2022
Date Results Expected to be Reported	27/07/2022

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	87 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	13
Cooling Method	Ice
Sampling Date Provided	YES

Comments

BH105 0.3-0.5 extra

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
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Sample ID	Misc Inorg - Soil	Texture and Salinity*	CEC	On Hold
BH101-0-0.1				✓
BH101-0.35-0.5	✓	✓		
BH105-0-0.1	✓	✓	✓	
BH120-0-0.1				✓
BH120-0.3-0.5	✓	✓		
BH128-0-0.1				✓
BH128-0.3-0.5	✓	✓		
BH129-0-0.1	✓	✓		
BH129-0.3-0.5				✓
BH130-0-0.1				✓
BH130-0.4-0.6	✓	✓	✓	
BH131-0-0.1	✓	✓	✓	
BH132-0-0.1				✓
BH132-0.3-0.5	✓	✓		
BH133-0-0.1				✓
BH133-0.2-0.4	✓	✓		
BH134-0-0.1				✓
BH134-0.3-0.5	✓	✓		
BH135-0-0.1				✓
BH135-0.3-0.5	✓	✓	✓	
BH136-0-0.1	✓	✓		
BH136-0.3-0.5				✓
BH137-0-0.1				✓
BH137-0.4-0.6	✓	✓		
BH143-0-0.1	✓	✓		
BH143-0.6-0.8				✓
BH144-0-0.1				✓
BH144-0.6-0.8	✓	✓		
BH145-0-0.1				✓
BH145-0.6-0.8	✓	✓		
BH146-0-0.1				✓
BH146-0.4-0.6	✓	✓		

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Sample ID	Misc Inorg - Soil	Texture and Salinity*	CEC	On Hold
BH147-0-0.1	✓	✓		
BH147-0.4-0.6				✓
BH148-0-0.1	✓	✓		
BH148-0.7-1.0				✓
BH149-0-0.1	✓	✓		
BH149-0.5-0.7				✓
BH150-0-0.1	✓	✓		
BH150-0.8-1.0				✓
BH151-0-0.1	✓	✓		
BH151-0.4-0.7				✓
BH152-0-0.1	✓	✓		
BH152-0.8-1.1				✓
BH153-0-0.1	✓	✓		
BH153-0.6-0.8				✓
BH154-0-0.1	✓	✓	✓	
BH154-0.4-0.6				✓
BH155-0-0.1				✓
BH155-0.6-0.9	✓	✓		
BH156-0-0.1				✓
BH156-0.6-0.8	✓	✓		
BH157-0-0.1				✓
BH157-0.3-0.5	✓	✓		
BH158-0-0.1				✓
BH158-0.5-0.7	✓	✓		
BH159-0-0.1	✓	✓		
BH159-0.4-0.6				✓
BH160-0-0.1				✓
BH160-0.5-0.7	✓	✓		
BH161-0-0.1				✓
BH161-0.6-0.8	✓	✓		
BH162-0-0.1				✓
BH162-0.3-0.6	✓	✓		

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Sample ID	Misc Inorg - Soil	Texture and Salinity*	CEC	On Hold
BH163-0-0.1	✓	✓		
BH163-0.3-0.6				✓
BH164-0-0.1	✓	✓		
BH164-0.5-0.7				✓
BH165-0-0.1	✓	✓		
BH165-0.4-0.7				✓
BH166-0-0.1	✓	✓		
BH166-0.4-0.6				✓
BH167-0-0.1	✓	✓		
BH167-0.5-0.7				✓
BH168-0-0.1	✓	✓		
BH168 -0.1-0.				✓
BH169-0-0.1	✓	✓		
BH169-0.7-0.9				✓
BH170-0-0.1				✓
BH170-0.5-0.7	✓	✓		
BH171-0-0.1				✓
BH171-0.4-0.6	✓	✓		
BH172-0-0.1				✓
BH172-0.6-0.8	✓	✓	✓	
BH173-0-0.1	✓	✓		
BH173-0.4-0.6				✓
BH105-0.3-0.5				✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.

TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

300717
coc recd 2017.

SAMPLE AND CHAIN OF CUSTODY FORM

TO: ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 1 of 4	**FROM:** JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya	Sample Preserved In Esky on Ice
Sampler:	AM/EW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
12/07/2022	1	BH101	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	2	BH101	0.35-0.5	G	Silty Sandy Clay	x	x	x	x	x	x						
12/07/2022	3	BH105	0-0.1	G	F: Silty Sandy Clay	x	x	x	x	x	x	x					
13/07/2022	4	BH120	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	5	BH120	0.3-0.5	G	Silty Sandy Clay	x	x	x	x	x	x						
14/07/2022	6	BH128	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	7	BH128	0.3-0.5	G	Silty Sandy Clay	x	x	x	x	x	x						
14/072022	8	BH129	0-0.1	G	F: Silty Sandy Clay	x	x	x	x	x	x						
14/072022	9	BH129	0.3-0.5	G	Silty Sandy Clay												
14/072022	10	BH130	0-0.1	G	F: Silty Clay												
14/072022	11	BH130	0.4-0.6	G	Silty Clay	x	x	x	x	x	x	x					
14/072022	12	BH131	0-0.1	G	F: Silty Sandy Clay	x	x	x	x	x	x	x					
14/072022	13	BH132	0-0.1	G	F: Silty Sandy Clay												
14/072022	14	BH132	0.3-0.5	G	Silty Sandy Clay	x	x	x	x	x	x						
14/072022	15	BH133	0-0.1	G	F: Silty Sandy Clay												
14/072022	16	BH133	0.2-0.4	G	Silty Sandy Clay	x	x	x	x	x	x						
14/072022	17	BH134	0-0.1	G	F: Silty Sandy Clay												
14/072022	18	BH134	0.3-0.5	G	Silty Sandy Clay	x	x	x	x	x	x						
14/072022	19	BH135	0-0.1	G	F: Silty Sandy Clay												
14/072022	20	BH135	0.3-0.5	G	Silty Sandy Clay	x	x	x	x	x	x	x					
13/07/2022	21	BH136	0-0.1	G	F: Silty Sandy Clay	x	x	x	x	x	x						
13/07/2022	22	BH136	0.3-0.5	G	Silty Sandy Clay												
13/07/2022	23	BH137	0-0.1	G	F: Silty Clayey Sand												
13/07/2022	24	BH137	0.4-0.6	G	Silty Clayey Sand	x	x	x	x	x	x						
14/07/2022	25	BH143	0-0.1	G	F: Silty Clay	x	x	x	x	x	x						

Remarks (comments/detection limits required):	**Sample Containers:** G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 2 of 4	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya	Sample Preserved in Esky on Ice
Sampler:	AM/EW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
14/07/2022	26	BH143	0.6-0.8	G	Silty Sandy clay												
14/07/2022	27	BH144	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	28	BH144	0.6-0.8	G	F: Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	29	BH145	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	30	BH145	0.6-0.8	G	Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	31	BH146	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	32	BH146	0.4-0.6	G	Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	33	BH147	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	34	BH147	0.4-0.6	G	Silty Sandy Clay												
17/07/2022	35	BH148	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
17/07/2022	24	BH148	0.7-1.0	G	Silty Sandy Clay												
14/07/2022	37	BH149	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	38	BH149	0.5-0.7	G	Silty Sandy Clay												
14/07/2022	39	BH150	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	40	BH150	0.8-1.0	G	Silty Clay												
14/07/2022	41	BH151	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
14/07/2022	42	BH151	0.4-0.7	G	Silty Sandy Clay												
13/07/2022	43	BH152	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	44	BH152	0.8-1.1	G	Silty Sandy Clay												
13/07/2022	45	BH153	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	46	BH153	0.6-0.8	G	Silty Sandy Clay												
13/07/2022	47	BH154	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X	X					
13/07/2022	48	BH154	0.4-0.6	G	Silty Sandy Clay												
14/07/2022	49	BH155	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	50	BH155	0.6-0.9	G	Silty Clay	X	X	X	X	X	X						

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD	JKE Job Number: E33942PL	JKEnvironments
12 ASHLEY STREET		
CHATSWOOD NSW 2067		
P: (02) 99106200	Date Results Required: STANDARD	REAR OF 115 WICKS ROAD
F: (02) 99106201		MACQUARIE PARK, NSW 2113
		P: 02-9888 5000 F: 02-9888 5001
Attention: Aileen	Page: 3 of 4	Attention: Harry Leonard
		hleonard@jkenvironments.com.au

Location:	Moruya					Sample Preserved in Esky on Ice											
Sampler:	AM/EW					Tests Required											
Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
13/07/2022	51	BH156	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	52	BH156	0.6-0.8	G	Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	53	BH157	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	54	BH157	0.3-0.5	G	Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	55	BH158	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	56	BH158	0.5-0.7	G	Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	57	BH159	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	58	BH159	0.4-0.6	G	Silty Clay												
12/07/2022	59	BH160	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	60	BH160	0.5-0.7	G	Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	61	BH161	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	62	BH161	0.6-0.8	G	Silty Clay	X	X	X	X	X	X						
12/07/2022	63	BH162	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	64	BH162	0.3-0.6	G	Silty Clay	X	X	X	X	X	X						
13/07/2022	65	BH163	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
13/07/2022	66	BH163	0.3-0.6	G	Silty Clay												
12/07/2022	67	BH164	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	68	BH164	0.5-0.7	G	Silty Clay												
12/07/2022	69	BH165	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	70	BH165	0.4-0.7	G	Silty Clay												
12/07/2022	71	BH166	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	72	BH166	0.4-0.6	G	Silty Clay												
12/07/2022	73	BH167	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	74	BH167	0.5-0.7	G	Silty Sandy Clay												
12/07/2022	75	BH168	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:

SAMPLE AND CHAIN OF CUSTODY FORM

TO:	JKE Job Number: E33942PL	FROM: JKEnvironments
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	Date Results Required: STANDARD Page: 4 of 4	REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya					Sample Preserved in Esky on Ice											
Sampler:	AM/EW					Tests Required											
Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
12/07/2022	76	BH168	0.1-0.8	G	Silty Clay												
11/07/2022	77	BH169	0-0.1	G	F: Silty Sand	X	X	X	X	X	X						
11/07/2022	78	BH169	0.7-0.9	G	Silty Clay												
13/07/2022	79	BH170	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	80	BH170	0.5-0.7	G	Silty Clay	X	X	X	X	X	X						
12/07/2022	81	BH171	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	82	BH171	0.4-0.6	G	Silty Clay	X	X	X	X	X	X						
12/07/2022	83	BH172	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	84	BH172	0.6-0.8	G	Silty Clay	X	X	X	X	X	X	X					
12/07/2022	85	BH173	0-0.1	G	F: Silty Sandy Clay	X	X	X	X	X	X						
12/07/2022	86	BH173	0.4-0.6	G	Silty Sandy Clay												
	87	BH105															

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 1 of 4	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya	Sample Preserved in Esky on Ice
Sampler:	AM/EW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity						
12/07/2022	1	BH101	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	2	BH101	0.35-0.5	G	Silty Sandy Clay												
12/07/2022	3	BH105	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	4	BH120	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	5	BH120	0.3-0.5	G	Silty Sandy Clay												
14/07/2022	6	BH128	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	7	BH128	0.3-0.5	G	Silty Sandy Clay												
14/072022	8	BH129	0-0.1	G	F: Silty Sandy Clay												
14/072022	9	BH129	0.3-0.5	G	Silty Sandy Clay												
14/072022	10	BH130	0-0.1	G	F: Silty Clay												
14/072022	11	BH130	0.4-0.6	G	Silty Clay												
14/072022	12	BH131	0-0.1	G	F: Silty Sandy Clay												
14/072022	13	BH132	0-0.1	G	F: Silty Sandy Clay												
14/072022	14	BH132	0.3-0.5	G	Silty Sandy Clay												
14/072022	15	BH133	0-0.1	G	F: Silty Sandy Clay												
14/072022	16	BH133	0.2-0.4	G	Silty Sandy Clay												
14/072022	17	BH134	0-0.1	G	F: Silty Sandy Clay												
14/072022	18	BH134	0.3-0.5	G	Silty Sandy Clay												
14/072022	19	BH135	0-0.1	G	F: Silty Sandy Clay												
14/072022	20	BH135	0.3-0.5	G	Silty Sandy Clay												
13/07/2022	21	BH136	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	22	BH136	0.3-0.5	G	Silty Sandy Clay												
13/07/2022	23	BH137	0-0.1	G	F: Silty Clayey Sand												
13/07/2022	24	BH137	0.4-0.6	G	Silty Clayey Sand												
14/07/2022	25	BH143	0-0.1	G	F: Silty Clay												

Scheduling to follow via email

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
AD	18/07/22	12:00pm	G Bartlett	18.07.22

ENVIROLAB SERVICES PTY LTD
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

1445

Job No: 300717

Date Received: 18.07.22
Time Received: 1445
Received by: G Bartlett
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

SAMPLE AND CHAIN OF CUSTODY FORM

TO:	JKE Job Number: E33942PL	FROM: JKEnvironments
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201	Date Results Required: STANDARD	REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001
Attention: Aileen	Page: 2 of 4	Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya	Sample Preserved In Esky on Ice
Sampler:	AM/EW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity						
14/07/2022	26	BH143	0.6-0.8	G	Silty Sandy clay												
14/07/2022	27	BH144	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	28	BH144	0.6-0.8	G	F: Silty Sandy Clay												
14/07/2022	29	BH145	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	30	BH145	0.6-0.8	G	Silty Sandy Clay												
14/07/2022	31	BH146	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	32	BH146	0.4-0.6	G	Silty Sandy Clay												
14/07/2022	33	BH147	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	34	BH147	0.4-0.6	G	Silty Sandy Clay												
17/07/2022	35	BH148	0-0.1	G	F: Silty Sandy Clay												
17/07/2022	36	BH148	0.7-1.0	G	Silty Sandy Clay												
14/07/2022	37	BH149	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	38	BH149	0.5-0.7	G	Silty Sandy Clay												
14/07/2022	39	BH150	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	40	BH150	0.8-1.0	G	Silty Clay												
14/07/2022	41	BH151	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	42	BH151	0.4-0.7	G	Silty Sandy Clay												
13/07/2022	43	BH152	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	44	BH152	0.8-1.1	G	Silty Sandy Clay												
13/07/2022	45	BH153	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	46	BH153	0.6-0.8	G	Silty Sandy Clay												
13/07/2022	47	BH154	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	48	BH154	0.4-0.6	G	Silty Sandy Clay												
14/07/2022	49	BH155	0-0.1	G	F: Silty Sandy Clay												
14/07/2022	50	BH155	0.6-0.9	G	Silty Clay												

Scheduling to follow via email

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
AD	18/07/22	12:00pm	G Barnett	18.07.22 1445

300717

GB 18/07

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 3 of 4	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya					Sample Preserved in Esky on Ice											
Sampler:	AM/EW					Tests Required											
Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity						
13/07/2022	51	BH156	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	52	BH156	0.6-0.8	G	Silty Sandy Clay												
13/07/2022	53	BH157	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	54	BH157	0.3-0.5	G	Silty Sandy Clay												
13/07/2022	55	BH158	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	56	BH158	0.5-0.7	G	Silty Sandy Clay			Scheduling									
13/07/2022	57	BH159	0-0.1	G	F: Silty Sandy Clay			to follow									
13/07/2022	58	BH159	0.4-0.6	G	Silty Clay			via email									
12/07/2022	59	BH160	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	60	BH160	0.5-0.7	G	Silty Sandy Clay												
12/07/2022	61	BH161	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	62	BH161	0.6-0.8	G	Silty Clay												
12/07/2022	63	BH162	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	64	BH162	0.3-0.6	G	Silty Clay												
13/07/2022	65	BH163	0-0.1	G	F: Silty Sandy Clay												
13/07/2022	66	BH163	0.3-0.6	G	Silty Clay												
12/07/2022	67	BH164	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	68	BH164	0.5-0.7	G	Silty Clay												
12/07/2022	69	BH165	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	70	BH165	0.4-0.7	G	Silty Clay												
12/07/2022	71	BH166	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	72	BH166	0.4-0.6	G	Silty Clay												
12/07/2022	73	BH167	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	74	BH167	0.5-0.7	G	Silty Sandy Clay												
12/07/2022	75	BH168	0-0.1	G	F: Silty Sandy Clay												

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag			
Relinquished By:	Date:	Time:	Received By:	Date:
AD ~~AHHHA~~	18/07/22	12:00pm		

300717

18/07 9B

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 4 of 4	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location:	Moruya	Sample Preserved in Esky on Ice
Sampler:	AM/EW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity						
12/07/2022	76	BH168	0.1-0.8	G	Silty Clay												
11/07/2022	77	BH169	0-0.1	G	F: Silty Sand												
11/07/2022	78	BH169	0.7-0.9	G	Silty Clay												
13/07/2022	79	BH170	0-0.1	G	F: Silty Sandy Clay			Scheduling to follow via email									
13/07/2022	80	BH170	0.5-0.7	G	Silty Clay												
12/07/2022	81	BH171	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	82	BH171	0.4-0.6	G	Silty Clay												
12/07/2022	83	BH172	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	84	BH172	0.6-0.8	G	Silty Clay												
12/07/2022	85	BH173	0-0.1	G	F: Silty Sandy Clay												
12/07/2022	86	BH173	0.4-0.6	G	Silty Sandy Clay												
	87	BH105	0.3-0.5														

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
AD	18/07/22	12:00pm		

#300717
18/07 915

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 300599

Client Details

Client	JK Environments
Attention	Harry Leonard
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E33942PL, Moruya**
Number of Samples	3 Water
Date samples received	15/07/2022
Date completed instructions received	15/07/2022

Analysis Details

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

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

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

Report Details

Date results requested by	22/07/2022
Date of Issue	21/07/2022

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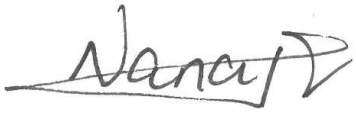
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics				
Our Reference		300599-1	300599-2	300599-3
Your Reference	UNITS	MW1	MW18	MW27
Date Sampled		15/07/2022	15/07/2022	15/07/2022
Type of sample		Water	Water	Water
Date prepared	-	15/07/2022	15/07/2022	15/07/2022
Date analysed	-	18/07/2022	18/07/2022	18/07/2022
pH	pH Units	7.3	7.3	7.1
Electrical Conductivity	µS/cm	450	270	250
Chloride, Cl	mg/L	61	43	19
Sulphate, SO4	mg/L	8	15	5

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			18/07/2022	[NT]	[NT]	[NT]	[NT]	18/07/2022	[NT]
Date analysed	-			18/07/2022	[NT]	[NT]	[NT]	[NT]	18/07/2022	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	109	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

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

SAMPLE RECEIPT ADVICE

Client Details

Client	JK Geotechnics
Attention	Harry Leonard

Sample Login Details

Your reference	E33942PL, Moruya
Envirolab Reference	300599
Date Sample Received	15/07/2022
Date Instructions Received	15/07/2022
Date Results Expected to be Reported	22/07/2022

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	3 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	8
Cooling Method	Ice
Sampling Date Provided	YES

Comments

Samples received with lose caps and leaked into esky.

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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

Sample ID	pH	Electrical Conductivity	Chloride, Cl	Sulphate, SO4
MW1	✓	✓	✓	✓
MW18	✓	✓	✓	✓
MW27	✓	✓	✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

COC 15/7 16:46

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33942PL Date Results Required: STANDARD Page: 1 of 1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Harry Leonard hleonard@jkenvironments.com.au

Location: Moruya
Sampler: AM

Sample Preserved in Esky on Ice

Tests Required

	Date Sampled	Lab Ref:	Sample Number	Sample Containers	PID	Sample Description	pH	EC	Sulphate	Chloride								
1	15/07/2022		MW1	PVC	-	water	X	X	X	X								
2	15/07/2022		MW18	PVC	-	water	X	X	X	X								
3	15/07/2022		MW27	PVC	-	water	X	X	X	X								

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 300599
Date Received: 15/07/22
Time Received: 1600
Received by: VC
Temp: Cool/Ambient 8°C.
Cooling: Ice/icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

All analysis PQLs to ANZECC (2000) Detection Limits Please

Sample Containers:
G1 - 500mL Amber Glass Bottle G2 - 1L Amber Glass Bottle
V - BTEX Vial H - HNO3 Wash PVC
PVC - HDPE Plastic Bottles

Relinquished By: HL	Date: 15 July 2022	Time: 1600.	Received By: Victoria Chan	Date: 15/07/22

Appendix G: Report Explanatory Notes

Standard Sampling Procedure (SSP)

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by JKE. The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

A. Soil Sampling:

- Prepare a borehole/test pit log or made a note of the sample description for stockpiles.
- Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill rig/excavator such that the machine can operate in a safe manner.
- Ensure all sampling equipment has been decontaminated prior to use.
- Remove any surface debris from the immediate area of the sampling location.
- Collect samples and place in appropriate sampling containers provided by the lab.
- Label the sampling containers with the JKE job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
- Record the lithology of the sample and sample depth on the borehole/test pit log generally in accordance with AS1726-1993[13].
- Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with the standards outlined in the report.
- Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.
- Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

B. Groundwater Sampling

Groundwater samples are more sensitive than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard. The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

- After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.
- Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling, the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.
- Take the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.

[13] Standards Australia, (1993), *Geotechnical Site Investigations.* (AS1726-1993)

- Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or other low flow) techniques.
- Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
  - Micropore filtration system or Stericup single-use filters (for heavy metals samples);
  - Filter paper for Micropore filtration system; Bucket with volume increments;
  - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles;
  - Bucket with volume increments;
  - Flow cell;
  - pH/EC/Eh/T meters;
  - Plastic drums used for transportation of purged water;
  - Esky and ice;
  - Nitrile gloves;
  - Distilled water (for cleaning);
  - Electronic dip meter;
  - Low flow pump pack and associated tubing; and
  - Groundwater sampling forms.
- If single-use stericup filtration is not used, clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.
- Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.
- Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.
- Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.
- During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.
- All measurements are recorded on specific data sheets.
- Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles or plastic bottles.
- All samples are preserved in accordance with water sampling requirements detailed in the NEPM 2013 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice as outlined in the report text.
- Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

Appendix H: Groundwater Field Records

JKEnvironments

WATER QUALITY METER CALIBRATION FORM

Client:	Health Infrastructure
Project:	Proposed Eurobodalla Health Service
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW
Job Number:	E33942PL

DISSOLVED OXYGEN

Make:	Model:
Date of calibration: 11/7/22 / 15/7/22	Name of Calibrator: AM
Span value: 70% to 130%	
Measured value: 98 111	
Measured reading Acceptable (Yes/No):	

pH

Make:		Model:	
Date of calibration: 11/7/22 / 15/7/22		Name of Calibrator: AM	
Buffer 1: Theoretical pH = 7 ± 0.01		Expiry date: 11/22	Lot No: 372831
Buffer 2: Theoretical pH = 4.01 ± 0.01		Expiry date: 9/9/23	Lot No: 386479
Measured reading of Buffer 1: 6.88	7.42		
Measured reading of Buffer 2: 4.04	4.29		
Slope:		Measured reading Acceptable (Yes/No):	

EC

Make:		Model:	
Date: 11/7/22 / 15/7/22	Name of Calibrator: AM		Temperature: 14 °C
Calibration solution: Conductivity Standard		Expiry date: 9/23	Lot No: 386922
Theoretical conductivity at temperature (see solution container): 1251 /			µS/cm
Measured conductivity: 1163 µS/cm		Measured reading Acceptable (Yes/No):	15/7/22 unable to calibrate due to YSI low readings and low temp

REDOX

Make:		Model:	
Date of calibration: 11/7/22 / 15/7/22		Name of Calibrator: AM	
Calibration solution: ORP Test Solution		Expiry date: 11/26	Lot No: 7221
Theoretical redox value:	240mV		
Measured redox reading: 205.1 mV		Measured reading Acceptable (Yes/No):	

268.5

JKEnvironments

Client:	Health Infrastructure	**Job No.:**	E33942PL
Project:	Proposed Eurobodalla Health Service	**Well No.:**	1
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	**Depth (m):**	5.8

WELL FINISH DETAILS

	Gatic Cover ☒	**Standpipe** ☐	**Other (describe)** ☐

WELL DEVELOPMENT DETAILS

Method:	Development	**SWL – Before (m):**	5.28
Date:	11/7/22	**Time – Before:**	3:10
Undertaken By:	AM	**SWL – After (m):**	—
Total Vol. Removed:	0	**Time – After:**	—
PID Reading (ppm):	0		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
	Well not developed due to low volume				

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved (YES / (NO))

YSI Used: 4

Tested By:	AM	**Remarks:**
Date Tested:	11/7/22	- Steady state conditions - Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
Checked By:	HL	- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date:	8/8/22	

JKEnvironments

Client:	Health Infrastructure	**Job No.:**	E33942PL
Project:	Proposed Eurobodalla Health Service	**Well No.:**	18
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	**Depth (m):**	5.7m

WELL FINISH DETAILS

	Gatic Cover ☒	Standpipe ☐	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	—	**SWL – Before (m):**	5.46
Date:	11/7/22	**Time – Before:**	1.50
Undertaken By:	AM	**SWL – After (m):**	—
Total Vol. Removed:	—	**Time – After:**	—
PID Reading (ppm):	0.1		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
Well not developed due to low volume					

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved (YES / (NO))

YSI Used: 4

Tested By:	AM	**Remarks:**
Date Tested:	11/7/22	- Steady state conditions - Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
Checked By:	HL	- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date:	8/8/22	

JKEnvironments

Client:	Health Infrastructure	Job No.:	E33942PL
Project:	Proposed Eurobodalla Health Service	Well No.:	27
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	Depth (m):	5.5

WELL FINISH DETAILS

	Gatic Cover ☒	Standpipe ☐	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	Development	SWL – Before (m):	3.37
Date:	11/7/22	Time – Before:	2:20
Undertaken By:	AM	SWL – After (m):	—
Total Vol. Removed:		Time – After:	2:40
PID Reading (ppm):	0		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	17.4	3.6	260.5	7.08	178.3
5	17.2	4.7	249.8	6.60	176.1
7	17.6	3.2	265.9	5.85	179.0
	with	Prospect	Pty		

Comments: Odours (YES / (NO)) NAPL/PSH (YES / (NO)) Sheen (YES / (NO)) Steady State Achieved (YES / (NO))

YSI Used: & Medium silt loam

Tested By:	DM	**Remarks:**
Date Tested:	11/7/22	- Steady state conditions - Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
Checked By:	HL	- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date:	8/8/22	

JKEnvironments

Client:	Health Infrastructure	Job No.:	E33942PL
Project:	Proposed Eurobodalla Health Service	Well No.:	1
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	Depth (m):	5.7

WELL FINISH

X	Gatic Cover		Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	Bailer	SWL – Before:	5.40
Date:	15/7/22	Time – Before:	8:25
Undertaken By:	AM	Total Vol Removed:	1L
Pump Program No:	–	PID (ppm):	0.1

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
8:30	–	0.5		14.5	4.3	28.6	6.14	185.9
			Started sampling					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)

Sampling Containers Used: 0 x glass amber, 0 x BTEX vials, 0 x HNO3 plastic, 0 H2SO4 plastic, 1 x unpreserved plastic

YSI used: 4

Tested By: ~~Harry Leonard~~ AM	**Remarks:**
Date Tested: 15/7/22	- Steady state conditions
Checked By: HL	- difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date: 8/8/22	

JKEnvironments

Client:	Health Infrastructure	**Job No.:**	E33942PL
Project:	Proposed Eurobodalla Health Service	**Well No.:**	18
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	**Depth (m):**	8.7

WELL FINISH

X	**Gatic Cover**		**Standpipe**		**Other (describe)**

WELL PURGE DETAILS:

Method:	Bailer	**SWL – Before:**	5.49
Date:	15/7/22	**Time – Before:**	9:15
Undertaken By:	BM	**Total Vol Removed:**	0.1
Pump Program No:	–	**PID (ppm):**	0

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
			Started Sampling					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)

Sampling Containers Used: 6x glass amber, 6x BTEX vials, 6x HNO3 plastic, 6x H2SO4 plastic, 1x unpreserved plastic

YSI used: A

Tested By: ~~Harry Leonard~~ BM	**Remarks:**
Date Tested: 15/7/22	- Steady state conditions
Checked By: HL	- difference in the pH less than 0.2 units, difference in conductivity less than 10%
Date: 8/8/22	10% and SWL stable/not in drawdown

JKEnvironments

Client:	Health Infrastructure	**Job No.:**	E33942PL
Project:	Proposed Eurobodalla Health Service	**Well No.:**	27
Location:	Lot 6 DP1212271, Princes Highway, MORUYA, NSW	**Depth (m):**	5.6

WELL FINISH

X	**Gatic Cover**		**Standpipe**		**Other (describe)**

WELL PURGE DETAILS:

Method:	Bailer	**SWL – Before:**	5.0m
Date:	15/7/22	**Time – Before:**	8:52
Undertaken By:	AM	**Total Vol Removed:**	1.5
Pump Program No:	—	**PID (ppm):**	0

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
8:57	—	1		15.7	4.4	252.9	6.66	115.1
			Started Sampling					

Comments: Odours (YES / (NO)) NAPL/PSH (YES / (NO)), Sheen (YES / (NO)) Steady State Achieved (YES / (NO))

Sampling Containers Used: 0 x glass amber, 0 x BTEX vials, 0 x HNO3 plastic, 0 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: 4

Tested By: ~~Harry Leonard~~ AM	**Remarks:**
Date Tested: 15/7/22	- Steady state conditions
Checked By: AL	- difference in the pH less than 0.2 units, difference in conductivity less than 10%
Date: 8/8/22	10% and SWL stable/not in drawdown