REPORT TO

NSW DEPARTMENT OF EDUCATION

ON

PRELIMINARY SALINITY ASSESSMENT

FOR

PROPOSED NEW HIGH SCHOOL IN BUNGENDORE

AT

BIRCHFIELD DRIVE, BUNGENDORE, NSW

Date: 17 March 2025

Ref: E37084PTrpt2rev4-SAL

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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 Planning, Housing and Infrastructure	**DPHI**
Department of Education	**DoE**
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**
Preliminary Site Investigation	**PSI**
Redox Potential	**Eh**
Review of Environmental Factors	**REF**
Site Assessment Criteria	**SAC**
Special Education Learning Unit	**SELU**
Standard Penetration Test	**SPT**
Standard Sampling Procedure	**SSP**
Standing Water Level	**SWL**
Standard Sampling Procedure	**SSP**
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**
Parts Per Million	**ppm**
micro Siemens per Centimetre	**µS/cm**

1 REF PREAMBLE

This Preliminary Salinity Assessment has been prepared to support a Review of Environmental Factors (REF) for the NSW Department of Education (DoE) for the construction and operation of the new high school at Bungendore (the activity).

The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37A of the T&I SEPP.

The REF has been prepared in accordance with the *Guidelines for Division 5.1 assessments* (the Guidelines) by the Department of Planning, Housing and Infrastructure (DPHI) as well as the *Addendum Division 5.1 guidelines for schools* and *Addendum October 2024 (Consideration of environmental factors for health services facilities and schools*). The purpose of this report is to make a preliminary assessment of the salinity conditions likely to be disturbed during development.

1.1 Client Provided Site Description

The current street address is part of 18 Harp Avenue, Bungendore, NSW, 2621 (the site), and is legally described as part Lot 125 in Deposited Plan 1297613. As shown on Figure 1 below, the proposed school site forms part of a larger lot which is the subject of a proposed residential subdivision.

The site is located within the North Bungendore Precinct (Elm Grove Estate) in Bungendore. As a result of precinct wide rezonings, the surrounding locality is currently transitioning from a semi-rural residential area to an urbanised area with new low density residential development.

The site is zoned R2 Low Density Residential, with all adjoining land also zoned R2 Low Density Residential.
The site has three frontages:

- Approx 500m southern frontage to Birchfield Drive;
- Approx 500m northern frontage to Bridget Avenue; and
- Approx 100m eastern frontage to Winyu Rise.

The site is currently cleared of all vegetation and consists of grassland, having been prepared for the purposes of future low density residential development.

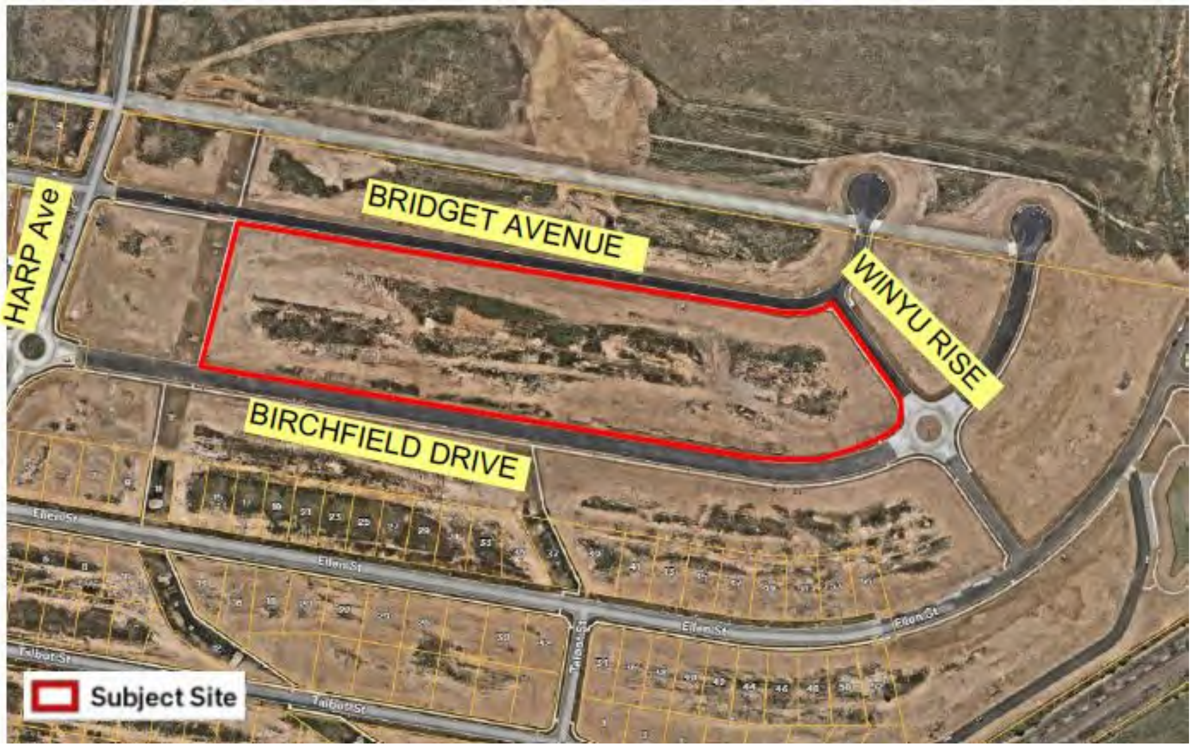


Figure 1 Aerial Photograph of the Site.
Source: Urbis 2024

1.2 Client Provided Project Description

The proposed activity is for the construction and operation of a new high school in Bungendore at part 18 Harp Avenue, Bungendore (the site). The new high school will accommodate 600 students and 68 staff. The school will provide 26 general learning spaces, and three support learning spaces across two buildings. The buildings will be predominantly three-storeys in height and will include permanent and support teaching spaces, specialist learning hubs, a library, administrative areas and a staff hub.

Additional core facilities are also proposed including a standalone school hall with covered outdoor learning area (COLA), a car park, a kiss and drop zone along Birchfield Drive, sports courts and a sports field. The new school also features a single storey building with associated paddocks in the far western portion of the site designed for livestock management and hands-on agricultural learning.

Specifically, the proposal involves the following:

- Building A, a three-storey learning hub accommodating general learning spaces, a special education learning unit (SELU), a physical education centre, a performing arts space, and other core facilities including administrative areas, staff hub, library and end of trip facilities.
- Building B, a part three/part four storey learning hub accommodating general learning spaces, specialist workshops for food, textile, wood and metal workshops, as well as visual arts studios, science labs and staff areas.
- Building C, a standalone school hall with COLA.
- Building D, a single-storey agricultural block comprising an animal storage space, a COLA and internal workshop.
- On-site staff car park with 50 spaces with access via Bridget Avenue.

- Kiss and drop zones and bus bays along Birchfield Drive.
- Open play space including a sports courts and sports field.
- Associated utilities and services including a 1000kv padmount substation.
- Main pedestrian entrance to be located off Birchfield Drive.
- Secondary pedestrian access from Bridget Avenue.
- Public domain/off-site works including the removal of street trees.

The design has been master planned to allow for an additional future stage. The second stage does not form part of this proposal.

Figure 2 below provides an extract of the proposed site plan.

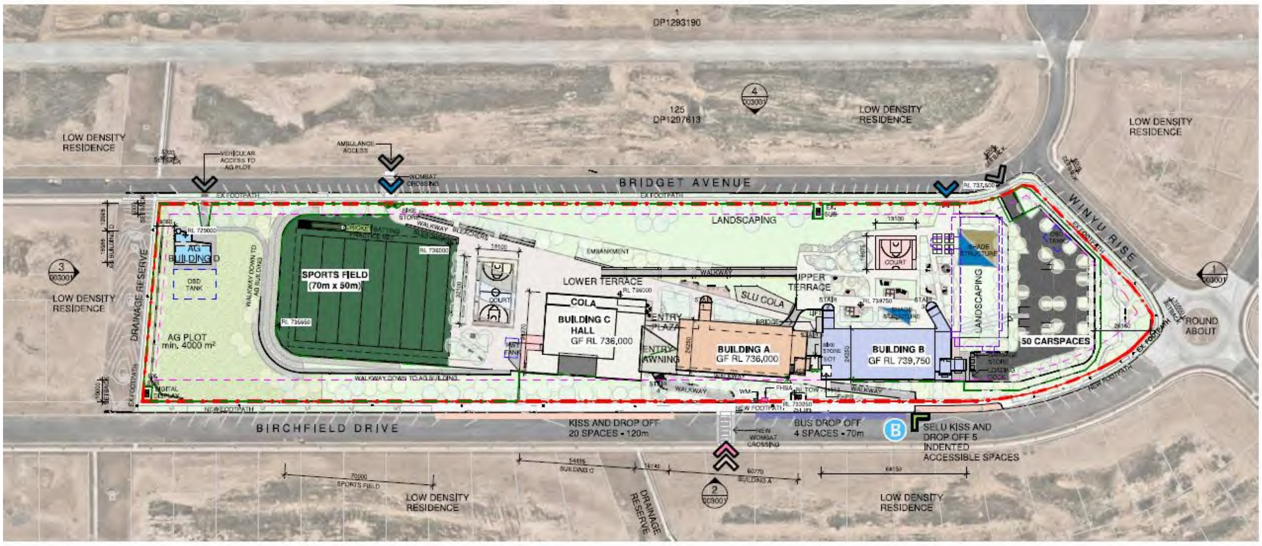


Figure 2 Site Plan
Source: NBRS, 2024

2 INTRODUCTION

NSW Department of Education ('the client') commissioned JK Environments (JKE) to undertake a Preliminary Salinity Assessment for the proposed high school in Bungendore at Birchfield Drive, Bungendore. 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 salinity assessment has been prepared to support a REF for the construction of Bungendore High School.

A geotechnical investigation by JK Geotechnics (JKG) and a Preliminary Site Investigation (PSI) by JKE were previously undertaken for the site in October 2024. Relevant information from these investigations has been included throughout this report.

Background information on salinity is included in the appendices.

2.1 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 activity. 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 sampling and analysis program; and
- Provide salinity management recommendations, and if/where required, a Salinity Management Plan (SMP).

2.2 Scope of Work

The investigation was undertaken generally in accordance with email correspondence of 8 November 2024 and written acceptance from the client for the Variation to DDWO05439/23 of 14 November 2024. 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
- Preparation of a site specific SMP for the proposed activity (if required).

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 2-1: 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)

3 SITE INFORMATION

3.1 Site Identification

Table 3-1: Site Identification

Site Address:	Birchfield Drive, Bungendore, NSW
Lot & Deposited Plan:	Part of Lot 125 in DP1297613 (as per the Section 10.7 planning certificate at the time of preparing the report)
Current Land Use:	Vacant land
Proposed Land Use:	Proposed high school (year 7 to 12)
Local Government Authority (LGA):	Queanbeyan Palerang Regional Council
Site Area (ha) (Approx.):	4.2
RL (AHD in m) (approx.):	725-745
Geographical Location (decimal degrees) (approx.):	Latitude: - 35.2418533 Longitude: 149.458176
Site Plans:	Appendix A

3.2 Site Location and Regional Setting

The site is located in an area of Bungendore that is currently under development as a new residential estate and is bound by Birchfield Drive to the south, Bridget Avenue to the north, and Winyu Rise to the east. The site is located approximately 100m to the west of a tributary of Turallo Creek, which itself is located approximately 1.25km to the south of the site.

3.3 Topography

The site is located within regional topography generally comprising rolling, low relief hills generally sloping at less than 10°. The site is located on the southern flank of a hill which rises on the northern side of Bungendore township. Surface levels within the site generally slope down to the south-east, south and south-west at approximately 6° to 8° from a local rise located within the central portion of the northern boundary. Parts of the site appear to have been levelled off to account for the newly constructed roads to the immediate north, south and east.

3.4 Site Inspection

A walkover inspection of the site was undertaken by JKE on 20 November 2024 for the preliminary salinity assessment. 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 majority of the site was grass and weed covered and appeared to be formerly agricultural grazing land, with some evidence of earthworks along the boundaries of the site and on the higher central section (most likely associated with the recent construction of the adjacent roads/road verges). No buildings or roads were observed on the site during the site inspection.

The site itself was not fenced, however access to the site was via locked gates and temporary fencing at the intersection of either Birchfield Drive and Harp Avenue, or Bridget and Harp Avenue. Some temporary fence panels were observed to be absent during the time of the inspection. Some surface scouring from surface water movement was evident along the lower southern and eastern sides of the site.

The site appeared to be in keeping with the surrounding topography with minimal cut and fill works evident. Some ironstone and quartz gravels and sands were visible on the site surface, generally along the northern or southern boundaries of the site and appeared to be associated with construction of the adjacent roads and services infrastructure as part of the infrastructure works.

Surface water would be expected to infiltrate the site surface, with excess surface water expected to flow in keeping with the localised falls of the site, to the east and west from the highest point of the site in the central north and in an overall southern direction. It was also noted that a French style drainage channel had been constructed to the immediate west of the site and on the southern side of Birchfield Drive, opposite the central-southern boundary of the site. These drains are assumed to feed into Turallo Creek located approximately 1.25km to the south of the site.

The majority of the site surface was generally grass and weed covered. All vegetation inspected appeared to be in good condition with no obvious evidence of phyto-toxic stress or die back.

There were no obvious indicators of salinity observed on the ground surfaces/vegetation during the site inspection.

3.5 Surrounding Land Use

During the site inspection, JKE observed the site to be surrounded by vacant undeveloped land that had been prepared for future development with infrastructure services (roads, gutters, underground utilities, etc), in all directions. Further to the south and south-west were newly developed residential properties.

4 GEOLOGY AND HYDROGEOLOGY

4.1 Regional Geology and Soils

The regional geological information previously reviewed for the PSI indicated that the site is underlain by Abercrombie Formation Sandstone, which typically consists of brown and buff to grey, thin- to thick-bedded, fine- to coarse grained mica-quartz (feldspar) sandstone, interbedded with laminated siltstone and mudstone.

Soil Landscapes of Central and Eastern NSW information previously reviewed indicated that the site is located within the Bywong Soil Group soil landscape. The Bywong Soil Group is generally characterised by rolling to undulated low hills, rises and minor flats on metasediments. Soils are generally shallow, and well to rapidly drained on crests and upper slopes with new rock outcrops. Moderately deep and moderately well-drained soils on mid-slopes; and deep imperfectly drained and poorly drained soils on lower slopes. This soil group is limited by its infertile, erodible and shallow soils, with water erosion and salinity hazards.

4.2 Dryland Salinity – National Assessment

There was no dryland salinity national assessment data for the site.

4.3 Acid Sulfate Soil Risk and Planning

The site is not located in an acid sulfate soil (ASS) risk area according to the risk maps prepared by the Department of Land and Water Conservation.

A review of the Queanbeyan Palerang Regional Council Local Environmental Plan (LEP) 2022 indicates that the site is not mapped as being within an ASS risk area.

4.4 Hydrogeology

Hydrogeological information presented in the PSI report indicated that:

- There were 46 registered bores within 2km of the site;
- The nearest registered bore was located approximately 950m cross-gradient to the west and registered for water supply purposes. The majority of the remaining bores were also registered for water supply purposes; and
- Subsurface conditions at the site are expected to consist of relatively low permeability (residual) soils overlying shallow bedrock. Abstraction and use of groundwater at the site or in the immediate surrounds may be viable under these conditions, however the use of groundwater is not proposed as part of the proposed activity and there were no registered groundwater bores in close proximity. We assume there is a reticulated water supply in the area and consumption of groundwater is not expected to occur, although it cannot be ruled out given that some registered groundwater bores in the region are listed as water supply bores.

Considering the local topography and surrounding land features, JKE anticipate groundwater to flow towards the south.

The closest surface water body is a tributary of Turallo Creek located approximately 100m to the east of the site. The tributary appeared to be ephemeral, and as it is cross to down-gradient from the site the tributary is considered to be a potential receptor.

5 SAMPLING AND ANALYSIS PLAN

5.1 Soil Sampling Rationale

The investigation included soil sampling from 10 locations (BH101 to BH110 inclusive) placed on a judgement sampling plan as shown on Figure 2. We note that Figure 2 also shows all locations drilling for the geotechnical investigation and the PSI. This density is equivalent to approximately 2-3 sampling points per hectare (the area of the site is approximately 4.2 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 confined to the depth of approximately 3m below ground level (BGL) due to shallow bedrock. This was considered adequate as the investigation was terminated in and included representative sampling of the bedrock which will be excavated as part of the proposed activity.

5.2 Soil Sampling Methods

Fieldwork for this investigation was undertaken between 20 and 21 November 2024. Sampling locations were set out using a hand-held GPS unit. Locations were marked using spray paint and were cleared for underground services prior to drilling.

The sample locations were drilled using a truck mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

Soil samples were collected from the soil and bedrock 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.

5.3 Groundwater Sampling Rationale

The assessment included sampling from four groundwater monitoring wells (MW1, MW6, MW17 and MW28), previously installed for the geotechnical investigation as shown on Figure 2. The wells were positioned for site coverage.

5.4 Monitoring Well Installation

The monitoring well construction details are documented on appropriate borehole logs presented in the appendices. The wells were installed to depths of approximately 3.7m to 7.75mBGL. 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
- The wells were finished with a 1m stick up and concrete plug at surface level to limit the inflow of surface water, and the wells were sealed with an envirocap.

The relative heights for all monitoring wells were surveyed using a GPS unit on 18 October 2024 as part of the geotechnical investigation. A detailed survey of the well heads was outside the scope of the assessment.

Table 5-1: Summary of Groundwater RLs

MW reference	Reduced Level (mAHD)	SWLs (mBGL) (recorded 22 November 2024)	SWL (mAHD)
MW1	724.9	Well dry	-
MW6	735.3	Well dry	-
MW17	744.2	Well dry	-
MW28	740.7	Well dry	-

5.5 Monitoring Well Development and Groundwater Sampling

The monitoring wells were developed using a submersible electric pump on 20 November 2024. All wells were developed (i.e. water was pumped out) until they were effectively dry using a submersible electrical pump, though we note that some wells were not pumped out as groundwater was not encountered.

The monitoring wells were allowed to recharge for 48 hours after development. All wells were dry on the day of sampling, 22 November 2024. The data sheets and field calibration information are attached in the appendices.

5.6 Laboratory Analysis

Samples were analysed by Envirolab Services Pty Ltd (NATA accreditation number 2901). Reference should be made to the laboratory report (Ref: 367148) attached in the appendices for further details of the analytical methods.

5.7 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 5-2: Analytical Schedule

Analyte	Fill Samples	Natural Soil Samples	Natural Bedrock Samples
pH	2	21	11
Electrical Conductivity (EC)	2	21	11
Resistivity	2	21	11
Texture (used to determine EC extract – ECe)	2	21	11
Cation Exchange Capacity (CEC)	1	8	1
Sulphate	2	21	11
Chloride	2	21	11

6 SITE ASSESSMENT CRITERIA (SAC)

6.1 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 6-1: 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

6.2 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)[7] presented below:

Table 6-2: Plant Response to Soil pH

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

[7] 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

6.3 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)[8] developed a set of ratings for effective CEC and the most abundant cations. These are summarised below (values are in meq/100g):

Table 6-3: 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

6.3.1 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)[9]. 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.

[8] Metson, A.J, (1961). *Methods of Chemical Analysis for Soil Survey Samples* (referred to as Metson 1961)
[9] Eckert, D.J, (1987) .*Soil Test Interpretation: Basic Cation Saturation Ratios and Sufficiency Levels* (referred to as Eckert 1987)

6.4 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[10]) indicate that a soil is generally considered sodic if the ESP exceeds 6% and extremely sodic if the ESP exceeds 15%.

6.5 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:

Table 6-4: 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

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

6.6 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 6-5: 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 (e.g. sands and gravels) which are in groundwater

2 – Low permeability soils (e.g. silts and clays) or all soils above groundwater

Table 6-6: 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 (e.g. sands and gravels) which are in groundwater

2 – Low permeability soils (e.g. silts and clays) or all soils above groundwater

7 INVESTIGATION RESULTS

7.1 Subsurface Conditions

A summary of the subsurface conditions encountered in BH101 to BH110 during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices, including the logs associated with the monitoring well locations, for further details.

Table 7-1: Summary of Subsurface Conditions

Profile	Description (metres below ground level - mBGL)
Fill	Fill was encountered at the surface in BH103 and extended to a depth of approximately 1.3mBGL. The fill depth is shown on Figure 2 in Appendix A. The fill typically comprised of silty clay and contained inclusions of ironstone gravels and slag.
Natural Soil	Natural residual silty clay soils were encountered at the surface or beneath the fill material in all boreholes and extended to depths of approximately 0.5m to 2.8mBGL.
Bedrock	With the exception of BH101, sandstone or mudstone bedrock was encountered in all boreholes and extended to the maximum termination depth of the investigation at 3mBGL.
Groundwater	Groundwater seepage was not encountered in the boreholes during drilling. All boreholes remained dry on completion of drilling and a short time after.

7.2 Laboratory Results

A summary of the results is presented below.

Table 7-2: Summary of Laboratory Results

Analyte	Results
EC & ECe	The EC results ranged from 17µS/m to 210µS/m. All ECe results were less than the practical quantitation limit (PQL).
Resistivity	Resistivity values were calculated based on the raw EC values. The resistivity values for the soil samples ranged from 4,762 ohm.cm to 58,824 ohm.cm.
pH	The results of the analysis ranged from 4.8 to 7.4.
CEC	The results of the analysis ranged from: • CEC – 1meq/100g to 14meq/100g; • Exchangeable Na – less than the PQL to 0.8meq/100g; • Exchangeable K – 0.2meq/100g to 0.7meq/100g; • Exchangeable Ca – 0.3meq/100g to 5.1meq/100g; and • Exchangeable Mg – 0.2meq/100g to 9.3meq/100g.
Sulphate	The results ranged from less than the PQL to 71mg/kg.

Analyte	Results
Chloride	The results ranged from less than the PQL to 250mg/kg.

Note:

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

8 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 8-1: Interpretation of Laboratory Results

Parameter	Notes
Soil Salinity and Plant Growth	The ECe results were all less than the PQL and were classed as non-saline.
Soil pH and Plant Growth	The soil pH results ranged from 4.8 to 7.4 and were classed as very strongly acidic to mildly alkaline. The majority of the soils and bedrock were within the optimum range for plant growth.
CEC in Soil	The CEC values ranged from 1meq/100g to 14meq/100g in the very low to moderate range. The majority of the samples were within the 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 have less calcium than magnesium. The CEC of the soil is generally very low to moderate. 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% to 12.9%. The majority of the ESP results were below the 5% threshold and were classed as non-sodic.
Concrete Slabs and Footings in Saline Soils (CCAA 2018)	The proposed earthworks are anticipated to expose soils generally classed as non-saline. The CCAA 2018 recommended concrete grade for slabs and footings in non-saline soils is N20. The results should be assessed by the project design team as applicable for the proposed development. 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 non-aggressive to mildly aggressive towards buried concrete. 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 results should be assessed by the project design team as applicable for the proposed development.

9 CONCLUSION

The investigation identified the following salinity conditions:

- The soils and bedrock were classed as very strongly acidic to mildly alkaline in relation to plant growth;
- The soils and bedrock were classed as non-saline;
- The soils and bedrock were non-sodic to sodic;
- The soils were generally non-aggressive to mildly aggressive towards buried concrete and the bedrock was generally non-aggressive towards buried concrete; and
- The soils and bedrock were generally non-aggressive towards buried steel.

The site is not located in an area covered by the Salinity Potential Map, however we note that the proposed activity includes some salinity risk activities as defined in the Salinity Code of Practice such as activities involving high levels of irrigation, infiltration to soil or groundwater, and/or major landscape re-shaping.

Considering the above, JKE is of the opinion that salinity poses a low risk at the site in the context of the proposed development and a detailed SMP is not required. However, we recommend that the soil aggressivity characteristics be appropriately considered by the project engineers during the design of the proposed activity, and in our opinion, it would be good practice to implement general salinity mitigation measures as part of the proposed activity, where applicable. These are outlined in Appendix H.

9.1 Mitigation Measures – REF Requirement

JKE was requested by the client to include a table to support the salinity related risk mitigation measures to be included in the REF. Mitigation measures are outlined in the table below:

Table 9-1: Mitigation Measures Relating to DSI Findings

Mitigation Number / Name	Aspect / Section	Mitigation Measure	Reason for Mitigation Measure
Preliminary Salinity Assessment	Pre-construction	Soil aggressivity characteristics detailed through this report be appropriately considered by the project engineers during the design of the proposed activity.	Design considerations.

10 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;
- 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, e.g. addition of basement levels, or deeper filling/cut excavations; 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

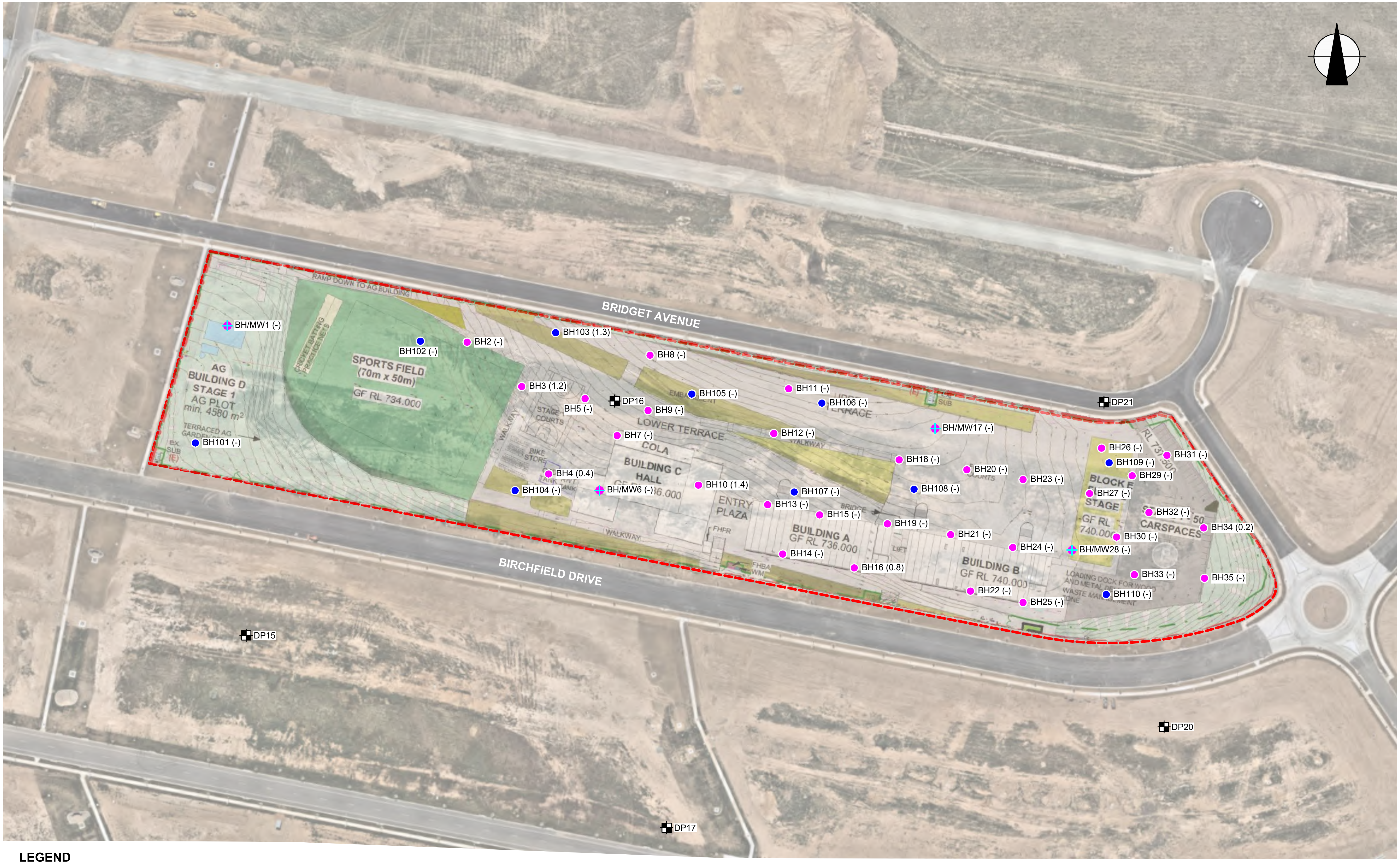
AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	**SITE LOCATION PLAN**
Location:	BIRCHFIELD DRIVE, BUNGENDORE, NSW
Project No: E37084rpt2-SAL	Figure No: 1

JKEnvironments

PLOT DATE: 2/12/2024 9:02:30 AM DWG FILE: K:\5C EIS JOBS\37000'S\E37084PT BUNGENDORE\CAD ZONE55\E37084PTRPT2-SAL.DWG



LEGEND

(red dashed line)	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)
DP16	DP ADDENDUM PSI 2017
BH101	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 15 30 45 60 75

SCALE 1:1500 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Project No: E37084rpt2-SAL

Figure No: 2

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PLOT DATE: 2/12/2024 9:03:10 AM DWG FILE: K:\5C EIS JOBS\37000'S\E37084PT BUNGENDORE\CAD ZONE55\E37084PTRPT2-SAL.DWG

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 limit.

SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

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

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	0-0.1	Silty clay	53	<2	NON SALINE
BH101 - LAB DUP	0-0.1	LAB DUPLICATE	54	<2	NON SALINE
BH101	0.8-0.95	Silty clay	24	<2	NON SALINE
BH101	1.8-1.95	Silty clay	180	<2	NON SALINE
BH102	0-0.1	Silty clay	79	<2	NON SALINE
BH102	0.8-0.95	Silty clay	42	<2	NON SALINE
BH102	1.8-1.95	Silty clay	140	<2	NON SALINE
BH102	2.4-2.5	Silty clay	200	<2	NON SALINE
BH102	2.9-3	XW: Sandstone	64	<2	NON SALINE
BH103	0-0.1	Fill: Silty clay	210	<2	NON SALINE
BH103	0.8-0.95	Fill: Silty clay	34	<2	NON SALINE
BH103 - LAB DUP	0.8-0.95	LAB DUPLICATE	31	<2	NON SALINE
BH103	1.4-1.5	Silty clay	51	<2	NON SALINE
BH103	1.8-1.95	Silty clay	40	<2	NON SALINE
BH103	2.9-3	XW: Sandstone	17	<2	NON SALINE
BH104	0-0.1	Silty clay	70	<2	NON SALINE
BH104	0.8-0.95	Silty clay	30	<2	NON SALINE
BH104	1.8-1.95	Silty clay	39	<2	NON SALINE
BH104	2.4-2.5	XW: Sandstone	21	<2	NON SALINE
BH104	2.9-3	XW: Sandstone	21	<2	NON SALINE
BH105	0.4-0.5	Silty clay	31	<2	NON SALINE
BH105 - LAB DUP	0.4-0.5	LAB DUPLICATE	32	<2	NON SALINE
BH105	0.8-0.95	XW: Sandstone	27	<2	NON SALINE
BH105	1.4-1.5	XW: Sandstone	48	<2	NON SALINE
BH106	0-0.1	Silty clay	91	<2	NON SALINE
BH106	0.8-0.95	XW: Sandstone	47	<2	NON SALINE
BH107	0-0.1	Silty clay	36	<2	NON SALINE
BH107	0.8-0.95	Silty clay	36	<2	NON SALINE
BH107	1.4-1.5	XW: Sandstone	20	<2	NON SALINE
BH108	0-0.1	Silty clay	48	<2	NON SALINE
BH108	0.8-0.95	Silty clay	40	<2	NON SALINE
BH108 - LAB DUP	0.8-0.95	LAB DUPLICATE	40	<2	NON SALINE
BH108	1.65-1.7	XW: Sandstone	43	<2	NON SALINE
BH109	0-0.1	Silty clay	91	<2	NON SALINE
BH109	0.8-0.95	Silty clay	41	<2	NON SALINE
BH109	1.8-1.95	XW: Sandstone	41	<2	NON SALINE
BH110	0-0.1	Silty clay	53	<2	NON SALINE
BH110	0.8-0.95	XW: Sandstone	31	<2	NON SALINE
Total Number of Samples			38	38	-
Minimum Value			17	<PQL	-
Maximum Value			210	<PQL	-

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

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TABLE C
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	0-0.1	Silty clay	53	18,868	Non Aggressive
BH101 - LAB DUP	0-0.1	LAB DUPLICATE	54	18,519	Non Aggressive
BH101	0.8-0.95	Silty clay	24	41,667	Non Aggressive
BH101	1.8-1.95	Silty clay	180	5,556	Non Aggressive
BH102	0-0.1	Silty clay	79	12,658	Non Aggressive
BH102	0.8-0.95	Silty clay	42	23,810	Non Aggressive
BH102	1.8-1.95	Silty clay	140	7,143	Non Aggressive
BH102	2.4-2.5	Silty clay	200	5,000	Non Aggressive
BH102	2.9-3	XW: Sandstone	64	15,625	Non Aggressive
BH103	0-0.1	Fill: Silty clay	210	4,762	Non Aggressive
BH103	0.8-0.95	Fill: Silty clay	34	29,412	Non Aggressive
BH103 - LAB DUP	0.8-0.95	LAB DUPLICATE	31	32,258	Non Aggressive
BH103	1.4-1.5	Silty clay	51	19,608	Non Aggressive
BH103	1.8-1.95	Silty clay	40	25,000	Non Aggressive
BH103	2.9-3	XW: Sandstone	17	58,824	Non Aggressive
BH104	0-0.1	Silty clay	70	14,286	Non Aggressive
BH104	0.8-0.95	Silty clay	30	33,333	Non Aggressive
BH104	1.8-1.95	Silty clay	39	25,641	Non Aggressive
BH104	2.4-2.5	XW: Sandstone	21	47,619	Non Aggressive
BH104	2.9-3	XW: Sandstone	21	47,619	Non Aggressive
BH105	0.4-0.5	Silty clay	31	32,258	Non Aggressive
BH105 - LAB DUP	0.4-0.5	LAB DUPLICATE	32	31,250	Non Aggressive
BH105	0.8-0.95	XW: Sandstone	27	37,037	Non Aggressive
BH105	1.4-1.5	XW: Sandstone	48	20,833	Non Aggressive
BH106	0-0.1	Silty clay	91	10,989	Non Aggressive
BH106	0.8-0.95	XW: Sandstone	47	21,277	Non Aggressive
BH107	0-0.1	Silty clay	36	27,778	Non Aggressive
BH107	0.8-0.95	Silty clay	36	27,778	Non Aggressive
BH107	1.4-1.5	XW: Sandstone	20	50,000	Non Aggressive
BH108	0-0.1	Silty clay	48	20,833	Non Aggressive
BH108	0.8-0.95	Silty clay	40	25,000	Non Aggressive
BH108 - LAB DUP	0.8-0.95	LAB DUPLICATE	40	25,000	Non Aggressive
BH108	1.65-1.7	XW: Sandstone	43	23,256	Non Aggressive
BH109	0-0.1	Silty clay	91	10,989	Non Aggressive
BH109	0.8-0.95	Silty clay	41	24,390	Non Aggressive
BH109	1.8-1.95	XW: Sandstone	41	24,390	Non Aggressive
BH110	0-0.1	Silty clay	53	18,868	Non Aggressive
BH110	0.8-0.95	XW: Sandstone	31	32,258	Non Aggressive
Total Number of Samples			38	38	-
Minimum Value			17	4,762	-
Maximum Value			210	58,824	-

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

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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	0-0.1	Silty clay	6.3	Non-Aggressive	Non-Aggressive
BH101 - LAB DUP	0-0.1	LAB DUPLICATE	6.3	Non-Aggressive	Non-Aggressive
BH101	0.8-0.95	Silty clay	7.4	Non-Aggressive	Non-Aggressive
BH101	1.8-1.95	Silty clay	6	Non-Aggressive	Non-Aggressive
BH102	0-0.1	Silty clay	6	Non-Aggressive	Non-Aggressive
BH102	0.8-0.95	Silty clay	7.2	Non-Aggressive	Non-Aggressive
BH102	1.8-1.95	Silty clay	6.4	Non-Aggressive	Non-Aggressive
BH102	2.4-2.5	Silty clay	6.5	Non-Aggressive	Non-Aggressive
BH102	2.9-3	XW: Sandstone	6.7	Non-Aggressive	Non-Aggressive
BH103	0-0.1	Fill: Silty clay	4.8	Mildly Aggressive	Non-Aggressive
BH103	0.8-0.95	Fill: Silty clay	6.4	Non-Aggressive	Non-Aggressive
BH103 - LAB DUP	0.8-0.95	LAB DUPLICATE	6.6	Non-Aggressive	Non-Aggressive
BH103	1.4-1.5	Silty clay	6.8	Non-Aggressive	Non-Aggressive
BH103	1.8-1.95	Silty clay	6.8	Non-Aggressive	Non-Aggressive
BH103	2.9-3	XW: Sandstone	6.5	Non-Aggressive	Non-Aggressive
BH104	0-0.1	Silty clay	5.1	Mildly Aggressive	Non-Aggressive
BH104	0.8-0.95	Silty clay	7.1	Non-Aggressive	Non-Aggressive
BH104	1.8-1.95	Silty clay	6.8	Non-Aggressive	Non-Aggressive
BH104	2.4-2.5	XW: Sandstone	6.4	Non-Aggressive	Non-Aggressive
BH104	2.9-3	XW: Sandstone	5.8	Non-Aggressive	Non-Aggressive
BH105	0.4-0.5	Silty clay	5.8	Non-Aggressive	Non-Aggressive
BH105 - LAB DUP	0.4-0.5	LAB DUPLICATE	5.9	Non-Aggressive	Non-Aggressive
BH105	0.8-0.95	XW: Sandstone	6.2	Non-Aggressive	Non-Aggressive
BH105	1.4-1.5	XW: Sandstone	5.7	Non-Aggressive	Non-Aggressive
BH106	0-0.1	Silty clay	5.7	Non-Aggressive	Non-Aggressive
BH106	0.8-0.95	XW: Sandstone	6.7	Non-Aggressive	Non-Aggressive
BH107	0-0.1	Silty clay	5.7	Non-Aggressive	Non-Aggressive
BH107	0.8-0.95	Silty clay	6.6	Non-Aggressive	Non-Aggressive
BH107	1.4-1.5	XW: Sandstone	7	Non-Aggressive	Non-Aggressive
BH108	0-0.1	Silty clay	6.2	Non-Aggressive	Non-Aggressive
BH108	0.8-0.95	Silty clay	6.4	Non-Aggressive	Non-Aggressive
BH108 - LAB DUP	0.8-0.95	LAB DUPLICATE	6.4	Non-Aggressive	Non-Aggressive
BH108	1.65-1.7	XW: Sandstone	7.1	Non-Aggressive	Non-Aggressive
BH109	0-0.1	Silty clay	6.2	Non-Aggressive	Non-Aggressive
BH109	0.8-0.95	Silty clay	7.2	Non-Aggressive	Non-Aggressive
BH109	1.8-1.95	XW: Sandstone	7.3	Non-Aggressive	Non-Aggressive
BH110	0-0.1	Silty clay	5.6	Non-Aggressive	Non-Aggressive
BH110	0.8-0.95	XW: Sandstone	6.8	Non-Aggressive	Non-Aggressive
Total Number of Samples			38	-	-
Minimum Value			4.8	-	-
Maximum Value			7.4	-	-

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

pH Value	Classification for Concrete Piles	pH Value	Classification for Steel Piles
>5.5	Non-Aggressive	>5	Non-Aggressive
4.5 - 5.5	Mildly Aggressive	4.0 - 5.0	Non-Aggressive
4 - 4.5	Moderately Aggressive	3.0 - 4.0	Mildly Aggressive
<4	Severely Aggressive	<3	Moderately Aggressive

JKEnvironments

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	0-0.1	Silty clay	<10	20	Non-Aggressive	Non-Aggressive
BH101 - LAB DUP	0-0.1	LAB DUPLICATE	<10	20	Non-Aggressive	Non-Aggressive
BH101	0.8-0.95	Silty clay	<10	<10	Non-Aggressive	Non-Aggressive
BH101	1.8-1.95	Silty clay	250	<10	Non-Aggressive	Non-Aggressive
BH102	0-0.1	Silty clay	<10	30	Non-Aggressive	Non-Aggressive
BH102	0.8-0.95	Silty clay	20	10	Non-Aggressive	Non-Aggressive
BH102	1.8-1.95	Silty clay	130	47	Non-Aggressive	Non-Aggressive
BH102	2.4-2.5	Silty clay	90	71	Non-Aggressive	Non-Aggressive
BH102	2.9-3	XW: Sandstone	44	31	Non-Aggressive	Non-Aggressive
BH103	0-0.1	Fill: Silty clay	10	20	Non-Aggressive	Non-Aggressive
BH103	0.8-0.95	Fill: Silty clay	<10	20	Non-Aggressive	Non-Aggressive
BH103 - LAB DUP	0.8-0.95	LAB DUPLICATE	<10	20	Non-Aggressive	Non-Aggressive
BH103	1.4-1.5	Silty clay	10	20	Non-Aggressive	Non-Aggressive
BH103	1.8-1.95	Silty clay	32	<10	Non-Aggressive	Non-Aggressive
BH103	2.9-3	XW: Sandstone	<10	<10	Non-Aggressive	Non-Aggressive
BH104	0-0.1	Silty clay	<10	44	Non-Aggressive	Non-Aggressive
BH104	0.8-0.95	Silty clay	<10	<10	Non-Aggressive	Non-Aggressive
BH104	1.8-1.95	Silty clay	10	10	Non-Aggressive	Non-Aggressive
BH104	2.4-2.5	XW: Sandstone	<10	<10	Non-Aggressive	Non-Aggressive
BH104	2.9-3	XW: Sandstone	10	10	Non-Aggressive	Non-Aggressive
BH105	0.4-0.5	Silty clay	<10	28	Non-Aggressive	Non-Aggressive
BH105	0.8-0.95	XW: Sandstone	<10	20	Non-Aggressive	Non-Aggressive
BH105	1.4-1.5	XW: Sandstone	10	35	Non-Aggressive	Non-Aggressive
BH106	0-0.1	Silty clay	<10	22	Non-Aggressive	Non-Aggressive
BH106	0.8-0.95	XW: Sandstone	<10	10	Non-Aggressive	Non-Aggressive
BH107	0-0.1	Silty clay	<10	10	Non-Aggressive	Non-Aggressive
BH107	0.8-0.95	Silty clay	<10	20	Non-Aggressive	Non-Aggressive
BH107	1.4-1.5	XW: Sandstone	<10	<10	Non-Aggressive	Non-Aggressive
BH108	0-0.1	Silty clay	10	20	Non-Aggressive	Non-Aggressive
BH108	0.8-0.95	Silty clay	10	33	Non-Aggressive	Non-Aggressive
BH108 - LAB DUP	0.8-0.95	LAB DUPLICATE	10	33	Non-Aggressive	Non-Aggressive
BH108	1.65-1.7	XW: Sandstone	20	<10	Non-Aggressive	Non-Aggressive
BH109	0-0.1	Silty clay	<10	20	Non-Aggressive	Non-Aggressive
BH109	0.8-0.95	Silty clay	<10	20	Non-Aggressive	Non-Aggressive
BH109	1.8-1.95	XW: Sandstone	<10	10	Non-Aggressive	Non-Aggressive
BH110	0-0.1	Silty clay	<10	10	Non-Aggressive	Non-Aggressive
BH110	0.8-0.95	XW: Sandstone	<10	20	Non-Aggressive	Non-Aggressive
Total Number of Samples			37	37	-	-
Minimum Value			<PQL	<PQL	-	-
Maximum Value			250	71	-	-

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	Chloride Values	Classification for Steel Piles
<5,000	Non-Aggressive	<5,000	Non-Aggressive
5,000 - 10,000	Mildly Aggressive	5,000 - 20,000	Non-Aggressive
10,000 - 20,000	Moderately Aggressive	20,000 - 50,000	Mildly Aggressive
>20,000	Severely 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)					%	
BH101	0-0.1	Silty clay	0.5	0.3	0.2	<0.1	1	10.0%	2.5:1
BH101 - LAB DUP	0-0.1	LAB DUPLICATE	0.5	0.3	0.2	<0.1	1	10.0%	2.5:1
BH102	0.8-0.95	Silty clay	4.1	0.4	5.5	0.2	10	2.0%	0.75:1
BH103	0-0.1	Fill: Silty clay	0.8	0.4	0.2	<0.1	1.4	7.1%	4.0:1
BH104	2.4-2.5	XW: Sandstone	0.3	0.2	5	0.8	6.2	12.9%	0.06:1
BH105	0.4-0.5	Silty clay	2.6	0.7	6.8	<0.1	10	1.0%	0.38:1
BH106	0-0.1	Silty clay	2.3	0.6	1.1	<0.1	4	2.5%	2.09:1
BH107	0.8-0.95	Silty clay	4	0.6	9.3	0.2	14	1.4%	0.43:1
BH108	0-0.1	Silty clay	1.8	0.4	4.5	0.3	7	4.3%	0.4:1
BH109	0.8-0.95	Silty clay	5.1	0.4	8	0.3	14	2.1%	0.64:1
BH110	0-0.1	Silty clay	4.4	0.2	6.2	0.5	11	4.5%	0.71:1
Total Number of Samples			11	11	11	11	11	11	11
Minimum Value			0.30	0.20	0.20	<PQL	1.0	1.0%	0.06 :1
Maximum Value			5.10	0.70	9.30	0.80	14.0	12.9%	4.0 :1

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

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: Borehole Logs

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BOREHOLE LOG

Borehole No. 1

1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT **Method:** SPIRAL AUGER **R.L. Surface:** 724.9 m
Date: 16/10/24 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** C.A.R./A.B.

Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION		CL-CI	Silty CLAY: low to medium plasticity, brown and grey, trace of fine to medium grained quartz and ironstone gravel.	w<PL	Hd		RESIDUAL SCREEN: 11.5kg 0-0.2m, NO FCF
	N = 30 12,12,18	CH	as above, but high plasticity and orange brown.			>600 >600 >600	SCREEN: 2.4kg 0.2-1.0m, NO FCF
		CL	Silty CLAY: low plasticity, grey and yellow brown.	w>PL	VSt	220 240 260	
	N = 28 6,8,20	CH	as above, but high plasticity, with fine to coarse grained quartz and ironstone gravel.		Hd	520 600 580	
		-	Extremely Weathered silty sandstone: silty CLAY, low plasticity, light grey.	XW	Hd		ABERCROMBIE FORMATION VERY LOW 'TC' BIT RESISTANCE
			Silty SANDSTONE: fine grained, light grey.	DW	M		MODERATE RESISTANCE
			END OF BOREHOLE AT 3.70 m				'TC' BIT REFUSAL GROUNDWATER MONITORING WELL INSTALLED TO 3.7m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.7m TO 3.0m. CASING 0m TO 0.7m. 2mm SAND FILTER PACK 0m TO 0.5m. BENTONITE SEAL 0m TO 0.5m.

RL (m AHD): 724, 723, 722, 721, 720, 719, 718
Depth (m): 1, 2, 3, 4, 5, 6

SAMPLES: ES, U50, DB, DS

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BOREHOLE LOG

Borehole No. 6

1 / 1

SDUP5: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT **Method:** SPIRAL AUGER **R.L. Surface:** 735.3 m
Date: 15/10/24 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** K.R./A.B.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	N = 15 6,8,7 (0.5–0.95 m) N = 18 3,6,12 (1.5–1.95 m)	0–1.3	CH	Silty CLAY: high plasticity, red brown and brown, with fine to medium grained quartz gravel, trace of fine to medium grained ironstone gravel, and root fibres.	w<PL	Hd	>600 >600 >600	GRASS COVER RESIDUAL SCREEN: 11.8kg 0-0.2m, NO FCF
		1.3–1.9		as above, but red brown, grey and orange brown, without root fibres.			>600 >600 >600	
		1.9–2.5	-	Extremely Weathered sandstone: silty CLAY, low plasticity, orange brown and light grey, trace of fine to medium grained ironstone and quartz gravel.	XW	Hd	>600 >600 >600	ABERCROMBIE FORMATION LOW 'TC' BIT RESISTANCE
		2.5–3.2		SANDSTONE: fine to medium grained, orange brown and grey, with extremely weathered and iron indurated bands and fine to medium grained quartz gravel.	HW	L		
		3.2–5.6		SANDSTONE: fine to medium grained, light grey, grey and orange brown, trace of fine to medium grained quartz gravel.	DW	M H		MODERATE RESISTANCE MODERATE TO HIGH RESISTANCE HIGH RESISTANCE
		5.6		END OF BOREHOLE AT 5.60 m				'TC' BIT REFUSAL GROUNDWATER MONITORING WELL INSTALLED TO 5.58m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.8m TO 5.58m. CASING 0m TO 2.8m. 2mm SAND FILTER PACK 2.5m TO 5.58m. BENTONITE SEAL 1.0m TO 2.5m. BACKFILLED WITH SAND TO THE SURFACE.

RL (m AHD): 735, 734, 733, 732, 731, 730, 729

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BOREHOLE LOG

Borehole No. 17

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT **Method:** SPIRAL AUGER **R.L. Surface:** 744.2 m
Date: 15/10/24 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** C.A.R./A.B.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	N = 14 8,7,7	744, 743	0–1.3	CH	Silty CLAY: high plasticity, ornage brown, trace of fine to medium grained ironstone and quartz gravel.	w<PL	Hd	>600 540 560	RESIDUAL SCREEN: 11.47kg 0-0.2m, NO FCF
		742	1.3–2.5	-	SANDSTONE: fine to medium grained, brown and grey.	DW	L		ABERCROMBIE FORMATION LOW 'TC' BIT RESISTANCE
		741, 740, 739, 738	2.5–7		REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 7.75m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 3.0m TO 7.75m. CASING 0m TO 3.0m. 2mm SAND FILTER PACK 2.1m TO 7.75m. BENTONITE SEAL 0.2m TO 2.1m. BACKFILLED WITH SAND TO THE SURFACE. STICKING OUT OF GROUND FOR VISIBILITY.

SAMPLES: ES, U50, DB, DS

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CORED BOREHOLE LOG

Borehole No.
17
2 / 2

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT **Core Size:** NMLC **R.L. Surface:** 744.2 m
Date: 15/10/24 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK500 **Bearing:** N/A **Logged/Checked By:** C.A.R./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	Formation
		742			START CORING AT 2.50m				
90% RETURN		741	3		SANDSTONE: fine to medium grained, light brown and grey, foliated at 40-50°.	MW	L	0.20	Abercrombie Formation
							M	0.60	
		740	4		MUDSTONE: grey and light brown, foliated at 35-50°.		M - H	0.80, 1.3, 0.60	
		739, 738	5, 6		Interbedded MUDSTONE: grey and light brown, and SANDSTONE: fine grained, light brown and grey, foliated at 40-50°.			1.2, 0.80, 1.5	
		737	7		SANDSTONE: fine grained, grey brown, foliated at 40-50°.		H	1.5, 1.2	
		736	8		END OF BOREHOLE AT 7.75 m				

Point load scale: VL -0.1, L -0.3, M -1, H -3, VH -10, EH
Spacing (mm): 600, 200, 60, 20

DEFECT DETAILS – DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness

Specific	General
(2.58m) J, 90°, Ir, R, Clay Ct	
(2.64m) XWS, 0°, 40 mm.t	
(2.74m) J, 80°, Ir, R, Fe Ct	
(3.06m) XWS, 40°, 8 mm.t	
(3.60m) Be, 45°, P, R, Clay Ct	
(3.62m) XWS, 0°, 30 mm.t	
(3.73m) Be, 40°, St, R, Clay Ct	
(3.89m) J, 90°, Ir, R, Clay FILLED, 2 mm.t	
(4.00m) J, 30°, P, R, Clay FILLED, 1 mm.t	
(4.39m) J, 30°, P, R, Clay FILLED, 2 mm.t	
(4.46m) J, 30°, P, R, Clay FILLED, 2 mm.t	
(4.50m) J, 30°, P, R, Clay FILLED, 8 mm.t	
(4.60m) J, 70°, St, R, Qz FILLED, 4 mm.t	
(4.64m) XWS, 30°, 6 mm.t	
	(4.65-4.87m) Closely spaced Ji, J and XWS, <10mm spacing
(5.16m) Be, 35°, P, R, Fe Ct	
(5.25m) Be, 35°, P, R, Fe Ct	
(5.51m) Be, 35°, P, R, Clay FILLED, 2 mm.t	
(5.60m) J, 0°, Ir, R, Clay Ct	
(5.89m) J x 2, 60°, P, R, Fe Ct	
(6.15m) Be, 40°, P, R, Fe Ct	
(6.18m) Ji, 70°, P	
(6.52m) XWS, 30°, 20 mm.t	
(6.84m) J, 80°, Ir, R, Fe Ct	
(7.03m) Be, 30°, P, R, Fe Ct	
(7.17m) Ji, 80°, Un	
(7.32m) Be, 40°, P, R, Fe Ct	
(7.42m) Be, 40°, P, R, Fe Ct	
(7.54m) Be, 40°, P, R, Fe Ct	
(7.67m) J, 70°, P, R, Fe Ct	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

BOREHOLE LOG

Borehole No.
28
1 / 2

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT **Method:** SPIRAL AUGER **R.L. Surface:** 740.7 m
Date: 16/10/24 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** C.A.R./A.B.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING			0	CI	Silty CLAY: medium plasticity, orange bronw, trace of fine to medium grained ironstone gravel.	w<PL	Hd	>600 >600 >600	RESIDUAL SCREEN: 10.5kg 0-0.2m, NO FCF
	N = 13 4,5,8	740							
			0.8	-	Extremely Weathered sandstone: silty CLAY, medium plasticity, light brown and grey.	XW	(Hd)		ABERCROMBIE FORMATION VERY LOW 'TC' BIT RESISTANCE TOO FRIABLE FOR HP TESTING
	N = 27 8,12,15	739	1–2						
			2.1		SANDSTONE: fine to medium grained, brown and grey.	DW	L - M		LOW TO MODERATE RESISTANCE
		738–734	2.5–6		REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 2.42m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 3.0m TO 7.42m. CASING 0m TO 3.0m. 2mm SAND FILTER PACK 2.0m TO 7.42m. BENTONITE SEAL 0m TO 2.0m.

SAMPLES: ES, U50, DB, DS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
28

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL IN BUNGENDORE
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: 37083LT	**Core Size:** NMLC	**R.L. Surface:** 740.7 m
Date: 16/10/24	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK500	**Bearing:** N/A	**Logged/Checked By:** C.A.R./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DETAILS – SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS – DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
					START CORING AT 2.48m						
90% RETURN		738			Interbedded SANDSTONE: fine to medium grained, brown, and MUDSTONE: grey brown, foliated at 50-60°.	HW	M	0.30		(2.58m) Be, 40°, P, R, Clay Ct (2.67m) XWS, 0°, 25 mm.t	Abercrombie Formation
			3		Extremely Weathered sandstone: silty CLAY, low plasticity, light brown, with fine to medium grained sand.	XW	(Hd)				
		737			MUDSTONE: grey brown and light brown, with occasional sandstone laminae, foliated at 35-50°.	HW	M	0.60		(3.19-3.62m) J, 90°, Ir, R, Clay FILLED, 10 mm.t (3.69m) Ji, 90°, Ir (3.78m) J, 80°, St, R, Clay Ct	
		736	4					0.60 0.70		(4.20m) J, 10°, Ir, R, Clay Ct (4.28m) J, 20°, P, R, Clay Ct (4.38m) Be, 35°, C, Clay Ct (4.44m) J x 2, 20°, C, R, Clay Ct (4.50m) XWS, 0°, 70 mm.t	
		735	5		as above, but with conglomerate bands and quartz gravel.			1.0 0.90 0.70		(4.83m) J, 20°, Ir, R, Qz FILLED (4.92m) J, 10°, St, R, Fe Ct (5.06m) Ji, 70°, P (5.18m) J, 90°, St, R, Fe Ct (5.34m) J, 80°, St, R, Clay Ct (5.37m) CS, 20°, 10 mm.t (5.53m) J, 90°, Ir, R, Qz FILLED (5.76m) J, 60°, St, R, Qz FILLED	
		734	6 7		MUDSTONE: brown and grey, with fine grained sandstone bands, foliated at 30-50°.			0.60 0.40 0.60 0.30 0.50 0.60		(5.93m) J, 20°, C, S, Fe Ct (6.07m) J, 10°, P, R, Clay Ct (6.16m) Be, 40°, P, R, Clay Ct (6.21m) Be, 40°, P, R, Clay Ct (6.30m) Be, 30°, P, R, Clay Ct (6.40m) J, 60°, C, R, Fe Ct (6.55m) Be, 50°, P, R, Clay Ct (6.60m) Be, 50°, P, R, Clay Ct (6.72m) Be, 50°, P, R, Clay Ct (6.79m) Be, 40°, P, R, Clay Ct (6.86m) Be, 35°, C, R, Fe Ct (6.90m) XWS, 15°, 25 mm.t (7.03m) Be, 30°, P, R, Clay Ct (7.10m) Be, 30°, P, R, Clay Ct (7.26m) J, 70°, P, R, Fe Ct	
		733 732	8		END OF BOREHOLE AT 7.42 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH101** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED NEW HIGH SCHOOL

Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 20/11/24 **Datum:** -

Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		0	CL	Silty CLAY: low plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
	N = 10 3,6,4	0.5	CI-CH	Silty CLAY: medium to high plasticity, grey and orange brown, trace of ironstone gravel.	w<PL			
	N = 8 3,3,5	1.5						
		2		END OF BOREHOLE AT 2.0m				

SAMPLES: ES, ASS, ASB, SAL, DB

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH102**

1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED NEW HIGH SCHOOL

Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 21/11/24 **Datum:** -

Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES / ASS / ASB / SAL / 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		CL-CI	Silty CLAY: low to medium plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
		N = 17 3,9,8	0.5							
					CI-CH	Silty CLAY: medium to high plasticity, orange brown, trace of quartz and ironstone gravel.	w<PL			
			1			Silty CLAY: medium to high plasticity, grey mottled orange brown, trace of quartz gravel.	w<PL			
		N = 7 2,2,5	1.5							
			2							
			2.5							
					-	Extremely Weathered sandstone: silty CLAY, low plasticity, orange brown, with fine grained sand.	XW			
			3			END OF BOREHOLE AT 3.0m				
			3.5							

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ENVIRONMENTAL LOG

Log No. **BH103** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, 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 clay, low plasticity, light brown, trace of ironstone gravel.	w<PL			
						as above, but orange brown.				
		N = 8 3,4,4	0.5			FILL: Silty clay, medium plasticity, orange brown, trace of slag.	w<PL			
			1							
		N = 9 3,4,5	1.5		CI-CH	Silty CLAY: medium to high plasticity, grey mottled red, trace of ironstone gravel.	w<PL			RESIDUAL
			2		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown and grey, with fine grained sand.	XW			
			2.5							LOW TO MODERATE RESISTANCE
			3			END OF BOREHOLE AT 3.0m				
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH104** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, 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		CL	Silty CLAY: low plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
					CI-CH	Silty CLAY: medium to high plasticity, red brown, trace of ironstone and quartz gravel.	w<PL			
		N = 27 6,14,13	0.5			Silty CLAY: medium to high plasticity, red mottled grey, trace of ironstone gravel.	w<PL			
			1							
		N = 5 2,3,2	1.5							
			2		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown, with fine grained sand.	XW			LOW RESISTANCE
			2.5							LOW TO MODERATE RESISTANCE
			3			END OF BOREHOLE AT 3.0m				
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH105** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, 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		CL-CI	Silty CLAY: low to medium plasticity, orange brown, trace of ironstone and quartz gravel.	w<PL			RESIDUAL
					CI-CH	Silty CLAY: medium to high plasticity, red brown, trace of ironstone gravel.	w<PL			
		N = 18 3,9,9	0.5							
			1		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown mottled grey, with fine grained sand.	XW			LOW TO MODERATE RESISTANCE
			1.5			END OF BOREHOLE AT 1.5m				
			2							
			2.5							
			3							
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH106** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	Samples (ES / ASS / ASB / SAL / 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		CL	Silty CLAY: low plasticity, orange brown, trace of ironstone and quartz gravel.	w<PL			RESIDUAL
					CI-CH	Silty CLAY: medium to high plasticity, red brown, trace of ironstone gravel.	w<PL			
		N = 19 5,9,10	0.5		-	Extremely Weathered sandstone: silty CLAY, low plasticity, red brown, with fine grained sand, trace of ironstone gravel.	XW			MODERATE RESISTANCE HIGH RESISTANCE
			1.5			END OF BOREHOLE AT 1.5m				

Depth scale: 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH107**

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED NEW HIGH SCHOOL

Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 21/11/24 **Datum:** -

Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES / ASS / ASB / SAL / 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		CL	Silty CLAY: low plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
					CI-CH	Silty CLAY: medium to high plasticity, red mottled grey, trace of ironstone gravel.	w<PL			
		N = 13 6,8,5	0.5							
			1		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown, with fine grained sand.	XW			
										LOW RESISTANCE
			1.5			END OF BOREHOLE AT 1.5m				
			2							
			2.5							
			3							
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH108** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED NEW HIGH SCHOOL

Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 21/11/24 **Datum:** -

Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, 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		CL	Silty CLAY: low plasticity, orange brown, trace of quartz and ironstone gravel, and root fibres.	w<PL			RESIDUAL
						as above, but red brown.				
		N = 17 4,9,8	0.5 – 1							
		N > 8 7,8/20mm REFUSAL	1.5		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown, with fine grained sand.	XW			LOW RESISTANCE
			2			END OF BOREHOLE AT 2.0m				MODERATE RESISTANCE
			2.5							
			3							
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH109** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	Samples (ES / ASS / ASB / SAL / 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		CL-CI	Silty CLAY: low to medium plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
		N = 11 6,6,5	0.5		CI-CH	Silty CLAY: medium to high plasticity, orange mottled red, trace of ironstone gravel.	w<PL			
		N > 7 4,7/20mm REFUSAL	1.5		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light brown, with fine grained sand.	XW			MODERATE TO HIGH RESISTANCE
			2			END OF BOREHOLE AT 2.0m				
			2.5							
			3							
			3.5							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH110** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED NEW HIGH SCHOOL
Location: BIRCHFIELD DRIVE, BUNGENDORE, NSW

Job No.: E37084PT **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 21/11/24 **Datum:** -
Plant Type: JK400 **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES (ES / ASS / ASB / SAL / 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		CL	Silty CLAY: low plasticity, orange brown, trace of quartz gravel.	w<PL			RESIDUAL
						as above, but red brown.				
		N = 25 6,11,14	0.5							
					-	MUDSTONE: fine grained, light brown.	DW			
			1							
			1.5			END OF BOREHOLE AT 1.5m				
			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:

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

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:

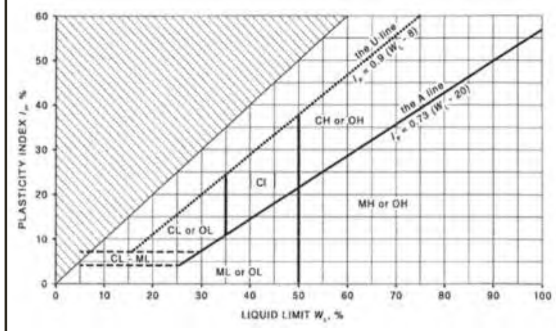
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

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



JKEnvironments

LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
	C	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	Vane shear reading in kPa of undrained shear strength.
	PID = 100	Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.
	w ≈ PL	Moisture content estimated to be approximately equal to plastic limit.
	w < PL	Moisture content estimated to be less than plastic limit.
	w ≈ LL	Moisture content estimated to be near liquid limit.
	w > LL	Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D	DRY – runs freely through fingers.
	M	MOIST – does not run freely but no free water visible on soil surface.
	W	WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.
	Hd	HARD – unconfined compressive strength > 400kPa.
	Fr	FRIABLE – strength not attainable, soil crumbles.
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.

Log Column	Symbol	Definition	Density Index (I_D) Range (%)	SPT 'N' Value Range (Blows/300mm)
Density Index/ Relative Density (Cohesionless Soils)	VL	VERY LOOSE	≤ 15	0 – 4
	L	LOOSE	> 15 and ≤ 35	4 – 10
	MD	MEDIUM DENSE	> 35 and ≤ 65	10 – 30
	D	DENSE	> 65 and ≤ 85	30 – 50
	VD	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

<table>
<tr><th colspan="2">Term</th><th colspan="2">Abbreviation</th><th>Definition</th></tr>
<tr><td colspan="2">Residual Soil</td><td colspan="2">RS</td><td>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.</td></tr>
<tr><td colspan="2">Extremely Weathered</td><td colspan="2">XW</td><td>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.</td></tr>
<tr><td>Highly Weathered</td><td rowspan="2">Distinctly Weathered (Note 1)</td><td>HW</td><td rowspan="2">DW</td><td>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.</td></tr>
<tr><td>Moderately Weathered</td><td>MW</td><td>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.</td></tr>
<tr><td colspan="2">Slightly Weathered</td><td colspan="2">SW</td><td>Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Fresh</td><td colspan="2">FR</td><td>Rock shows no sign of decomposition of individual minerals or colour changes.</td></tr>
</table>

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

			Guide to Strength	
Term	Abbreviation	Uniaxial Compressive Strength (MPa)	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 E: Laboratory Reports & COC Documents

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CERTIFICATE OF ANALYSIS 367148

Client Details

Client	JK Environments
Attention	Katrina Taylor
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E37084PT Bungendore**
Number of Samples	51 Soil
Date samples received	22/11/2024
Date completed instructions received	22/11/2024

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	29/11/2024
Date of Issue	29/11/2024

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

Results Approved By
Giovanni Agosti, Group Technical Manager
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Texture and Salinity*						
Our Reference		367148-1	367148-3	367148-5	367148-6	367148-8
Your Reference	UNITS	BH101	BH101	BH101	BH102	BH102
Depth		0-0.1	0.8-0.95	1.8-1.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	μS/cm	53	24	180	79	42
Texture Value	-	9.0	9.0	7.0	9.0	6.0
Texture	-	CLAY LOAM	CLAY LOAM	MEDIUM CLAY	CLAY LOAM	HEAVY 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		367148-10	367148-11	367148-12	367148-13	367148-15
Your Reference	UNITS	BH102	BH102	BH102	BH103	BH103
Depth		1.8-1.95	2.4-2.5	2.9-3	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	μS/cm	140	200	64	210	34
Texture Value	-	7.0	7.0	9.0	7.0	7.0
Texture	-	MEDIUM CLAY	MEDIUM CLAY	CLAY LOAM	MEDIUM CLAY	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		367148-16	367148-17	367148-19	367148-20	367148-22
Your Reference	UNITS	BH103	BH103	BH103	BH104	BH104
Depth		1.4-1.5	1.8-1.95	2.9-3	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	μS/cm	51	40	17	70	30
Texture Value	-	9.0	7.0	9.0	9.0	7.0
Texture	-	CLAY LOAM	MEDIUM CLAY	CLAY LOAM	CLAY LOAM	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		367148-24	367148-25	367148-26	367148-28	367148-29
Your Reference	UNITS	BH104	BH104	BH104	BH105	BH105
Depth		1.8-1.95	2.4-2.5	2.9-3	0.4-0.5	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	27/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	µS/cm	39	21	21	31	27
Texture Value	-	7.0	9.0	9.0	7.0	7.0
Texture	-	MEDIUM CLAY	CLAY LOAM	CLAY LOAM	MEDIUM CLAY	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		367148-30	367148-31	367148-33	367148-35	367148-37
Your Reference	UNITS	BH105	BH106	BH106	BH107	BH107
Depth		1.4-1.5	0-0.1	0.8-0.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	µS/cm	48	91	47	36	36
Texture Value	-	9.0	9.0	6.0	9.0	6.0
Texture	-	CLAY LOAM	CLAY LOAM	HEAVY CLAY	CLAY LOAM	HEAVY 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		367148-38	367148-39	367148-41	367148-43	367148-44
Your Reference	UNITS	BH107	BH108	BH108	BH108	BH109
Depth		1.4-1.5	0-.1	0.8-0.95	1.65-1.7	0-0.1
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	µS/cm	20	48	40	43	91
Texture Value	-	7.0	9.0	6.0	9.0	9.0
Texture	-	MEDIUM CLAY	CLAY LOAM	HEAVY 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	UNITS	367148-46	367148-48	367148-49	367148-51
Your Reference		BH109	BH109	BH110	BH110
Depth		0.8-0.95	1.8-1.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Date analysed	-	25/11/2024	25/11/2024	25/11/2024	25/11/2024
Electrical Conductivity 1:5 soil:water	µS/cm	41	41	53	31
Texture Value	-	6.0	6.0	9.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	CLAY LOAM	HEAVY CLAY
ECe	dS/m	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Misc Inorg - Soil						
Our Reference		367148-1	367148-3	367148-5	367148-6	367148-8
Your Reference	UNITS	BH101	BH101	BH101	BH102	BH102
Depth		0-0.1	0.8-0.95	1.8-1.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	6.3	7.4	6.0	6.0	7.2
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	250	<10	20
Sulphate, SO4 1:5 soil:water	mg/kg	20	<10	<10	30	10
Resistivity in soil*	ohm m	190	410	56	130	240

Misc Inorg - Soil						
Our Reference		367148-10	367148-11	367148-12	367148-13	367148-15
Your Reference	UNITS	BH102	BH102	BH102	BH103	BH103
Depth		1.8-1.95	2.4-2.5	2.9-3	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	6.4	6.5	6.7	4.8	6.4
Chloride, Cl 1:5 soil:water	mg/kg	130	90	44	10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	47	71	31	20	20
Resistivity in soil*	ohm m	74	51	160	47	290

Misc Inorg - Soil						
Our Reference		367148-16	367148-17	367148-19	367148-20	367148-22
Your Reference	UNITS	BH103	BH103	BH103	BH104	BH104
Depth		1.4-1.5	1.8-1.95	2.9-3	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	6.8	6.8	6.5	5.1	7.1
Chloride, Cl 1:5 soil:water	mg/kg	10	32	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	20	<10	<10	44	<10
Resistivity in soil*	ohm m	200	250	580	140	340

Misc Inorg - Soil						
Our Reference		367148-24	367148-25	367148-26	367148-28	367148-29
Your Reference	UNITS	BH104	BH104	BH104	BH105	BH105
Depth		1.8-1.95	2.4-2.5	2.9-3	0.4-0.5	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	6.8	6.4	5.8	5.8	6.2
Chloride, Cl 1:5 soil:water	mg/kg	10	<10	10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	10	<10	10	28	20
Resistivity in soil*	ohm m	260	480	470	320	370

Misc Inorg - Soil						
Our Reference		367148-30	367148-31	367148-33	367148-35	367148-37
Your Reference	UNITS	BH105	BH106	BH106	BH107	BH107
Depth		1.4-1.5	0-0.1	0.8-0.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	5.7	5.7	6.7	5.7	6.6
Chloride, Cl 1:5 soil:water	mg/kg	10	<10	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	35	22	10	10	20
Resistivity in soil*	ohm m	210	110	210	280	280

Misc Inorg - Soil						
Our Reference		367148-38	367148-39	367148-41	367148-43	367148-44
Your Reference	UNITS	BH107	BH108	BH108	BH108	BH109
Depth		1.4-1.5	0-.1	0.8-0.95	1.65-1.7	0-0.1
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	7.0	6.2	6.4	7.1	6.2
Chloride, Cl 1:5 soil:water	mg/kg	<10	10	10	20	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	20	33	<10	20
Resistivity in soil*	ohm m	510	210	250	230	110

Misc Inorg - Soil					
Our Reference		367148-46	367148-48	367148-49	367148-51
Your Reference	UNITS	BH109	BH109	BH110	BH110
Depth		0.8-0.95	1.8-1.95	0-0.1	0.8-0.95
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024
Date analysed	-	27/11/2024	27/11/2024	27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units	7.2	7.3	5.6	6.8
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	20	10	10	20
Resistivity in soil*	ohm m	240	250	190	320

CEC						
Our Reference		367148-1	367148-8	367148-13	367148-25	367148-28
Your Reference	UNITS	BH101	BH102	BH103	BH104	BH105
Depth		0-0.1	0.8-0.95	0-0.1	2.4-2.5	0.4-0.5
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	28/11/2024	28/11/2024	28/11/2024	28/11/2024	28/11/2024
Date analysed	-	28/11/2024	28/11/2024	28/11/2024	28/11/2024	28/11/2024
Exchangeable Ca	meq/100g	0.5	4.1	0.8	0.3	2.6
Exchangeable K	meq/100g	0.3	0.4	0.4	0.2	0.7
Exchangeable Mg	meq/100g	0.2	5.5	0.2	5.0	6.8
Exchangeable Na	meq/100g	<0.1	0.2	<0.1	0.8	<0.1
Cation Exchange Capacity	meq/100g	1.0	10	1.4	6.2	10

CEC						
Our Reference		367148-31	367148-37	367148-39	367148-46	367148-49
Your Reference	UNITS	BH106	BH107	BH108	BH109	BH110
Depth		0-0.1	0.8-0.95	0-.1	0.8-0.95	0-0.1
Date Sampled		21/11/2024	21/11/2024	21/11/2024	21/11/2024	21/11/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	28/11/2024	28/11/2024	28/11/2024	28/11/2024	28/11/2024
Date analysed	-	28/11/2024	28/11/2024	28/11/2024	28/11/2024	28/11/2024
Exchangeable Ca	meq/100g	2.3	4.0	1.8	5.1	4.4
Exchangeable K	meq/100g	0.6	0.6	0.4	0.4	0.2
Exchangeable Mg	meq/100g	1.1	9.3	4.5	8.0	6.2
Exchangeable Na	meq/100g	<0.1	0.2	0.3	0.3	0.5
Cation Exchange Capacity	meq/100g	4.0	14	7.0	14	11

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. 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.
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: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			25/11/2024	1	25/11/2024	25/11/2024		25/11/2024	[NT]
Date analysed	-			25/11/2024	1	25/11/2024	25/11/2024		25/11/2024	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	53	54	2	99	[NT]
Texture Value	-		INORG-123	[NT]	1	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-2	[NT]
Date prepared	-			[NT]	15	25/11/2024	25/11/2024		25/11/2024	[NT]
Date analysed	-			[NT]	15	25/11/2024	25/11/2024		25/11/2024	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	15	34	31	9	99	[NT]
Texture Value	-		INORG-123	[NT]	15	7.0	7.0	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]	28	25/11/2024	25/11/2024		[NT]	[NT]
Date analysed	-			[NT]	28	25/11/2024	25/11/2024		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	28	31	32	3	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	28	7.0	7.0	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]	41	25/11/2024	25/11/2024		[NT]	[NT]
Date analysed	-			[NT]	41	25/11/2024	25/11/2024		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	41	40	40	0	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	41	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	367148-3
Date prepared	-			27/11/2024	1	27/11/2024	27/11/2024		27/11/2024	27/11/2024
Date analysed	-			27/11/2024	1	27/11/2024	27/11/2024		27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	6.3	6.3	0	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	109	100
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	20	20	0	99	110
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	1	190	190	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	367148-29
Date prepared	-			[NT]	15	27/11/2024	27/11/2024		27/11/2024	27/11/2024
Date analysed	-			[NT]	15	27/11/2024	27/11/2024		27/11/2024	27/11/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	15	6.4	6.6	3	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	15	<10	<10	0	109	104
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	15	20	20	0	101	107
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	15	290	320	10	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	28	27/11/2024	27/11/2024		[NT]	[NT]
Date analysed	-			[NT]	28	27/11/2024	27/11/2024		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	28	5.8	5.9	2	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	28	<10	[NT]		[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	28	28	[NT]		[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	28	320	320	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]	41	27/11/2024	27/11/2024		[NT]	[NT]
Date analysed	-			[NT]	41	27/11/2024	27/11/2024		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	41	6.4	6.4	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	41	10	10	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	41	33	33	0	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	41	250	250	0	[NT]	[NT]

QUALITY CONTROL: CEC					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			28/11/2024	1	28/11/2024	28/11/2024		28/11/2024	[NT]
Date analysed	-			28/11/2024	1	28/11/2024	28/11/2024		28/11/2024	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	1	0.5	0.5	0	98	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	1	0.3	0.3	0	105	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	1	0.2	0.2	0	94	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	1	<0.1	<0.1	0	105	[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.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

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 Environments
Attention	Katrina Taylor

Sample Login Details	
Your reference	E37084PT Bungendore
Envirolab Reference	367148
Date Sample Received	22/11/2024
Date Instructions Received	22/11/2024
Date Results Expected to be Reported	29/11/2024

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	51 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	21
Cooling Method	None
Sampling Date Provided	YES

Comments

Nil

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
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Sample ID	Texture and Salinity*	Misc Inorg - Soil	CEC	On Hold
BH101-0-0.1	✓	✓	✓	
BH101-0.4-0.5				✓
BH101-0.8-0.95	✓	✓		
BH101-1.4-1.5				✓
BH101-1.8-1.95	✓	✓		
BH102-0-0.1	✓	✓		
BH102-0.4-0.5				✓
BH102-0.8-0.95	✓	✓	✓	
BH102-1.4-1.5				✓
BH102-1.8-1.95	✓	✓		
BH102-2.4-2.5	✓	✓		
BH102-2.9-3	✓	✓		
BH103-0-0.1	✓	✓	✓	
BH103-0.4-0.5				✓
BH103-0.8-0.95	✓	✓		
BH103-1.4-1.5	✓	✓		
BH103-1.8-1.95	✓	✓		
BH103-2.4-2.5				✓
BH103-2.9-3	✓	✓		
BH104-0-0.1	✓	✓		
BH104-0.4-0.5				✓
BH104-0.8-0.95	✓	✓		
BH104-1.4-1.5				✓
BH104-1.8-1.95	✓	✓		
BH104-2.4-2.5	✓	✓	✓	
BH104-2.9-3	✓	✓		
BH105-0-0.1				✓
BH105-0.4-0.5	✓	✓	✓	
BH105-0.8-0.95	✓	✓		
BH105-1.4-1.5	✓	✓		
BH106-0-0.1	✓	✓	✓	
BH106-0.4-0.5				✓

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customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	Texture and Salinity*	Misc Inorg - Soil	CEC	On Hold
BH106-0.8-0.95	✓	✓		
BH106-1.4-1.5				✓
BH107-0-0.1	✓	✓		
BH107-0.4-0.5				✓
BH107-0.8-0.95	✓	✓	✓	
BH107-1.4-1.5	✓	✓		
BH108-0-.1	✓	✓	✓	
BH108-0.4-0.5				✓
BH108-0.8-0.95	✓	✓		
BH108-1.4-1.5				✓
BH108-1.65-1.7	✓	✓		
BH109-0-0.1	✓	✓		
BH109-0.4-0.5				✓
BH109-0.8-0.95	✓	✓	✓	
BH109-1.4-1.5				✓
BH109-1.8-1.95	✓	✓		
BH110-0-0.1	✓	✓	✓	
BH110-0.4-0.5				✓
BH110-0.8-0.95	✓	✓		

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.

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: E37084PT Date Results Required: STANDARD Page: 1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Katrina Taylor

Location: Bungendore, NSW

Sampler: LR

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	Aggressivity: Sulfate, chloride, pH, EC, resistivity	ECe (texture)	CEC									
20.11.2024	1	BH101	0-0.1	P	Silty Clay	X	X	X									
20.11.2024	2	BH101	0.4-0.5	P	Silty Clay												
20.11.2024	3	BH101	0.8-0.95	P	Silty Clay	X	X										
20.11.2024	4	BH101	1.4-1.5	P	Silty Clay												
20.11.2024	5	BH101	1.8-1.95	P	Silty Clay	X	X										
21.11.2024	6	BH102	0-0.1	P	Silty Clay	X	X										
21.11.2024	7	BH102	0.4-0.5	P	Silty Clay												
21.11.2024	8	BH102	0.8-0.95	P	Silty Clay	X	X	X									
21.11.2024	9	BH102	1.4-1.5	P	Silty Clay												
21.11.2024	10	BH102	1.8-1.95	P	Silty Clay	X	X										
21.11.2024	11	BH102	2.4-2.5	P	Silty Clay	X	X										
21.11.2024	12	BH102	2.9-3	P	XW: Siltstone	X	X										
21.11.2024	13	BH103	0-0.1	P	F: Silty Clay	X	X	X									
21.11.2024	14	BH103	0.4-0.5	P	F: Silty Clay												
21.11.2024	15	BH103	0.8-0.95	P	F: Silty Clay	X	X										
21.11.2024	16	BH103	1.4-1.5	P	Silty Clay	X	X										
21.11.2024	17	BH103	1.8-1.95	P	Silty Clay	X	X										
21.11.2024	18	BH103	2.4-2.5	P	XW: Siltstone												
21.11.2024	19	BH103	2.9-3	P	XW: Siltstone	X	X										
21.11.2024	20	BH104	0-0.1	P	Silty Clay	X	X										
21.11.2024	21	BH104	0.4-0.5	P	Silty Clay												
21.11.2024	22	BH104	0.8-0.95	P	Silty Clay	X	X										
21.11.2024	23	BH104	1.4-1.5	P	Silty Clay												
21.11.2024	24	BH104	1.8-1.95	P	Silty Clay	X	X										
21.11.2024	25	BH104	2.4-2.5	P	XW: Siltstone	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:
			ENVIROLAB GROUP	

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

Job No: 367148

Date Received: 22/11/24
Time Received: 1530
Received By: EW
Temp: Cool/Ambient 21°C
Cooling: Ice/Icepack
Security: Intact/Broken/None

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: E37084PT Date Results Required: STANDARD Page: 2	**FROM:** JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Katrina Taylor

Location: Bungendore, NSW

Sampler: LR

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	Aggressivity: Sulfate, chloride, pH, EC, resistivity	ECe (texture)	CEC
21.11.2024	26	BH104	2.9-3	P	XW: Siltstone	X	X	
21.11.2024	27	BH105	0-0.1	P	Silty Clay			
21.11.2024	28	BH105	0.4-0.5	P	Silty Clay	X	X	X
21.11.2024	29	BH105	0.8-0.95	P	XW: Siltstone	X	X	
21.11.2024	30	BH105	1.4-1.5	P	XW: Siltstone	X	X	
21.11.2024	31	BH106	0-0.1	P	Silty Clay	X	X	X
21.11.2024	32	BH106	0.4-0.5	P	Silty Clay			
21.11.2024	33	BH106	0.8-0.95	P	XW: Siltstone	X	X	
21.11.2024	34	BH106	1.4-1.5	P	XW: Siltstone			
21.11.2024	35	BH107	0-0.1	P	Silty Clay	X	X	
21.11.2024	36	BH107	0.4-0.5	P	Silty Clay			
21.11.2024	37	BH107	0.8-0.95	P	Silty Clay	X	X	X
21.11.2024	38	BH107	1.4-1.5	P	XW: Siltstone	X	X	
21.11.2024	39	BH108	0-0.1	P	Silty Clay	X	X	X
21.11.2024	40	BH108	0.4-0.5	P	Silty Clay			
21.11.2024	41	BH108	0.8-0.95	P	Silty Clay	X	X	
21.11.2024	42	BH108	1.4-1.5	P	XW: Siltstone			
21.11.2024	43	BH108	1.65-1.7	P	XW: Siltstone	X	X	
21.11.2024	44	BH109	0-0.1	P	Silty Clay	X	X	
21.11.2024	45	BH109	0.4-0.5	P	Silty Clay			
21.11.2024	46	BH109	0.8-0.95	P	Silty Clay	X	X	X
21.11.2024	47	BH109	1.4-1.5	P	XW: Siltstone			
21.11.2024	48	BH109	1.8-1.95	P	XW: Siltstone	X	X	
21.11.2024	49	BH110	0-0.1	P	Silty Clay	X	X	X
21.11.2024	50	BH110	0.4-0.5	P	Silty 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:

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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: E37084PT Date Results Required: STANDARD Page: 3	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Katrina Taylor

Location:	Bungendore, NSW	Sample Preserved in Esky on Ice
Sampler:	LR	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	Aggressivity: Sulfate, chloride, pH, EC, resistivity	ECe (texture)	CEC									
21.11.2024	S1	BH110	0.8-0.95	P	XW: Siltstone	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:

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Appendix F: 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[11].
- 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.

[11] 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 G: Groundwater Field Records

JKEnvironments

Client:	School Infrastructure NSW	Job No.:	E37084PT
Project:	~~ESI~~ Salinity Investigation	Well No.:	MW1
Location:	Birchfield Drive, Bungendore, NSW	Depth (m):	3.7m

WELL FINISH

Gatic Cover	X	Standpipe		Other (describe)	

WELL PURGE DETAILS:

Method:	Bailer	SWL – Before:	Dry
Date:	22/11/24	Time – Before:	8:01am
Undertaken By:	LR	Total Vol Removed:	—
Pump Program No:	—	PID (ppm):	—

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
—	—	—	—	—	—	—	—	—
			Well effectively Dry					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)
Sampling Containers Used: x glass amber, x BTEX vials, x HNO3 plastic, x H2SO4 plastic, x unpreserved plastic
YSI used: —

Tested By:	LR	**Remarks:** - Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date Tested:	22.11.24	
Checked By:	KT	
Date:	29-11-24	

JKEnvironments

Client:	School Infrastructure NSW	Job No.:	E37084PT
Project:	Salinity Investigation	Well No.:	MW6
Location:	Birchfield Drive, Bungendore, NSW	Depth (m):	5.58m

WELL FINISH

Gatic Cover	X	Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	Bailer	SWL – Before:	Dry
Date:	22.11.24	Time – Before:	8:05am
Undertaken By:	LR	Total Vol Removed:	–
Pump Program No:	–	PID (ppm):	–

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
–	–	–	–	–	–	–	–	–
			Well effectively Dry					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)
Sampling Containers Used: x glass amber, x BTEX vials, x HNO3 plastic, x H2SO4 plastic, x unpreserved plastic
YSI used:
–

Tested By:	LR
Date Tested:	22.11.24
Checked By:	KT
Date:	29.11.24

Remarks:
- Steady state conditions
- difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown

JKEnvironments

Client:	School Infrastructure NSW	Job No.:	E37084PT
Project:	Salinity Investigation	Well No.:	MW17
Location:	Birchfield Drive, Bungendore, NSW	Depth (m):	7.75m

WELL FINISH

	Gatic Cover	X	Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	Bailer	SWL – Before:	Dry
Date:	22.11.24	Time – Before:	8:10am
Undertaken By:	LR	Total Vol Removed:	–
Pump Program No:	–	PID (ppm):	–

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
–	–	–	–	–	–	–	–	–
			Well effectively					
			Dry					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)
Sampling Containers Used: x glass amber, x BTEX vials, x HNO3 plastic, x H2SO4 plastic, x unpreserved plastic
YSI used: –

Tested By:	LR	**Remarks:** - Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date Tested:	22.11.24	
Checked By:	KT	
Date:	29-11-24	

JKEnvironments

Client:	Schol Infrastucture NSW	**Job No.:**	E37084PT
Project:	~~PSI~~ Salinity Investigation	**Well No.:**	MW20
Location:	Birchfield Drive, Bungendore, NSW	**Depth (m):**	7.42m

WELL FINISH

	Gatic Cover	X	Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	Bailer	**SWL – Before:**	Dry
Date:	22/11/24	**Time – Before:**	8:20am
Undertaken By:	LR	**Total Vol Removed:**	–
Pump Program No:	–	**PID (ppm):**	–

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
–	–	–	–	–	–	–	–	–
			Well effectively Dry					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)
Sampling Containers Used: x glass amber, x BTEX vials, x HNO3 plastic, x H2SO4 plastic, x unpreserved plastic
YSI used: –

Tested By:	LR	**Remarks:**
Date Tested:	22.11.24	- Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Checked By:	KT	
Date:	29.11.24	

JKEnvironments

Client:	School Infrastructure NSW	**Job No.:**	E37084PT
Project:	Salinity Investigation	**Well No.:**	MW1
Location:	Birchfield Drive, Bungendore, NSW	**Depth (m):**	3.7m

WELL FINISH DETAILS

Gatic Cover ☐ Standpipe ☒ Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	Development Pump	**SWL – Before (m):**	3.36m
Date:	20/11/24	**Time – Before:**	1:02pm
Undertaken By:	LR	**SWL – After (m):**	Dry
Total Vol. Removed:	1L	**Time – After:**	1:14pm
PID Reading (ppm):	–		
Comments:	0.49m standpipe		

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	SWL	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
0.5	3.36	22.3	13.4	2154	6.57	139.8
1	3.7	21.5	7.2	1280	6.52	127.2
–	–	–	–	–	–	–
Well effectively Dry						

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

YSI Used: YSI 4

Well effectively Dry

Tested By:	LR	**Remarks:**
Date Tested:	20.11.24	- 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 - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Checked By:	KT	
Date:	29.11.24	

JKEnvironments

Client:	School Infrastructure NSW	**Job No.:**	E37084PT
Project:	Salinity Investigation	**Well No.:**	MW6
Location:	Birchfield Drive, Bungendore, NSW	**Depth (m):**	5.58m

WELL FINISH DETAILS

	Gatic Cover ☐	Standpipe ☒	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	Development	**SWL – Before (m):**	Dry
Date:	20/11/24	**Time – Before:**	3:06pm
Undertaken By:	LR	**SWL – After (m):**	–
Total Vol. Removed:	0	**Time – After:**	–
PID Reading (ppm):	–		
Comments:	Standpipe = 0.37m		

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	SWL	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
–	–	–	–	–	–	–
Well effectively Dry						

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

YSI Used: YSI4

Well effectively Dry

Tested By:	LR	**Remarks:** - 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 - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date Tested:	20.11.24	
Checked By:	KT	
Date:	29.11.24	

JKEnvironments

Client:	School Infrastructure NSW	**Job No.:**	E37084PT
Project:	Salinity Investigation	**Well No.:**	MW17
Location:	Birchfield Drive, Bungendore, NSW	**Depth (m):**	7.75m

WELL FINISH DETAILS

	Gatic Cover ☐	Standpipe ☒	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	Development	**SWL – Before (m):**	6.33m
Date:	20/11/24	**Time – Before:**	1:37pm
Undertaken By:	LR	**SWL – After (m):**	Dry
Total Vol. Removed:	2.5L	**Time – After:**	1:53pm
PID Reading (ppm):	—		

Comments: Standpipe = 0.19m

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	SWL	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
1	6.78	16.9	2.9	1393	7.82	72.2
2		15.8	2.0	1259	8.02	58.8
2.5	7.75	16.1	3.4	1226	7.84	49.8
—	—	—	—	—	—	—
Well effectively	Dry					

Comments:Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO) Steady State Achieved (YES / NO)
YSI Used: YSI4

Well effectively Dry

Tested By:	LR	**Remarks:**
Date Tested:	20.11.24	- 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 - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Checked By:	KT	
Date:	24.11.24	

JKEnvironments

Client:	Schol Infrastucture NSW	**Job No.:**	E37084PT
Project:	Salinity Investigation	**Well No.:**	MW28
Location:	Birchfield Drive, Bungendore, NSW	**Depth (m):**	7.42m

WELL FINISH DETAILS

	Gatic Cover ☐	Standpipe ☒	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	Development	**SWL – Before (m):**	6.99m
Date:	20/11/24	**Time – Before:**	2:23pm
Undertaken By:	LR	**SWL – After (m):**	Dry
Total Vol. Removed:	2L	**Time – After:**	2:35pm
PID Reading (ppm):	–		

Comments: Standpipe = 0.02m

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	SWL	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
0.5	–	15.6	2.1	1344	7.97	81.4
2	7.43	15.0	2.0	1240	7.95	80.3
–	–	–	–	–	–	–
Well effectively Dry						

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

YSI Used: YSI4

Well effectively Dry

Tested By:	LR	**Remarks:**
Date Tested:	20.11.24	- 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 - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Checked By:	KT	
Date:	29.11.24	

JKEnvironments

PID FIELD CALIBRATION FORM

Client:	School Infrastructure NSW
Project:	Salinity Investigation
Location:	Birchfield Drive, Bungendore, NSW
Job Number:	E37084PT

PID

Make: Honeywell	Model: Minirae Lite +	Unit: Pid 2	Date of last factory calibration: 18/07/24
Date of calibration: 20/11/24		Name of Calibrator: LR	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: 100.4 ppm		Error in measured reading: ± 0.4 ppm	
Measured reading Acceptable (Yes/No): Yes			

PID

Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			

PID

Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			

PID

Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			

PID

Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			

JKEnvironments

WATER QUALITY METER CALIBRATION FORM

Client:	School Infrastructure NSW
Project:	~~PSI~~ Salinity Investigation
Location:	Birchfield Drive, Bungendore, NSW
Job Number:	E37084PT

DISSOLVED OXYGEN

Make:	Professional Series	Model:	YSI 4
Date of calibration:	20/11/24	Name of Calibrator:	LR
Span value: 70% to 130%			
Measured value:	76%		
Measured reading Acceptable (Yes/No):			

pH

Make:	Professional Series	Model:	YSI4	
Date of calibration:	20/11/24	Name of Calibrator:	LR	
Buffer 1: Theoretical pH = 7.01± 0.01		Expiry date: 5/25	Lot No:	EB040624
Buffer 2: Theoretical pH = 4.01± 0.01		Expiry date: 3/25	Lot No:	DU030124
Measured reading of Buffer 1:	6.96			
Measured reading of Buffer 2:	3.95			
Slope:		Measured reading Acceptable (Yes/No):		

EC

Make:	Professional Series	Model:	YSI4	
Date:	20/11/24	Name of Calibrator: LR	Temperature:	26 °C
Calibration solution:	Rowes scientific	Expiry date: 22/11/25	Lot No:	1C19548
Theoretical conductivity at temperature (see solution container):		1440 µS/cm		
Measured conductivity:	1432 µS/cm	Measured reading Acceptable (Yes/No):		

REDOX

Make:	Professional Series	Model:	YSI4	
Date of calibration:	20/11/24	Name of Calibrator:	LR	
Calibration solution:	ORP test Solution	Expiry date: 4/24	Lot No:	9920
Theoretical redox value:	240mV			
Measured redox reading:	240.6 mV	Measured reading Acceptable (Yes/No):		

Appendix H: General Salinity Mitigation Measures

Water inputs

- Infiltration of stormwater eliminated.
- Water features and permanent water bodies lined to eliminate infiltration.
- Underground water carrying pipes properly installed to eliminate leaks and on established sites existing pipes checked for damage/leaks.
- Swimming pools designed to eliminate leakage and an on-going maintenance plan developed.

Drainage

- Disturbance of natural drainage patterns avoided.
- Areas of cut and fill on sites restricted to building envelope.
- Necessary slab, foundations and retaining walls all must be designed for good drainage and to avoid water logging.
- Existing areas of waterlogging and poor drainage avoided or remediated, with consideration of shrink swell hazard.
- Stormwater management eliminates infiltration.
- Retaining walls, driveways and service connections designed to avoid cut, minimises impediment of natural groundwater flows and provides for good drainage.
- Guttering and down pipes properly connected and maintained.

Vegetation

- Areas of established vegetation maintained.
- Landscaping plans - apply Waterwise gardening principles.
- Gardens designed so that they are not adjacent to the property.
- Erosion/disturbance minimised and revegetated with appropriate species.
- Irrigation properly installed to avoid leakage and ‘smart’ sprinkler systems used.

Building/ Engineering

- Damp Proof Courses properly installed and maintained throughout construction, landscaping and finishing.
- Damp Proof membrane installed under slab.
- Reduce the exposure of materials to corrosive soils, eg. raised slab or pier and beam designs, with consideration of shrink swell hazard.
- Construction techniques minimise site disturbance and the exposure of sensitive soil material.
- Soil management plan addresses the management of saline and sodic soil
- Susceptible construction materials avoided, eg. porous material.
- Utilise appropriate salt resistant bricks and construction materials.
- Design and layout of drives and service connections minimises disturbance and exposure of susceptible soil and uses corrosive resistant material.
- Disturbance of soil on the site minimised and properly rehabilitated.

Source: Salinity Code of Practice