core
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Geotechnical & Acid Sulfate Soils Investigation Report

Proposed Multi-Storey Residential Development
260 Macarthur Avenue, Hamilton
Site 18

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Report Number: J002466-005-R-Rev0

16 December 2024

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Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery
Silverstone	Wade Fraser	Rev0	December 2024	Email (PDF)

1.0 INTRODUCTION

This report presents the results of a geotechnical and acid sulfate soils (ASS) investigation carried out by Core Consultants Pty Ltd (Core) for a proposed multi-storey residential development at 260 Macarthur Avenue, Hamilton. The site consists of Lot 6 on SP326594 (Site 18) with the area split into the eastern portion (Site 18A), in discussion, and the western portion (Site 18B), set aside for future development.

The work was carried out for Silverstone Developments (SD), in accordance with our proposal Q005146-001-L-Rev0, dated 13 June 2024.

2.0 PROPOSED DEVELOPMENT

The proposed development includes two buildings of 9 and 12 levels over a shared single-level inground basement, as shown in Images 1 to 3 below. Basement levels are to be finalised but bulk excavation to about RL 1.8 m with finished ground level at RL5.9 m (easement) and RL 4.720m (Footpath to Angora Road).

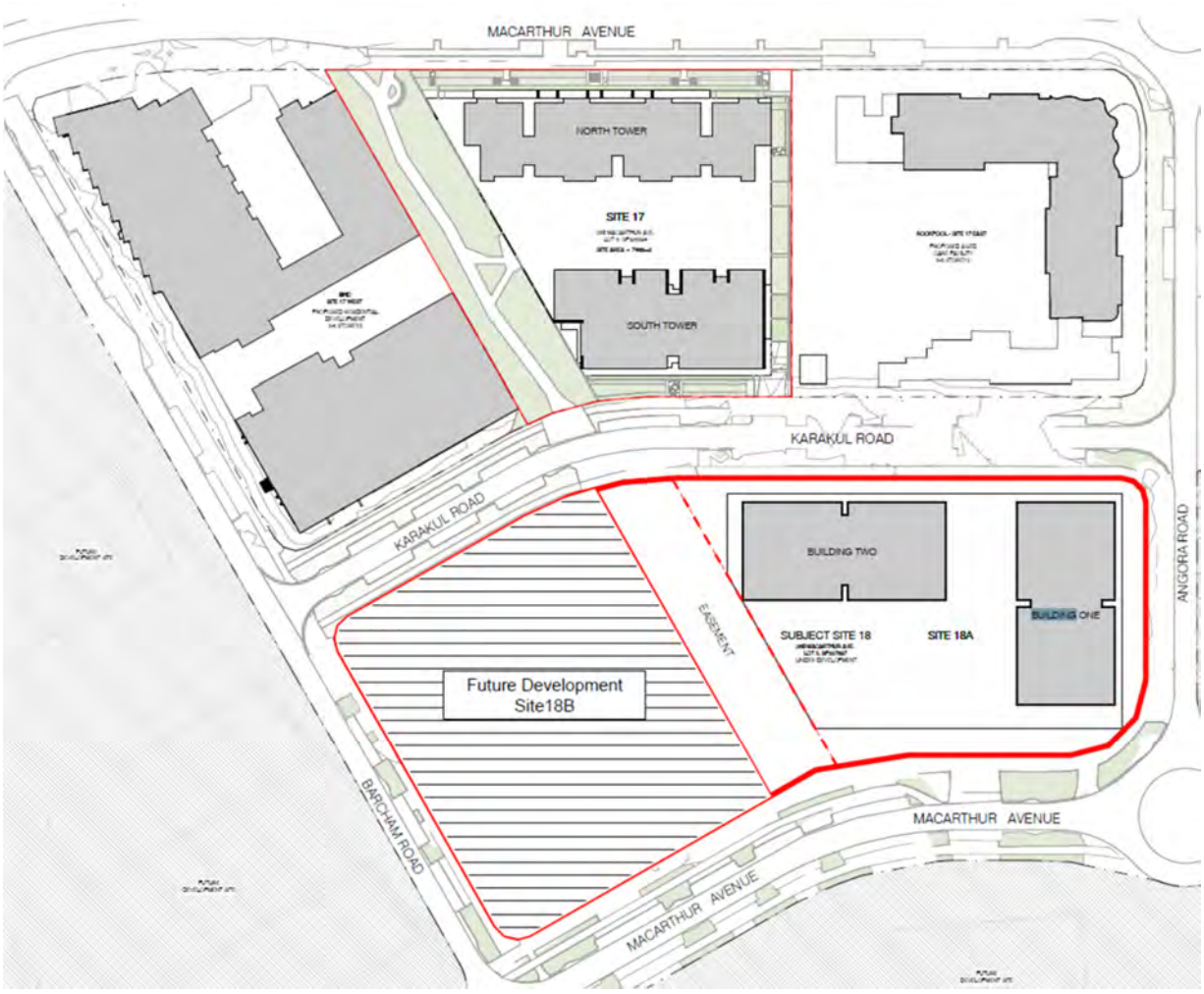

Image 1: Extract from proposed precinct development plan (Carr.

Image 2: Extract from proposed development plan at ground level (Carr 24047-TP2-1002).

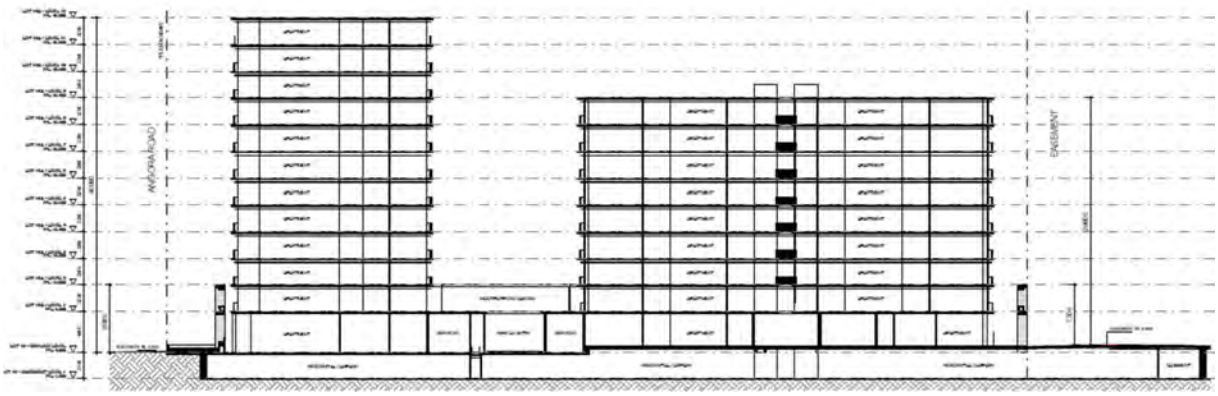

Image 3: Extract from proposed development Section plan (Carr 24047-TP2-3002).

3.0 SITE DESCRIPTION

The site is located at 260 Macarthur Avenue, Hamilton. Site 17 previously defined and is not a part of this report. Site 18 comprises Lot 6 on SP326594 which covers 14740 m^2. Site 18 is split into two portions, Site 18A the eastern portion and 18B western portion for future development. The site location is shown in Image 4 below.

Image 4: Site location (Aerial image sourced from Nearmap, Annotations by Core).

3.1 Site 18 (Lot 6 SP326594)

Site 18 (currently known as Lot 6 on SP326594) was entirely fenced and comprised an area of grass, bitumen sealed carparking area, concrete pads, a single storey warehouse and a few established trees along the south western boundary. Lot 6 was used for storage of construction equipment with multiple shipping containers observed and metal structure beams stacked over the bitumen hardstand areas. Light poles, in working order, were evident across the site (refer to photographs 1 and 2).

The elevation of the site ranges between about RL 4.3 m and 5.0 m Australian Height Datum (AHD), generally sloping down towards the southern boundary.

Karakul Road bounds Site 18 (6 on SP326594) to the north and east, followed by Site 17 (Lot 5 on SP326594). To the south east the site is bounded by Angora Road, with Sales and Display Centre for Northshore developments. Macarthur Avenue bounds the south followed by Northshore Tennis and carparking facility. To the west Barcham Road form the western boundary, followed by Northshore industrial development areas. The Brisbane River is located approximately 150 m to the south, with the cruise terminal approximately 200 m to the south west. Access is currently available from Karakul Road and Angora Road.

Photograph 1: Site 18 (Lot 6 SP326594) looking northwest towards the Corner of Karakul Road and Barcham Road.

Photograph 2: Site 18 looking east towards Angora Road.

4.0 METHOD OF INVESTIGATION

4.1 Review of Available Information

To assess likely ground conditions a review of published geological maps, aerial images, acid sulfate soils (ASS) maps and available geotechnical information was undertaken (refer Section 5).

4.2 Boreholes and Test Pits

Boreholes were drilled between 19 and 20 June 2024 in the presence of geotechnical personnel from Core, at the locations shown on the attached Figure 1 (Appendix A). Borehole positions were recorded in the field using a handheld GPS unit. All Boreholes were auger drilled using a 4WD mounted drill rig.

Site 18 (Lot 6 SP326594) comprised the following fieldwork:

- Six (6) boreholes (designated BH1 to BH6) auger-drilled to 3 m BGL
- Standard Penetration Testing (SPT) conducted at regular intervals in the boreholes with disturbed and undisturbed samples collected
- ASS samples were collected at 0.25 m intervals to 3 m BGL
- Dynamic Cone Penetrometer (DCP) testing was conducted within the boreholes to 1 m BGL
- A groundwater standpipe was installed on-site in BH2 and BH6 (denoted MW01 and MW02) and two were installed off-site for groundwater level measurement and sampling; the other boreholes were backfilled with drilled spoils and patched with cold-mix asphalt at the surface.

4.3 Geophysical Testing

Geophysical testing in the form of multi-channel analysis of surface waves (MASW) was undertaken on 9 July 2024 by a geotechnical engineer/engineering geophysicist from Core and comprised four survey alignments, Lines 1 and 2 in Lot 17 (Lot 5 SP326594) and Lines 3 and 4 in Lot 18 (Lot 6 SP326594).

MASW geophysical surveys use seismic surface (Rayleigh) wave phase and frequency data to estimate shear-wave velocities of the subsurface materials.

The MASW acquisition comprised the use of a 24-channel land streamer array with 4.5 Hz geophones spaced horizontally at 1 m. Each survey comprises a single 1-Dimensional vertical sounding recorded at the centre of the geophone array; as shown on Image 1 below. Vertical soundings were carried out at approximately 10 m intervals along each survey line.

The array was connected to a Geometrics Geode, with data recorded using the Geometrics Seismodule Controller Software (SCS). A sampling rate of 0.5 ms and sample record length of 2 seconds was adopted. The seismic source was a 7 kg sledgehammer striking a polyethylene plate, with an offset of 6 m. Vertical stacking of the seismic source was carried out to minimise ambient noise (i.e., wind and traffic) and increase the signal to noise ratio.

Sounding co-ordinates (X-Y-Z) were recorded in the field with a Trimble GNSS device with typically ± 0.2 m accuracy. Co-ordinates were recorded using Map Grid of Australia (GDA2020) and height above mean sea level (AUSGeoid20).

The acquired data was processed using the *SurfSeis 6* software, by Kansas Geological Society. Dispersion images were generated, which show the frequency versus the percentage intensity of phase velocity, for each acquired field record. A dispersion curve was then produced by picking the maximum intensity velocities (of the fundamental mode) across the useful range of frequencies. The dispersion curves for each survey alignment were put through an 8-layer inversion algorithm to produce one-dimensional shear-wave velocity soundings.

The S-wave soundings were then gridded using Golden Software's *Surfer 22* to produce two-dimensional shear-wave velocity sections.

The quality of the produced MASW dispersion curves for each sounding was typically good, with high signal-to-noise (S/N) ratios for the fundamental-mode dispersion energy, for a frequency range between about 4 Hz and 20 Hz.

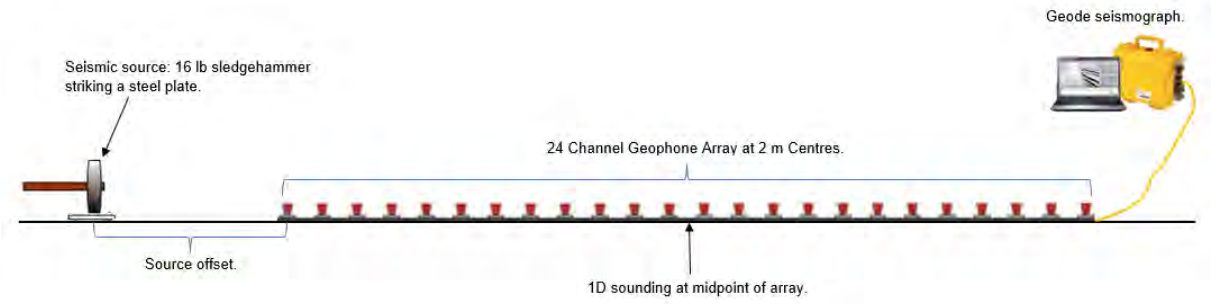

Image 5: Example MASW acquisition schematic.

4.4 Acid Sulfate Soils Sampling

The ASS component of the investigation was planned based on the findings of a desktop assessment (refer Section 7.0) and with reference to the following '*National Acid Sulfate Soils Guidance'* documents:

- National acid sulfate soils sampling and identification methods manual[1]
- National acid sulfate soils identification and laboratory methods manual[2]
- Guidance for the dewatering of acid sulfate soils in shallow groundwater requirements[3]
- Queensland State Planning Policy 2017 (SPP17) [4]

For this assessment, samples were recovered from six boreholes (BH1 – BH6) at 0.25 m intervals to a depth of 3 m BGL. ASS sampling protocols in the field were conducted to minimise oxidation prior to laboratory testing and followed the above referenced guidelines.

4.5 Groundwater Sampling

Groundwater sampling was undertaken in accordance with the following:

- Department of Environment Science and Innovation (DESI) Monitoring and Sampling Manual 2018.
- Groundwater was assessed using the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 *Brisbane River Estuary Environmental Values and Water Quality Objectives Part of Basin 143*.

The site is located within the Brisbane River Estuary – middle estuary waters area with the water quality objectives adopted for the environmental Value Zone and water type.

For this assessment, samples were recovered from the four monitoring wells (MW01 to MW04), two located on-site (Lot 6 SP326594) and two located off-site on neighbouring property (Lot 5 SP337697) that were installed to a depth of 3 m BGL. Samples were immediately placed in airtight containers supplied by the testing laboratory and then placed into a chilled insulated esky for transportation to the laboratory.

4.6 Laboratory Testing

4.6.1 Geotechnical Testing

Soil samples were forwarded to a NATA-accredited laboratory for geotechnical laboratory classification testing comprising particle size distribution, Atterberg limits, Emerson class, soil aggressivity and soaked CBR testing.

Geotechnical laboratory test results are discussed in Section 5.7.

4.6.2 Acid Sulfate Soil Testing

A total of 56 samples were screened for Lot 5 SP337697, to assess field pH (pH_F) and pH after oxidation (pH_{FOX}) using 30% hydrogen solution.

The pH_F/pH_{FOX} screening method consists of two steps. In the first step, the field pH of a 1:5 soil/water suspension is measured (pH_F). In the second step, a 30% Hydrogen Peroxide solution is added to a second sample of the same material which is then heated to accelerate the oxidation of the sample. The pH after oxidation (pH_{FOX}) is then measured. A significant difference between the pH_F and pH_{FOX} results is an

[1] Sullivan L, Ward N, Toppler N, Lancaster G, *National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual* (2018), Department of Agriculture and Water Resources, Canberra ACT.

[2] Sullivan L, Ward N, Toppler N, Lancaster G, *National Acid Sulfate Soils guidance: National acid sulfate soils identification and laboratory methods manual* (2018), Department of Agriculture and Water Resources, Canberra ACT.

[3] Sullivan L, Ward N, Toppler N, Lancaster G, *National Acid Sulfate Soils guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (2018), Department of Agriculture and Water Resources, Canberra ACT.

[4] State Planning Policy (2017), State of Queensland, Department of Infrastructure, Local Government and Planning.

indication of potential acid sulfate soils (PASS); however, test results may be affected by other inclusions such as shell material and organics.

Based on the results of pH screening tests, 17 samples were selected and dispatched to Eurofins to undergo quantitative analysis by the Chromium Reducible Sulfur (CRS) suite in accordance with ASS Method 23F and 22B laboratory procedures of Ahern et al (2004).

This CRS method includes analysis of ‘inherent buffering capacity’ from naturally occurring alkaline materials (i.e. calcite, coral debris, fine shell fragments) and 'retained acidity' which includes sulfur held in stable oxidation minerals such as 'jarosite' and allows for calculation of 'net acidity'. The CRS test method was selected in preference to the Suspension Peroxide Oxidation Combined Acidity & Sulfur (SPOCAS) method as is gives more accurate indications of pyrite content where significant amounts of organic matter (and organic derived acidity) are present in the soil samples. An overall acid-base accounting method was used to calculate a ‘net acidity’ value which is used to qualify analytical test results and calculate liming rates. This equation is:

Net Acidity = Actual Acidity (as TAA) + Retained Acidity (as S_{NAS}) + Potential Acidity (as S_{CR}) - insitu Acid Neutralising Capacity (ANC).

Groundwater samples were recovered from the standpipes (MW1 to MW4) and screened in the field, after initial purging. The groundwater sample was then dispatched to Eurofins/MGT (Eurofins) to undergo further water quality analysis.

All sample collection, in-situ testing and dispatch were performed in accordance with Core procedures for water quality monitoring and the Department of Environment and Science (DES) Monitoring and Sampling Manual 2018.

All groundwater samples were analysed for Total and dissolved Aluminium and Iron, Anions Cations, Chloride and Sulphides.

5.0 RESULTS

5.1 Published Geological Mapping

The Queensland Geotechnical Database (QGD) indicates that the site is located in an area of Quaternary age Anthropocene comprising :*Gravel, sand and silt; man-made deposits generally associated with land-fill or mining (tailings, dumps and rehabilitated areas*)”. An extract of the relevant geological map is shown in Image 4 below.

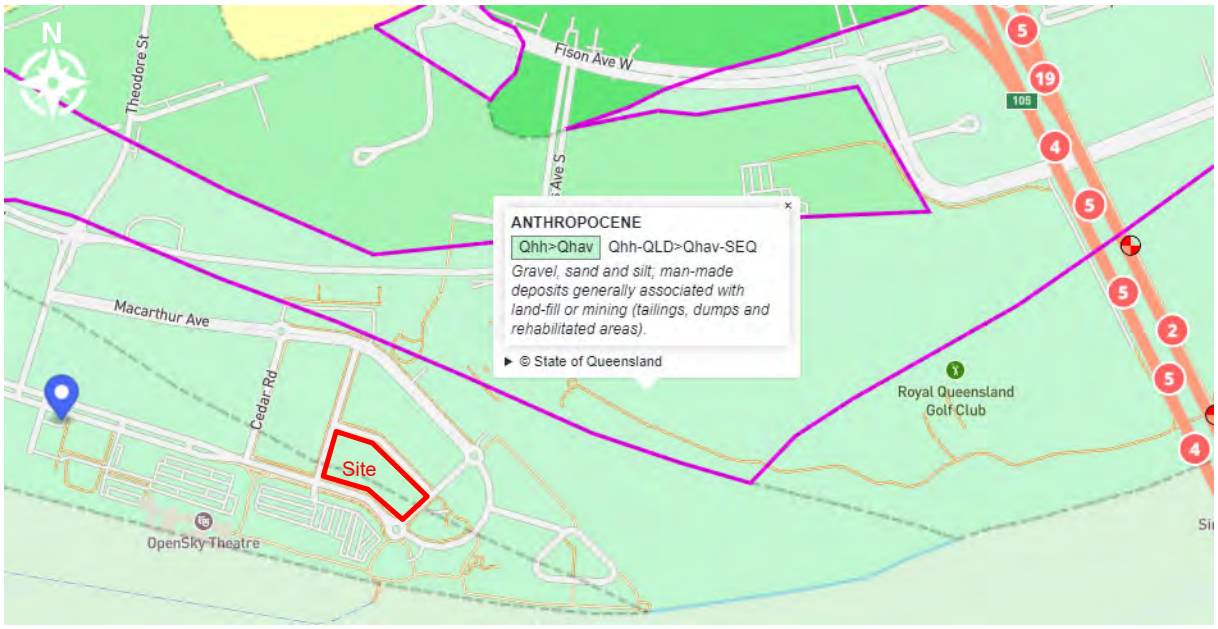

Image 4: Extract from QGD map showing regional geology (not to scale).

5.2 Historical Information & Aerial Images

The site history ('Northshore History') indicates that the site consisted of a river inlet until the early 1900's when the area of Hamilton was reclaimed as part of dredging of the Brisbane River to allow safer access for vessels, with the dredge spoil placed behind a 'training wall' across the inlet to create additional land. This dredging and filling process was conducted over decades of time. In 1999 the land was considered high enough to produce a Deed of Grant to the Port of Brisbane. The land was initially leased for shipping freight handling purposes until the 2010's when the land was redeveloped for future community development.

Historical aerial images (QImagery) indicate the following:

- In 1936 and up until 1963 the land was a back channel of the Brisbane River and grass paddocks (refer Image 6a).
- By 1967 (refer Image 6b) land development along the riverbank had started and the river channel was less evident.
- By 1972 (refer Image 6c) surrounding land was largely developed with buildings, although the site itself appeared undeveloped.
- In 1981 (refer Image 6d) there appears to be land reclamation at the site; after that the site appears grassed until the car storage was constructed sometime between 1994 and 1997.
- The site was used for shipping storage until 2009 at which time MacArthur Avenue was constructed and part of the site adjoining MacArthur Avenue became grassed whilst the remainder continued as vehicle storage.
- The vehicle storage was discontinued by late 2020 and construction of local roads had occurred.

Image 5a: 1936 aerial image (QImagery).

Image 5b: 1967 aerial image (QImagery).

Image 5c: 1972 aerial image (QImagery).

Image 5d: 1991 aerial image (QImagery).

5.3 Previous Geotechnical Investigations

A previous 'broad-scale' geotechnical investigation has been carried out in the area by Butler Partners, including the current site of interest (refer report *Preliminary Geotechnical Investigation, Proposed High Density Residential Development, 240A, 250 and 280 Macarthur Avenue, Hamilton'*, ref. 018-150J, dated October 2020; and Image 6 below).

The previous investigation included four deep boreholes (1 to 4), ten shallow boreholes (5 to 14) and eleven Cone Penetration Tests (CPT 1 to 11). The subsurface profile encountered in boreholes 4, 6 and 12 and inferred in CPTs 3 to 6 in the area of the current site of interest in summary comprised:

Site 18 (Lot 6 SP326594)

- Bituminous Concrete of 50 mm thick only in BH4.

- Fill to 1.1 m BGL comprising sandy clayey gravel, and gravelly clayey sand; dynamic cone penetration (DCP) tests indicate this fill was mostly relatively very dense at borehole 6. No records to confirm the fill was placed in a controlled manner were seen (nor would be usually available for dredge spoil placement) and the fill would be considered uncontrolled.

- 'Upper alluvium' (possibly including some dredge spoil?) comprising very soft to firm clay to about 8 to 9 m BGL, then very loose to loose clayey sand (with a firm clay band in places) to about 11.5 to 13.5 m BGL.

- Lower alluvium comprising loose to medium dense clayey sand (with stiff clay bands in places) then medium dense with dense material encountered below about 27 to 31.4 m BGL where the CPTs met refusal.

- Dense sand was encountered at 27.5 m BGL in CPT 5, and 28 m BGL in CPT 6, which extended to the end of the boreholes at 31.92 m and 31.22 m BGL respectively.

Groundwater was encountered mostly at levels of RL 1.1 m to 2.5 m but locally down to RL 0.4 m and up to RL 3.3 m.

The previous investigation included geotechnical laboratory testing as follows:

- Emerson class tests with results of 4 to 5

- Particle size distribution tests with silt/clay fractions of 16% to 54% and sand fractions of 46% to 84%

- Plasticity tests with liquid limits of 55% to 78% and plasticity indexes of 2% to 47%

- Shrink swell tests with shrinkages of 4.5% to 10.1% and shrink swell indexes of 2.4% to 5.7%

- Standard compaction tests with a maximum dry density of 1.76 to 2.08 t/m^3 and optimum moisture contents of 9.3% to 14.5%

- Soaked CBR tests with CBR values of 4%, 15% and 25 %.

The previous ASS laboratory testing indicated that the sand and clay have potential acidity but also contained high levels of acid neutralising capacity (ANC) which appeared to be due to shells. Shells cannot not be relied upon for neutralising acidity and are not included in the assessment of nett acidity. The liming rates for the sand fill (in one sample only tested) were found to be 4 kg/t and for the underlying clays varying from 5kg/t to 6 kg/t (e.g. boreholes 1, 2, 7, 12 and 13 but 23 kg/t to 33 kg/t in others, e.g. boreholes 4, 5, 6, 7 and 10).

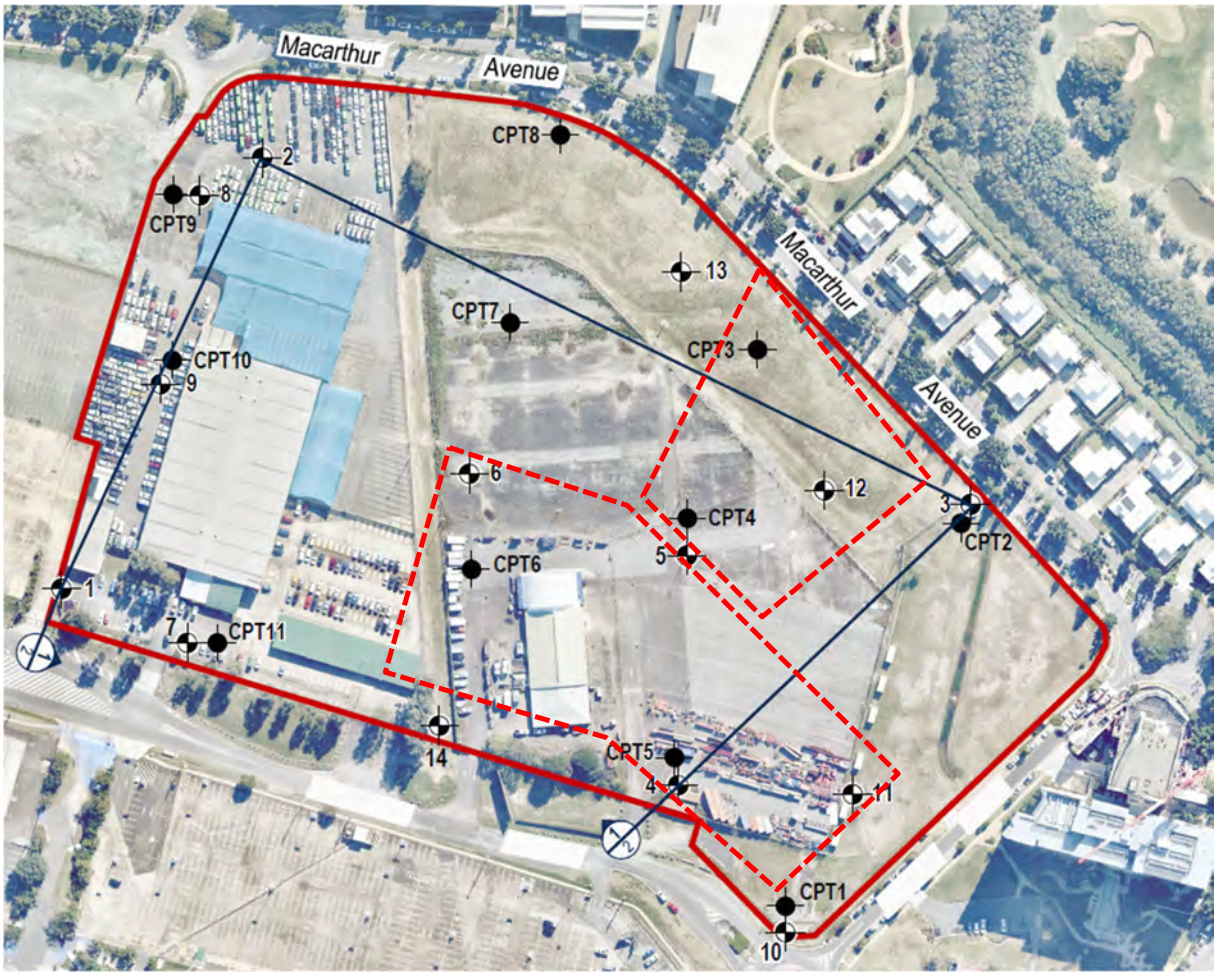

Image 6: Previous investigation locations (extract from Butler Partners report, site location by Core).

A geotechnical investigation was also carried out by Core for the lot adjoining Site 17 (Lot 5 SP326594) immediately to the west which included a deep borehole (BH 7) and Cone penetration Test (CPT6) close to the south west corner of Site 17 (Lot 5 SP326594) (about 40m west of CPT 4). The borehole encountered the following subsurface profile:

- Soft and very soft sandy and silty clay dredge spoil fill to 4.5 m BGL
- Soft silty clay to 7m BGL
- Loose and medium dense silty sand to 11.5m BGL
- Stiff silty o sandy clay to 14.5m BGL
- Very loose and loose clayey sand to 24.8m BGL and then medium dense to 29.5m BGL
- Medium dense to dense sandy gravel to borehole termination at 35.5m BGL

The CPT terminated about 32 m BGL with cone tip resistance of 20 MPa.

5.4 Published Acid Sulfate Soil Information

This site is mapped as a high probability (>70%) for the presence of ASS, likely due to the elevation of the site and proximity to the Brisbane River. An extract of the relevant ASS map is shown in Image 7.

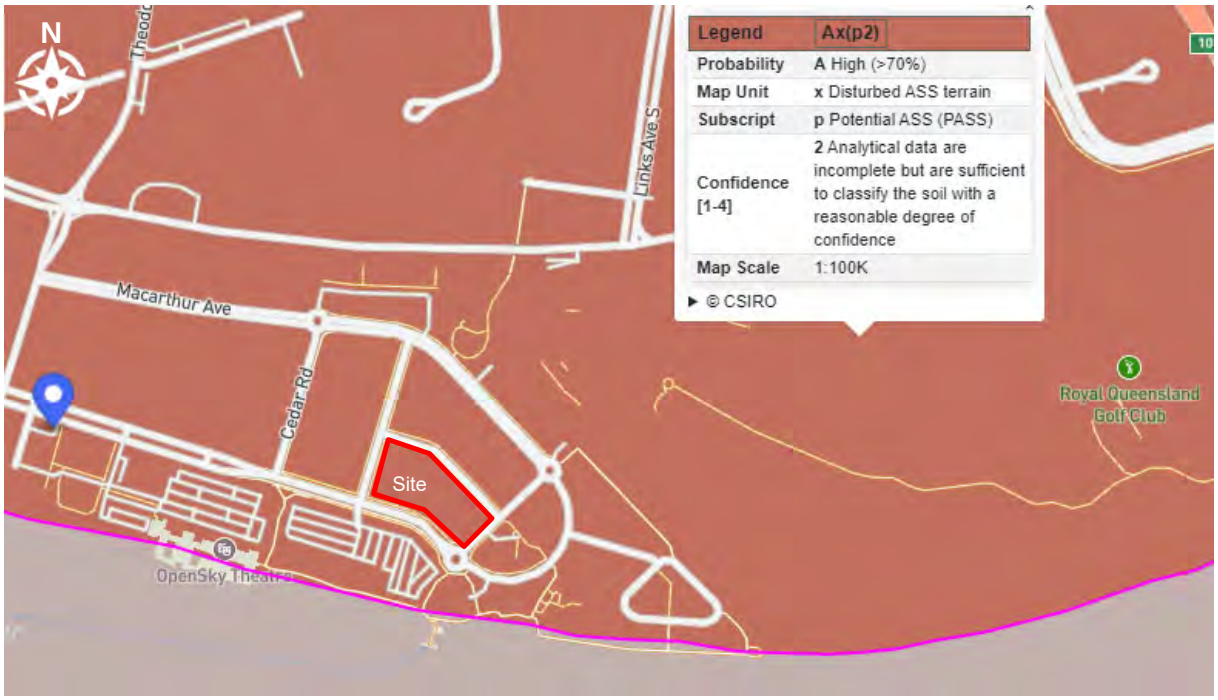

Image 7: Extract from QGD map showing ASS classification (not to scale).

5.5 Subsurface Conditions

The locations of boreholes, test pits and geophysical survey line locations are shown on Figure 1 in Appendix A. The Borehole and Test Pits logs are contained in Appendix B and the geophysical survey results are shown in Figure 2 in Appendix A.

The subsurface conditions encountered in the boreholes, test pits, MASW and interpreted from the site history, previous CPT results generally comprised the following:

- Fill, typically firm or stiff gravelly sand with clay, to about 1 to 1.2 m BGL, over
- Fill/dredge spoil comprising soft clay (material likely dredged from the adjacent Brisbane River channel), to depths of possibly about 5 m BGL, although very similar to and difficult to differentiate from the underlying alluvium,
- Upper alluvium, generally comprising interbedded loose sand and firm clay to about 15 m to 20 m BGL, over
- Lower alluvium, generally loose to medium dense sand and stiff clay, becoming medium dense or dense gravel from about 30 m to 32 m BGL.

The upper fill and dredge spoil is considered ‘uncontrolled’ because of lack of geotechnical inspection and density testing records.

Groundwater seepage was encountered in the auger boreholes at about 2 m BGL at Lot 18 (Lot 6 SP326594) but no groundwater seepage was encountered in any boreholes at Site 17 (Lot 5 SP326594). Groundwater seepage levels in the standpipes at 2.45 m, 2.52 m, 2 m, and 2.39 m BGL respectively were observed during the groundwater samplings. Ordinarily near the Brisbane River where sands are present, groundwater levels would be tidally dominated and occur at or around high tide level about RL 1 m to 1.5 m and rise temporarily and locally due to ingress after rainfall. It is understood the storm tide level for this site is about RL 3.1 m. Groundwater conditions can vary over distance and time and apart from tide and rainfall be influenced by changes to surface and subsurface drainage conditions and human influences.

5.6 In Situ Permeability Testing

Insitu falling head permeability testing was undertaken in monitoring wells on 20 and 26 June 2024. The test results provided the following indicative permeability (*k*) values:

- BH2/MW01: *k* value of 8.4 x 10^{-7} m/sec
- BH6/MW02: *k* value of 1.5 x 10^{-6} m/sec

5.7 Laboratory Testing

Geotechnical laboratory testing was performed at a NATA-accredited laboratory and comprised Atterberg limits, Emerson class and soil aggressivity tests. The laboratory test results are attached in Appendix C and summarised below in Tables 1 to 3. Laboratory test results are discussed further in Section 6.

Table 1: Summary Particle Size Distribution (PSD), Atterberg Limits and Emerson Class Number (ECN) Testing Results

Borehole /Test Pit (no.)	Depth (m)	Soil Description	PSD (% passing)				Plasticity				LS (%)	ECN
			4.75 (mm)	2.36 (mm)	0.425 (mm)	0.075 (mm)	LL (%)	PL (%)	PI (%)	WPI (%)		
BH2	0.5-1.0	Gravelly sand	-	-	-	-	-	-	-	-	-	4
BH4	1.0-1.45	Sandy clay	100	100	93	55	41	16	25	2324	10.5	3
BH6	1.0-1.45	Silty clay trace sand	100	100	100	77	61	21	40	4000	12.0	-

Notes: LL – Liquid Limit, PL – Plastic Limit, PI – Plastic Index, LS – linear shrinkage, WPI – weighted plasticity index (PI x %<0.425mm)

Table 2: Summary of Compaction and CBR results

Borehole/ Test Pit (no.)	Depth (m)	Soil Description	Compaction and CBR			
			SMDD (t/m^3)	OMC (%)	CBR (%)	Swell (%)
BH2	0.5-1.0	Gravelly sand	1.91	12.5	11	0.0

Notes: SMDD – standard maximum dry density, OMC - optimum moisture content

Table 3: Summary of Soil Aggressivity Testing Results

Borehole No./Depth	Soil Description	Chloride (mg/kg)	Conductivity (uS/cm)	pH	Resistivity (Ωm)	Sulphate (mg/kg)	% moisture
BH6 1.0-1.45 m	Silty Clay trace sand	<5	130	6.5	75	<30	2.2

6.0 GEOTECHNICAL COMMENTS & RECOMMENDATIONS

6.1 Excavations

Basement excavation is anticipated to encounter predominantly sand or clay fill including dredge spoil. These materials are expected to be excavatable using conventional earthmoving equipment such as excavators up to 8 t in size although larger machines would likely be used for higher production rates. If concrete is encountered, a rock breaker could be required for the removal of concrete (i.e. pavements and building foundations). The sand and the underlying clay should be separated during excavation as they are likely to require differing disposal and treatment requirements.

6.2 Temporary Batter Stability

Temporary batters in the sands and clays (up to 2 m deep) could be formed at 1V:1.5H, provided there are no surcharge loads, services or structures close to the excavation crest. Batter slopes will need to be confirmed by a geotechnical engineer at the time of construction. Flatter slopes or temporary support will be required in soft clays or if groundwater is present in the face or toe of the batter.

For excavations where space does not permit temporary batters (e.g. close to the site boundary), engineer-designed temporary support will be required. This could comprise temporary sheet piling, with possibly one or two rows of temporary anchors in the sand fill (due to poor toe support afforded by the soft clays) depending on wall height. Anchors extending beyond the site boundary would require permission from the adjacent landowner. Propping of sheet piles could be considered with angled prop to a block on the subgrade; cross excavation props will not be practical given the large excavation width. A fully piled support system (e.g. contiguous piles) could also be considered which could be incorporated into the structural design (piled foundations / basement wall); but would be significantly greater cost.

6.3 Trafficability & Working Platforms

The existing sand subgrade should be trafficable for tracked machines but not trucks and other rubber-tyred machines. Capping with 0.2 m to 0.3 m of granular fill (e.g. recycled ‘CBR45’) is expected to be required on sand subgrade. For a piling rig with bearing pressures of up to 250 kPa (e.g. driven pile rig), a working platform of 0.3 m to 0.5 m of CBR45 granular fill might be required.

At basement level where clay is encountered, the subgrade be untrafficable for almost all machines. A working platform of at least 0.3 m would be required for smaller machines, underlain by geofabric (which would be beneficial for support for construction of the basement slab). For larger equipment (e.g. piling rig), a substantial working platform of 0.8 m to 1 m or more could be required on the soft clay subgrade (involving over-excavation and additional spoil to manage). Consideration should be given to undertake excavation, and if practical piling, from the existing surface (with piles cut off to design level).

Working platform design must be undertaken by suitably qualified RPEQ when the crane/rig load specifications are known.

6.4 Filling

Any localised new filling required to achieve design levels should be undertaken under ‘Level 1’ inspection and testing as detailed in Australian Standard AS3798-2007 *Guidelines on earthworks for residential and commercial developments*. A low plasticity granular fill (CBR 15 material) should be used, compacted to a minimum Dry Density ratio of 98 % (Standard) within 2 % of optimum moisture content.

6.5 Consolidation Settlement

Long term settlements of the land due to compression of the softer clays in the upper alluvium is anticipated (e.g. as evidenced in the road surface adjoining access shafts along Macarthur Avenue). Previous local experience has indicated that the upper alluvial clays are lightly over-consolidated and consolidation settlement should therefore be anticipated under new loads (e.g. from structure or pavements supported on ground and not piles, or fill). The primary consolidation settlements might range up to about 75 mm for assumed new development loads not exceeding 20 kPa. If larger loads are proposed then higher primary settlements can be expected as well as additional secondary settlements; further advice should be obtained if such higher loads are to be considered.

Differential settlement will be likely due to variation in clay thickness/extent as well as due to varying structural loads and supports (e.g. between piled and non-piled elements). This will need to be considered in the development design, e.g. detailing of gravity services and other entry points as well as other parts of the development, noting they will be remaining settlements in the existing roads and filled areas due to that fill.

6.6 Basement Design

If that partly in-ground basement is constructed below expected groundwater levels then tanking/ waterproofing and catering for hydrostatic uplift would be required. Basement walls above design water levels should have drainage behind them to cater for any localised seepage from the surface and to prevent water pressures on the wall. Because the wall is propped by the ground floor/podium slab an at rest active earth pressure coefficient of 0.5 would be appropriate for design of walls retaining the materials encountered. Walls should be designed for surcharge loads by multiplying the surcharge by the earth pressure coefficient. Unless walls are designed for surcharges from compaction equipment, only small hand guided equipment should be used behind walls.

6.7 Site Classification

This structure it outside the scope of Australian Standard AS 2870-2011 *Residential slabs and footings* but the site classification derived in accordance that standard can provide an indication of the likely magnitude of reactive (shrink and swell) movements associated with normal seasonal soil moisture variations and is required for hydraulic design.

Due to the presence of uncontrolled fill and potential consolidations settlements, the site would be classified ***Class P*** in accordance with AS 2870-2011. Ground surface movement due to seasonal moisture variation ('y_s' value) for at this site are likely to be negligible due to the presence of surface sands. However, consolidation settlement will be the main ground movement criteria for design (refer Section 6.5). Based on available information, provided there are no large development loads not supported on piles, *Class H1* could be adopted for plumbing design.

6.8 Foundations

Due to the compressible soils with settlement potential as well as the presence of very loose and loose silty sands which may be susceptible to liquefaction under earthquake conditions, the structure will need to be fully suspended on piles (including the basement slab).

Driven precast concrete piles are considered suitable, founded in the dense gravel alluvium expected from approximately 30 m to 32 m BGL. Piles driven to set would achieve the full structural capacity of the piles. Driven piles generate vibrations, however as there are no structures close to the site the impacts are expected to be manageable by a competent piling contractor.

Alternatively, CFA piles could be considered, founding in the dense materials at depth. Bored piles are likely to encounter construction difficulty due to the loose/soft soils and groundwater and would be unsuitable. The ultimate geotechnical strengths ($R_{d,ug}$) given in Table 1 may be adopted for the design of CFA piles.

Table 4: Ultimate Geotechnical Strengths ($R_{d,ug}$) for CFA Pile Design.

Strata	Unfactored Ultimate Shaft Adhesion (kPa)	Unfactored Ultimate End Bearing (kPa)
Soft to Firm clays or Loose / Very Loose sands	-	-
Medium Dense sands and Stiff to Hard clays	25	-
Dense to Very Dense sandy gravel	100	1,800

The $R_{d,ug}$ values provided in Table 1 above will need to be multiplied by a suitable geotechnical strength reduction factor (Φ_{gb}) to obtain design geotechnical strength ($R_{d,g}$) of piles in compression and tension. Where no load testing is proposed, and after assessing the design average risk rating (ARR) in accordance with the guidelines presented in AS 2159, a Φ_{gb} value of 0.45 is suggested for preliminary design but higher values may be possible depending on verification testing undertaken.

Where piles are designed to carry tension loads, the shaft adhesion values provided above are to be used, multiplied by a suitable a Φ_{gb} value. Where pile load testing is undertaken on a sufficient number of piles for compression loads the use of higher Φ_{gb} values may be possible, in accordance with AS 2159.

If working stress methods are used in pile design, the $R_{d,ug}$ values should be divided by a factor of safety of 2.5 to calculate the maximum single pile working load.

Piles should be designed and installed by an appropriately experienced contractor and in accordance with AS 2159-2009 (Ref.5).

If any soil conditions encountered during footing construction are found to differ from those noted in the geotechnical investigation, Core should be notified immediately, and further assessment carried out to determine if changes to footing design are required.

All footings should found such that they are not adversely affected by any adjacent excavations batter slopes, trenches, or retaining walls that are not designed to support building loads. To minimise the potential for any adverse interaction effects, footings should found at least below a plane extending 1 m horizontally from the base of trenches/batter slopes/excavations/retaining walls, then rising up at 1V:1H. This requirement is illustrated in Diagram 1.

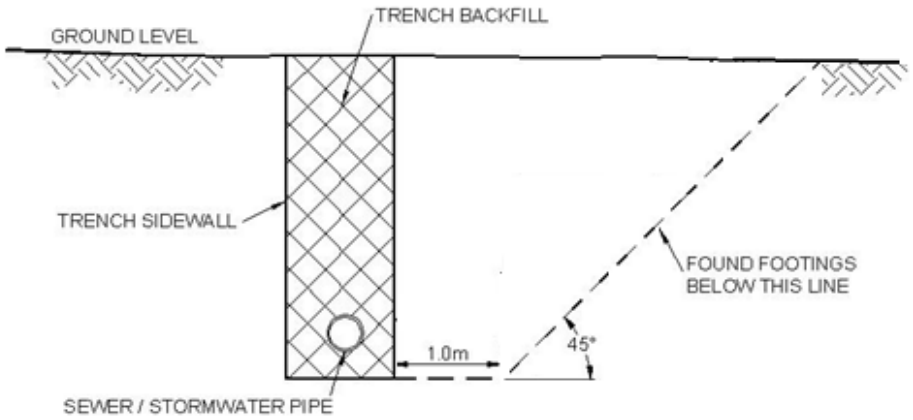

Diagram 1: Exclusion zone for base of footings.

6.9 Site Sub-soil Classification

The shear wave velocities indicated in the geophysical testing are very low, typically about 100 m/s in the upper 8 m then increasing to about 150 m/s; velocities of over 250 m/s were encountered about 16 m BGL. The AS1170.4-2007 *Structural design actions* site subsoil classification for earthquake actions design is considered to be *Class D_e – Deep or soft soil site*, due to the presence of very soft and very loose soils.

6.10 Aggressivity of Soils

Chemical analysis can provide an indication of the potential for long term damage to foundations, buried pipelines, in-ground structures, services and other infrastructure. Soil texture is also important in this regard, as granular soils allow oxygen exchange (oxidation) to occur more readily and are also more permeable.

Australian Standard AS 2159-2009 *Piling - Design and installation* provides the range of exposure classification of the surface of steel piles and concrete piles based on the range of chemical conditions in the soil and the possibility of changes in groundwater levels.

Exposure classifications will be provided on receipt of laboratory testing results, as follows:

- For concrete piles in soil, *Non-aggressive* in accordance with Table 6.4.2(C) of AS 2159-2009
- For steel piles in soil, *Non-aggressive* in accordance with Table 6.5.2(C) of AS 2159-2009.

6.11 Pavements

It is expected the basement will be fully suspended, so pavements relying on ground support would only likely comprise the crossover and entrance driveways. Design parameters for pavements will depend on the subgrade materials present after earthworks and the type, depth and quality of any fill used (if any) to bring the site to design levels. If subgrade conditions exposed following earthworks differ from those encountered in the boreholes, further subgrade evaluation (including further testing) should be undertaken during the construction stage.

The likely subgrade conditions for on-ground pavements (such as entry driveways) could comprise sand or clay fill. The laboratory CBR test on a sandy clay sample retuned a CBR value of 6% in Lot 18 (Lot 6 SP326594) and 11% in more gravelly material in Lot 17 (Lot 5 SP326594). A preliminary design CBR of 5% is recommended for the sandy clay fill.

Properly drained subgrades should allow for open graded drains that shed water and prevent ponding.

7.0 ACID SULFATE SOIL ASSESSMENT

The development of ASS is commonly the result of marine or estuarine deposition of sulfate and iron bearing sediments in the presence of an abundant source of readily decomposable organic matter resulting in the deposition of pyrite. This pyrite is stable within the soil so long as anoxic conditions prevail. Oxidation of this material produces acidic conditions and oxidation typically occurs as the material is exposed above the water table by excavation, and by lowering the water table during dewatering processes.

Previous experience and available guidelines indicate that ASS are normally restricted in extent to recent (Holocene to Pleistocene age) soil horizons deposited in a saline environment below RL 5 m. The National Acid Sulfate Soils sampling and identification methods manual indicates that sites should be investigated for ASS materials if there is any evidence that reasonably suggests that ASS materials may be present in the vicinity, and that these materials may be disturbed. Examples of such evidence may include the following:

- Soil materials disturbance of 100 m^3 or more located within an area mapped with at least a moderate risk of ASS materials occurring within 3 m of the natural soil surface.
- Soil materials disturbance of 100 m^3 or more, with excavation likely from below the natural water table, in an area with at least a moderate risk of ASS materials occurring within 3 m of the natural soil surface, or with at least a moderate risk of ASS materials occurring deeper than 3 m of the natural soil surface.
- Temporary or permanent lowering of the water table in areas mapped with a risk of ASS materials occurring within 3 m of the natural soil surface.

The topography of the site is consistent with the above criteria (i.e. surface elevation below RL 5 m AHD) and the proposed development involves excavations that will exceed the above trigger levels. Due to the proposed excavation works required, an assessment of potential disturbance of ASS is required.

7.1 Investigation Aims

The aims of this investigation were to:

- Conduct an ASS assessment in general accordance with the National Sampling Guidelines.
- Quantitatively identify the presence or absence of ASS across the site.
- If necessary, assess the likely impact of the proposed development on ASS and groundwater.
- If necessary, provide prudent management measures so that the release of acid leachate from disturbed soil and groundwater does not have significant adverse effects on the natural and built environment or human health.

The results of the ASS investigation are set out in the following sections.

7.2 Groundwater Conditions

A groundwater sample was collected from MW01 to MW04 to provide a baseline reading of the groundwater conditions. The following groundwater test results were obtained:

Site 17 (Currently Lot 5 SP337697 and located off-site) - MW03 & MW04:

- Neutral conditions (pH 7.00 to 6.97).
- Electrical conductivity reported saline conditions.
- Alkalinity (Bicarbonate as $CaCO_3$) was reported in groundwater (MW03 & MW04) above 200mg/L.
- Chloride was reported in groundwater (MW04) with a concentration of 11,000 mg/L and sodium at 10,000 mg/L.
- Elevated heavy metals were reported including iron, magnesium and potassium. MW04 has high levels of magnesium and potassium. This is common in these groundwater environments and potentially due to the high turbidity observed in MW03 & MW04.
- Calcium is considered high (330 mg/L) within MW04 due to potential lime existing within the dredged spoil.

Site 18 (Lot 6 SP326594)) - MW01 & MW02:

- Neutral conditions (pH 7.09 to 6.51).
- Electrical conductivity reported brackish conditions.
- Alkalinity (Bicarbonate as $CaCO_3$) was reported in groundwater (MW01 & MW02) above 200mg/L.
- Elevated heavy metals were reported including iron, aluminium and calcium. MW01 has high levels of total aluminium, total and dissolved iron and calcium. This is common in these groundwater environments and potentially due to high turbidity. Calcium is considered high due to potential lime existing within the dredged spoil.

A copy of the groundwater results is provided in Appendix E.

7.3 Preliminary Screening

Results of preliminary screening are summarised in Table D1 (Appendix D).

The mean soil pH (represented by pH_F results) was 8.5, ranging from pH 7.2 to pH 9.1.

The preliminary screening results indicate a low probability of actual (existing) acid sulfate soils (AASS) and a low to moderate potential for potential acid sulfate soils (PASS).

7.4 Quantitative Soils Analysis

Table 5 below shows the ASS action levels adopted in Queensland. These categories are used to identify whether action / management of ASS spoil is required, based on ‘net acidity’. For major fill works and disturbances of more than 1,000 tonnes, an action criterion of 0.03% S equivalents (18 moles / tonne) is adopted for all soil types. We estimate more than about 1000 m^3 of material will be excavated (e.g. stripping, footings, ground slabs, basements), therefore, we have adopted > 1000 tonnes as the criteria for this investigation.

Table 5: ASS Action Criteria.

Type of Material		Action Criteria 1-1000 tonnes disturbed		Action Criteria > 1000 tonnes disturbed (and major fill projects)	
		Existing + Potential Acidity		Existing + Potential Acidity	
Texture range McDonald et al. (1990)	Approx clay content (%)	Equivalent sulfur %S oxidisable	Equivalent acid mol H^+/ tonne	Equivalent sulfur %S oxidisable (oven-dry basis)	Equivalent acid mol H^+/ tonne (oven-dry basis)
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5 – 40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.10	62	0.03	18

Results of quantitative analysis carried out are summarised in Table D1, attached. Laboratory test certificates are also included in Appendix D.

Results of the 17 samples analysed are summarised below:

- All 17 samples returned Titratable Actual Acidity (TAA) results below the Action Criteria of 18 mol H+/ tonne with <2 mole H+/t concentrations provided.
- Twelve (12) samples, returned Oxidisable Sulfur as Scr above the Action Criteria of 0.03%S ranging from 0.01 to 0.68%S.
- Fourteen (14) samples returned pH KCl values exceeding pH 6.5 and as such, these 14 samples were subjected to analysis for acid neutralising capacity (ANC) and reported concentrations ranging up to 1220 mole H+/t.
- No samples returned pH HCl value of pH 4.5 and therefore were not tested for retained acidity (S_{NAS}).

Concentrations of acid neutralising capacity (ANC) were high in fourteen samples >250 mole H+/t. ANC can be an indicator of a natural lime source (e.g. shells). Shells (small in size) were observed throughout the soil profile particularly in the dredged materials. For 12 of the 17 samples analysed, net acidity exceeded the relevant QASSIT 'Action Criteria' indicating that management and/or lime neutralisation treatment will be required if these soils are disturbed.

7.5 Extent and Severity

The results from this investigation indicate high levels of potential acidity are distributed throughout the soil profile (up to 3.0 m BGL). The results also suggest previous liming has occurred. At this stage without documentation regarding previous lime treatment, we have considered the net acidity (excluding ANC). This may change once the Management Plan has been prepared.

The SPP14 Guidelines require that the level of treatment for management of ASS is based on treatment of all existing and potential acidity. The results of the laboratory testing have been accumulated in an Acid-Base Account to give the Net Acidity for each sample in units of mol H^+/tonne as presented in Table D1 (excluding ANC), attached. This value has been calculated from sulfur trail potential acidity (S_{Cr}) plus actual acidity (TAA).

A preliminary liming rate has been calculated in kg $CaCO_3$/t and kg $CaCO_3/m^3$ using a factor of safety (fineness factor) of 1.5 and an assumed bulk density of 1.8 tonne/m^3. Consideration of the tabulated laboratory results indicates that high levels of potential acidity are fairly uniformly distributed throughout the soil profile.

Due to the difficulty in mixing the soft silty clay material and the presence of lime within the dredge spoil fill, it is considered that adoption of a uniform liming rate, not exceeding the 90th percentile of relevant test results for 'net acidity', i.e., 50 kg $CaCO_3/m^3$, will be sufficiently conservative to limit the risk of environmental impact. Soils have been separated into two types the surface Gravelly Clay Fill to 0.75m BGL and the lower alluvial Clays and dredging spoil from 0.75 m BGL. Table 6 below provides the recommended liming rates calculated for each soil type.

Table 6: Recommended Liming Rates

Soil Type	Colour	Bottom of Layer, Depth Range	Treatment Rate**
Gravelly Clay (Fill)	Brown	0.0 – 0.75 m BGL	Nil
Alluvial Clays / Fill Dredging Spoil	Grey, dark grey, dark brown and black	0.75 – 3.0 m BGL*	50 kg $CaCO_3/m^3$

Note: * Maximum depth of ASS sampling and analysis
** Liming rate based on 90th percentile values.

7.6 Risk Assessment

As the proposed excavations will intersect soils with potential acidity, there will be a requirement for management of that acidity. Given the anticipated volume of soils that will be disturbed (calculated to be greater than 1,000 m^3) and required lime treatment, management of potential acidity at this site would be classified as XH (Extra high) treatment in accordance with Queensland Soil Management Guidelines V4.0 - Table 4.2 (i.e. > 25 tonnes of aglime).

The Guidelines require that for Category XH treatment a stand-alone Acid Sulfate Soil Management Plan (ASS MP) must be provided. Recommendations on strategies included in the ASS MP are outlined below in Section 7.7.

Based on the results of the investigation and the currently proposed earthworks are in discussion to 3.5 m BGL (approximately 1.0m RL), the risk of impact to the surrounding environment is considered moderate. Provided that an ASS MP is prepared for the project and implemented, the environmental risk will be further reduced.

7.7 Recommendations

The results of this investigation indicate there is the likelihood of disturbance of high levels of potential acidity associated with the proposed development. Based on the net acidity values, lime treatment is considered necessary for the proposed excavation works. It is recommended that an ASS management plan (ASS MP) be developed and implemented.

The results also suggest previous liming has occurred. At this stage without documentation regarding previous lime treatment, we have considered the net acidity (excluding ANC). This may change once the Management Plan has been prepared.

Potential for groundwater seepage to be encountered during earthworks and construction will be dependent upon the prevailing weather conditions at that time. All groundwater seepage (if encountered) and stormwater collected within excavations, should be directed to a holding point for regular monitoring and treatment as necessary before discharging off site.

Water quality monitoring should be undertaken for the full duration of earthworks activities.

8.0 LIMITATIONS

Should you require any further information please contact the undersigned. We draw your attention to the document, Limitations, which is included in Appendix F.

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Appendix A
Figures

LEGEND

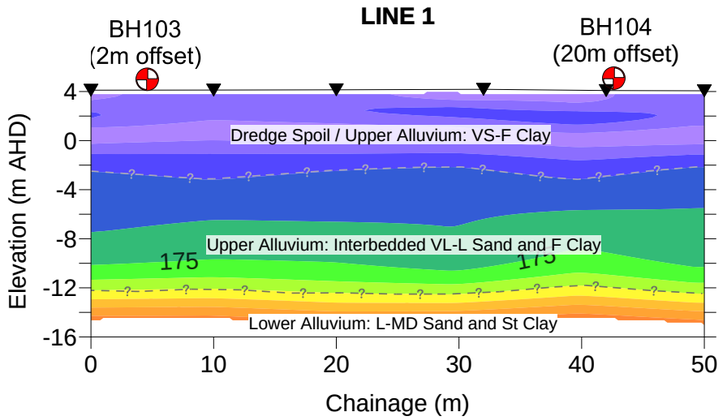
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE BOREHOLE LOCATION
- GEOPHYSICS SEISMIC SOUNDING LOCATIONS
- GEOPHYSICS SEISMIC LINES

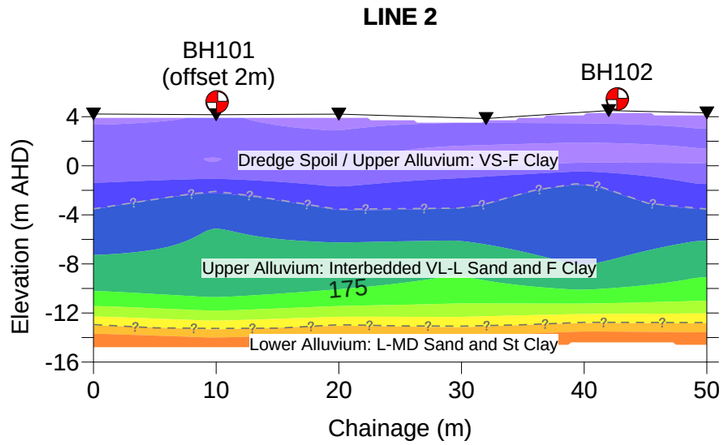
Aerial image sourced from Nearmap Pty Ltd, image dated 13 November 2021. Annotations by Core Consultants Pty Ltd.

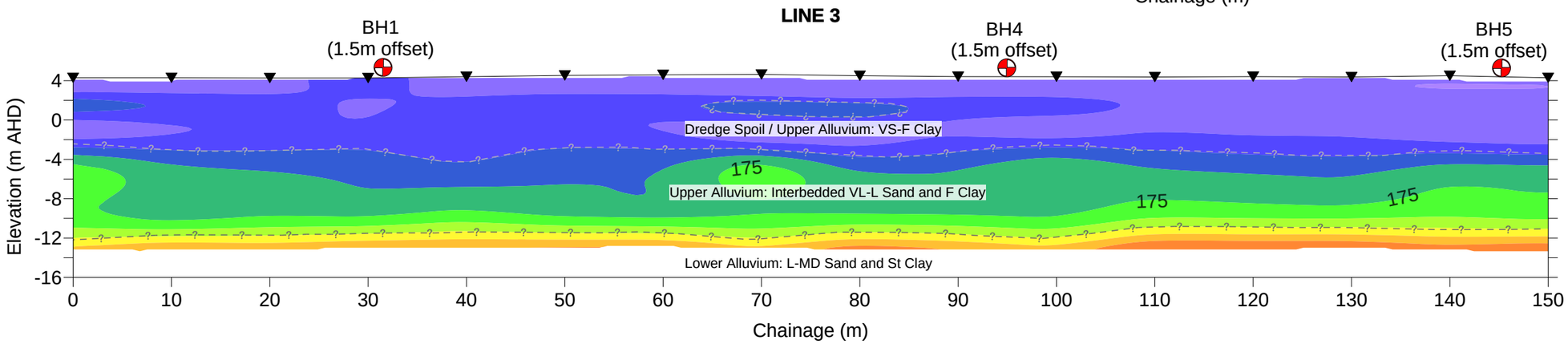
core consultants pty ltd
www.coreconsultants.com.au

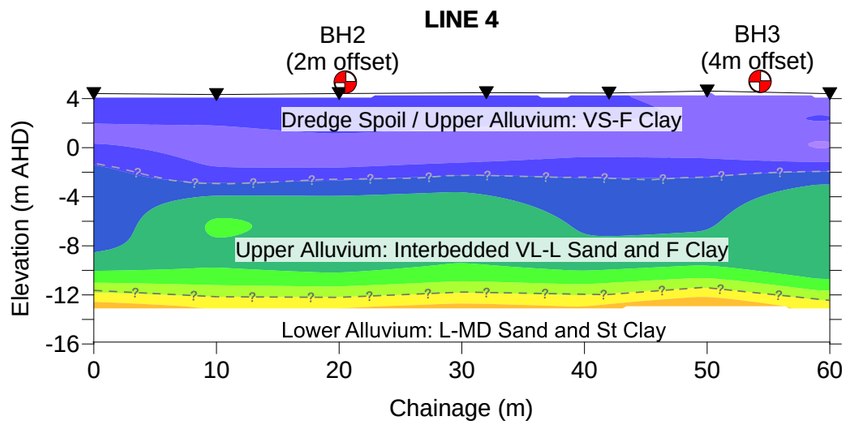
CLIENT: SILVERSTON DEVELOPMENTS		PROJECT: GEOTECHNICAL AND ACID SULFATE SOILS INVESTIGATION	
DRAWN BY: MR	DATE: 19/07/2024	DRAWING TITLE: SITE BOUNDARY AND BOREHOLE LOCATIONS	
CHECKED BY: EA	DATE: 24/07/2024		
SCALE: 1:1500	SHEET SIZE: A3	PROJECT No: J002466	DOC No: 001 / DOC TYPE: R / FIGURE No: F001 / REVISION: 0 / SHEET 1 OF 1

Plot Date: 24 July 2024 Time: 2:23 PM By: CAD Path: C:\Users\CAD\Core Consultants\Jobs 2020–2023 - General\Jobs2024 J002263-\J002466 - Silverstone- Resi Units-Macarthur Av Hamilton\PHASE 1000\Figures



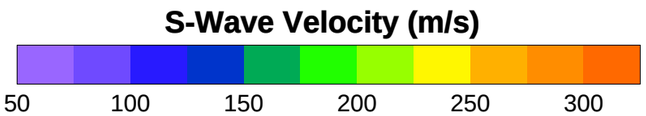






LEGEND

- APPROXIMATE LOCATION OF BOREHOLE TESTING
- APPROXIMATE CHAINAGE LOCATIONS FOR SEISMIC SURVEY
- DENOTES INFERRED UNIT CHANGE



REFER TO FIGURE 1 FOR SECTION LOCATION.

THIS DOCUMENT MUST BE READ IN CONJUCTION WITH CORE DOCUMENT J002466-001-R-Rev0.

Core geophysical services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar circumstances and privy to not only the time limits but financial and physical constraints applicable to the services. MASW is a remote sensing geophysical method that may not detect all subsurface features and anomalies. The depth of the survey is largely dependent on the characteristics of the subsurface conditions, survey parameters and quality of data obtained. Interpreted features such as service utilities, hazards, rock-layer constraints or subsurface soil and/or geology, faults, voids, and other geological hazards have been and can be misinterpreted upon physical sampling. Inversion of MASW data has been implemented to model and characterise subsurface condition and geological structure.

core consultants pty ltd
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Scale Bar (m)
0 5 10 15 20

Projection: UTM
Datum: Australian GDA2020 - GRS 1980 / IUGG 1980

DRAWN	DS	CLIENT: SILVERSTONE DEVELOPMENTS PTY LTD		
CHECKED	BH	PROJECT: PROPOSED MULTI-STOREY RESIDENTIAL UNIT DEVELOPMENT MACARTHUR AVENUE HAMILTON		
DATE	19/07/2024			
SCALE	AS SHOWN	TITLE: MASW SECTIONS: LINES 1 TO 4		
ORIGINAL SIZE	A3	PROJECT NO: J002466	FIGURE NO: 002	REV: 0

Appendix B
Reports of Boreholes
Explanatory Notes

REPORT OF BOREHOLE: BH1

core consultants pty ltd

Client	: Silverstone Developments	East	: 508,327.00	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,446.00 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA			0.06				ASP	Asphalt		
	M			4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		SM	FILL Silty to gravelly SAND: medium grained, medium sized gravel, pale brown.	D	D
			0.5				SP	FILL Gravelly SAND: coarse grained, coarse sized gravel, brown.	SLM-D	MD
			1	1	SPT 1,4,3 (N=7)		CI	FILL Sandy CLAY: medium grained sand, trace medium sized gravel, medium plasticity, brown grey-brown.	w ≈ PL	F
	L	Inflow - groundwater seepage observed	1.75	3			CI	Brown and dark brown.	w > PL-w ≈ LL	S
			2							
			2.25	2			CH	High plasticity, dark brown and grey-brown.		
			2.75		SPT 0,0,1 (N=1)		CH	Fine grained sand, trace shells.		
				1				**BH1 Terminated at 3m**		

5 10 15 20 25

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH2/MW1

Client	: Silverstone Developments	East	: 508,308.68	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,421.47 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY	WELL DIAGRAM MW1
100mm SFA	M		0		ASS Sample: recovered at 0.25 m intervals to 3 m depth		GP	FILL Sandy GRAVEL: coarse sized, coarse grained sand, trace low plasticity clay, orange-brown.	D	VD	Solid
			0.5	3.92	BDS: 0.5-1.0 m		SP	FILL Gravelly SAND: medium grained, medium sized gravel, with low plasticity clay, brown.	SLM	L-MD	
	L		1		SPT 2,4,5 (N=9)						
		▼	1.75	2.67			CI	FILL Sandy CLAY: medium grained sand, with fine sized gravel, medium plasticity, brown orange-brown.	w < PL-w ≈ PL	S	50mm PVC Slotted
			2								
			2.75	1.67	SPT 0, 0, 1		CL	Fine grained sand, low plasticity, dark brown.	w ≈ PL		
					Shear Vane: ~ 18 kPa			**BH2/MW1 Terminated at 3m**			

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH3

Client	: Silverstone Developments	East	: 508,287.19	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,446.91 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA	M	Inflow - groundwater seepage observed	0.03	4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		ASP	Asphalt	D	VH
							GP	FILL Sandy GRAVEL: medium sized, medium to coarse grained sand, brown red brown.	SLM	D
	L		0.5				SP	FILL Gravelly SAND: fine grained, medium sized gravel, brown.	SLM-D	MD-D
			0.75				SC	FILL Clayey SAND: fine grained, low plasticity clay, grey-brown.	M	
			1	3	SPT 4,7,8 (N=15)					
			1.25				SC	Trace medium sized gravel, medium to high plasticity clay.		MD
			2	2			CL	FILL Sandy CLAY: fine to coarse grained sand, low plasticity, dark grey.	w ≈ PL	F
					Shear Vane: 31 kPa					
			2.75	2	SPT 1,0,1 (N=1)		CL	Trace shells.		
								BH3 Terminated at 3m		

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH4

		East	: 508,260.79	Sheet	: 1 OF 1
Client	: Silverstone Developments	North	: 6,964,490.98 56J	Logged	: AD
Project	: Proposed Unit Development	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Location	: 330 MacArthur Avenue, Hamilton QLD	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
Job No	: J002466	Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA	L-M	Inflow - groundwater seepage observed	0.03				ASP	Asphalt	D	HS
							SP	FILL Gravelly SAND: medium grained, coarse sized gravel, red brown.		VD
			0.25		ASS Sample: recovered at 0.25 m intervals to 3 m depth		GP	FILL Sandy GRAVEL: coarse sized, coarse grained sand, orange-brown red.		D
			0.54	4			GM	FILL Silty to sandy GRAVEL: coarse sized, medium grained sand, trace low plasticity clay, dark brown.	SLM	
			0.75				SP	FILL SAND: coarse grained, brown orange-brown.		
			1	1			CL	FILL Silty to sandy CLAY: fine to medium grained sand, low plasticity, dark brown and brown.	w ≈ PL-w ≈ LL	S-F
			1.25		SPT 1,0,2 (N=2)		CL-CI	Low to medium plasticity.		
			1.5	3			CI	FILL Sandy CLAY: fine grained sand, medium plasticity, dark brown.	w > LL	S
	L		2	2			CI	Fine to coarse grained sand, trace fine to medium sized gravel, dark brown and orange-brown.	w ≈ PL-w > LL	
			2.25				CI	Fine grained sand, dark brown.		
			2.5	2			CH	High plasticity.		
					SPT 0,0,0 (N=0)					
								BH4 Terminated at 3m		

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH5

Client	: Silverstone Developments	East	: 508,225.04	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,533.84 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA	M	Inflow - groundwater seepage observed	0.03	4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		ASP	Asphalt	D	HS
							GP	FILL Sandy GRAVEL: coarse sized, coarse grained sand, orange-brown dark brown.	SLM	D-VD
			0.5				SM	FILL Silty SAND: coarse grained, with fine to medium sized gravel, orange-brown.		MD
			0.75				SC	FILL Clayey to gravelly SAND: medium to coarse grained, medium sized gravel, medium plasticity clay, orange-brown dark brown.		
			1	1			SM	FILL Silty SAND: medium grained, orange-brown dark brown black yellow-brown.		VL
			1.25		SPT 3,0,1 (N=1)		SM	With low to medium plasticity clay, with clay bands.		
			1.5	3	Shear Vane: 32 kPa		CI	FILL Silty to sandy CLAY: fine grained sand, medium plasticity, dark brown dark grey.	w > PL	F
	L		1.75				CI-CH	FILL Sandy CLAY: fine grained sand, medium to high plasticity, dark brown grey-brown dark grey.		
			2	2			CI	Fine to medium grained sand, medium plasticity.		
			2.25				CL	FILL Silty CLAY: low plasticity, dark brown black dark grey.	w ≈ PL	
			2.5		Shear Vane: 32 kPa		CL-CI	With fine grained sand, low to medium plasticity.	w ≈ PL-w ≈ LL	
					SPT Failed Under Hammer Weight					
				1				**BH5 Terminated at 3m**		

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REPORT OF BOREHOLE: BH6/MW2

Client	: Silverstone Developments	East	: 508,197.71	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,493.91 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	19/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY	WELL DIAGRAM
100mm SFA	M		0.03	4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		ASP	Asphalt	D	HS	MW2
							GP	FILL Sandy GRAVEL: coarse sized, medium grained sand, red brown.	SLM-D	MD	
			0.5				GW	Fine to coarse sized, dark brown with grey.			Solid
			0.75				SM	FILL Silty SAND: medium grained, dark brown red.	SLM	MD-D	
	L		1	1	SPT 1,2,1 (N=3)		CH	FILL Silty to sandy CLAY: trace fine grained sand, high plasticity, dark brown dark green.	w ≈ PL	F	
			1.25	3			CL-CI	FILL Silty CLAY: low to medium plasticity, dark grey.	w > PL	S	
					Shear Vane: 20 kPa						
			1.75				CL-CI	With fine to medium grained sand, band.			50mm PVC Slotted
		▼	2	2							
			2.5		Shear Vane: 15 kPa		CH	High plasticity.			
					SPT 0,0,0 (N=0)						
				1				**BH6/MW2 Terminated at 3m**			

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REPORT OF BOREHOLE: BH101/MW3

Client	: Silverstone Developments	East	: 508,340.80	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,527.30 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	20/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY	WELL DIAGRAM
100mm SFA	L	▼	0.5	4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		SC	FILL Clayey to gravelly SAND: coarse grained, coarse sized gravel, low plasticity clay, orange-brown and red.	D	L-MD	MW3 Solid
			0.75				SC	Medium sized gravel, brown, trace shells.	M	D	
			1	3	Shear Vane: 16.5 kPa		CL-CI	FILL Sandy CLAY: medium grained sand, with medium sized gravel, low to medium plasticity, brown and dark brown and orange-brown.	w ≈ PL-w > PL	S	
			1.5		SPT 2,1,3 (N=4)						
			2	2			CI	FILL Silty CLAY: medium plasticity, dark brown grey-brown dark blue grey.	w ≈ LL-w > LL		50mm PVC Slotted
							CH	High plasticity, dark brown grey-brown dark grey.	w ≈ PL-w ≈ LL		
					Shear Vane: 22 kPa						
					SPT 0,0,0 (N=0)						
					Shear Vane: 16 kPa						
				1				**BH101/MW3 Terminated at 3m**			

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REPORT OF BOREHOLE: BH102

Client	: Silverstone Developments	East	: 508,358.34	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,555.28 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	20/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA	M	GNO - no groundwater seepage observed	0.25	4.3	ASS Sample: recovered at 0.25 m intervals to 3 m depth		SC	FILL Clayey to gravelly SAND: coarse grained, coarse sized gravel, low plasticity clay, orange-brown.	M	MD-D
				4			CL	FILL Silty CLAY: low plasticity, dark grey.	w < PL	H
			0.75				CL	Dark grey and dark brown.		F
			1		Shear Vane: 15.5 kPa					
	L		1.25	3	SPT 0,1,0 (N=2)		CL-CI	FILL Silty to sandy CLAY: low to medium plasticity, dark brown and dark grey.	w ≈ PL	S
			1.75				CL-CI	Medium grained sand, dark grey.		
			2	2						
			2.5		Shear Vane: 30 kPa		CH	FILL Silty CLAY: trace fine grained sand, high plasticity, dark grey.	w > PL-w > LL	F
			2.75		SPT 0,0,0 (N=0)		CI	Medium plasticity, dark grey and grey-brown.	w ≈ PL-w ≈ LL	
					Shear Vane: 26 kPa					
				1				**BH102 Terminated at 3m**		

5 10 15 20 25

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REPORT OF BOREHOLE: BH103

core consultants pty ltd

Client	: Silverstone Developments	East	: 508,297.76	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,559.66 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	20/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
100mm SFA	L	GNO - no groundwater seepage observed	0	4.3	ASS Sample: recovered at 0.25 m intervals to 3 m depth		SP	FILL Gravelly SAND: coarse grained, coarse sized gravel, trace low plasticity clay, pale brown and yellow-brown.	SLM-D	L
			0.5	4			SW	Medium to coarse grained, medium sized gravel, with low to medium plasticity clay, yellow-brown and dark brown.	M	D
			0.75				SC	FILL Clayey SAND: medium grained, trace medium sized gravel, low plasticity clay, dark brown and yellow-brown.		
			1	1	Shear Vane: 50 kPa		CH	FILL Silty CLAY: high plasticity, black and dark brown.	w ≈ PL	F-St
				3	SPT 2,2,2 (N=4)					
			1.5				CI-CH	Medium to high plasticity, dark grey and dark brown.	w ≈ PL-w ≈ LL	S-F
			2	2	Shear Vane: 17.5 kPa					
					SPT 0,0,0 (N=0)					
					Shear Vane: 8.5 kPa					
				1				**BH103 Terminated at 3m**		

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REPORT OF BOREHOLE: BH104/MW4

Client	: Silverstone Developments	East	: 508,307.17	Sheet	: 1 OF 1
Project	: Proposed Unit Development	North	: 6,964,600.63 56J	Logged	: AD
Location	: 330 MacArthur Avenue, Hamilton QLD	Contractor	: All-Tech Drilling	Logged Date	20/06/2024
Job No	: J002466	Drill Rig	: 4WD Mounted Auger Rig	Checked	: CJ
		Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY	WELL DIAGRAM MW4
100mm SFA	L	Standing	0.5	4.4	ASS Sample: recovered at 0.25 m intervals to 3 m depth		SP	FILL Gravelly SAND: medium grained, coarse sized gravel, with low plasticity clay, yellow-brown pale brown.	SLM	MD-D	Solid
			0.75	4			CL	FILL Gravelly CLAY: medium sized gravel, trace fine to medium grained sand, low plasticity, brown and grey.	w < PL	St	
			1				SC	FILL Clayey SAND: fine grained, low plasticity clay, brown dark brown.	D	D	
			1.25		SPT 1,1,0 (N=2)		SC	Brown.	M	L	
			1.5	3			CI	FILL Silty CLAY: trace fine grained sand, medium plasticity, dark brown and black.	w > PL	F	
					Shear Vane: 34 kPa		CI-CH	With fine to medium sized gravel, medium to high plasticity, dark brown and grey-brown.	w > PL-w > LL		50mm PVC Slotted
			2	2	Shear Vane: 23 kPa						
					SPT 0,0,0 (N=0)						
				1				**BH104/MW4 Terminated at 3m**			

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REPORT OF TESTPIT: TP1

		East	: 508,342.01	Sheet	: 1 OF 1
Client	: Silverstone Developments	North	: 6,964,529.61 56J	Logged	: EA
Project	: Proposed Unit Development	Contractor	:	Logged Date	09/07/2024
Location	: 330 MacArthur Avenue, Hamilton QLD	Excavator	: 14T Excavator	Checked	: CJ
Job No	: J002466	Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
EX	L	GNO - no groundwater seepage observed	0	4			SW	FILL Gravelly SAND: fine to coarse grained, fine to medium sized gravel, with low to medium plasticity clay, brown orange and dark brown, lime layers at 0.3 m bgl.	M	D
			1		Shear Vane: 35~40 kPa					
			1.2	3			CL-CI	FILL Sandy CLAY: fine to coarse grained sand, trace fine to medium sized gravel, low to medium plasticity, dark grey.	w ≈ PL-w ≈ LL	F-St
			1.8				CH	FILL Silty CLAY: high plasticity, grey and dark grey, geofabric .	w ≈ PL	F
			2	2						
			3	1	Shear Vane: 25~30 kPa					
								TP1 Terminated at 3.3m		

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REPORT OF TESTPIT: TP2

		East	: 508,342.01	Sheet	: 1 OF 1
Client	: Silverstone Developments	North	: 6,964,529.61 56J	Logged	: EA
Project	: Proposed Unit Development	Contractor	:	Logged Date	17/07/2024
Location	: 330 MacArthur Avenue, Hamilton QLD	Excavator	: 14T Excavator	Checked	: CJ
Job No	: J002466	Inclination	:	Checked Date	: 04/12/2024

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (meters)	DEPTH RL	SAMPLE OR FIELD TEST	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE DESCRIPTION	CONSISTENCY DENSITY
EX	L	GNO - no groundwater seepage observed	0.5	4.4			SW	FILL Gravelly SAND: fine to coarse grained, fine to medium sized gravel, with low to medium plasticity clay, brown orange and dark brown, lime layers at 0.3 m bgl.	M	D
			1.1	4			CL-CI	FILL Sandy CLAY: fine to coarse grained sand, trace fine to medium sized gravel, low to medium plasticity, dark grey.	w ≈ PL-w ≈ LL	F-St
			1		Shear Vane: 25~40 kPa					
			2	3	Shear Vane: 20~25 kPa		CH	FILL Silty CLAY: trace fine grained sand, high plasticity, grey and dark grey.	w ≈ PL	S-F
			3	2	Shear Vane: 32~55 kPa		CH			F
				1				**TP2 Terminated at 3.3m**		

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EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V - Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
T	TC - Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatubre Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance** . Rapid penetration possible with little effort from the equipment used

M **Medium resistance.** Excavation possible at an acceptable rate with moderate effort from equipment used

H **High resistance to penetration/excavation**. Further penetration is possible at a slow rate

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level shown at date	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUND WATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed Sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (sv = peak value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Dynamic cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quantity Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100\text{ mm}}{\text{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

FILL	CLAY (CL,CI, or CH)
GRAVEL (GP or SW)	ORGANIC SOILS (OL or OH or Pt)
SAND (SP or SW)	COBBLES or BOULDERS
SILT (ML or MH)	

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

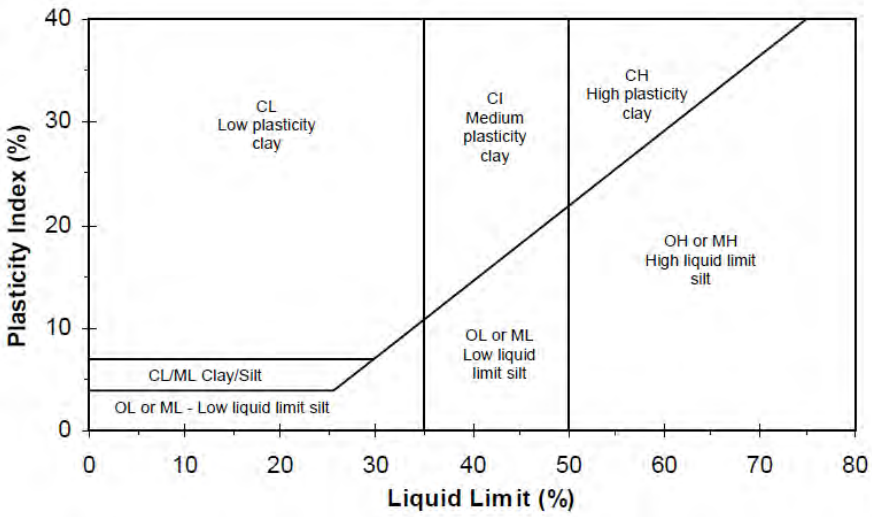
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS 1726 - 2017. The material properties are assessed in the field by visual/tactile methods.

PARTICLE SIZE

Major Division	Sub Division	Particle Size
Boulders		>200 mm
Cobbles		63 - 200 mm
Gravel	Coarse	20 - 63 mm
Gravel	Medium	6.7 - 20 mm
Gravel	Fine	2.36 - 6.7 mm
Sand	Coarse	0.6 - 2.36 mm
Sand	Medium	0.21 - 0.6 mm
Sand	Fine	0.075 - 0.21 mm
Silt		0.002 - 0.075 mm
Clay		<0.002 mm

PLASTIC PROPERTIES



MOISTURE CONDITION FOR COARSE GRAINED SOIL — AS 1726 - 2017

Symbol	Term	Description
D	Dry	Non-cohesive and free running
M	Moist	Soil feels cool, darkened in colour, tends to stick together
W	Wet	Soil feels cool, darkened in colour, soil sticks together, free water forms when handling

MOISTURE CONDITION FOR FINE GRAINED SOIL — AS1726 - 2017

Symbol	Term	Description
W<PL	Moist dry of liquid limit	Hard and friable or powdery
W = PL	Moist near plastic limit	Soils can be molded at a moisture condition approximately equal to the plastic limit
W >PL	Moist, wet of plastic limit	Soils usually weakened and free water forms on hands when handling
W = LL	Wet near plastic limit	
W > LL	Wet, wet of liquid limit	

CONSISTENCY TERMS FOR COHESIVE SOILS — AS1726—2017

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

RELATIVE DENSITY OF COARSE GRAINED SOILS — AS1726—2017

Symbol	Term	Density Index %	SPT 'N' #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

ROCK MATERIAL STRENGTH CLASSIFICATION				AS1726—2017
Symbol	**Term**	**Uniaxial Compressive Strength (MPa)**	**Point Load Strength $I_{s\ (50)}$ (MPa)**	**Field Guide**
VL	Very Low Strength	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick. Pieces up to 30 mm thick can be broken with finger pressure.
L	Low Strength	2 to 6	0.1 to 0.3	Easily scored with knife. Indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point. A piece of core 150 mm by 50 mm may be broken by hand. Sharp edges of core are friable and break during handling.
M	Medium Strength	6 to 20	0.3 to 1	Readily scored with a knife. A piece of core 150 mm by 50 mm can be broken by hand with difficulty.
H	High Strength	20 to 60	1 to 3	A piece of core 150 mm by 50 mm cannot be broken by hand but can be broken by a pick with a single firm blow. Rock rings under hammer.
VH	Very High Strength	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow. Rock rings under hammer.
EH	Extremely High Strength	Above 200	Above 10	Specimen requires many blows with geological pick to break through intact material. Rock rings under hammer.

● = Diametral Point Load Test ▼ = Axial Point Load Test

CLASSIFICATION OF MATERIAL WEATHERING		AS1726—2017
Symbol	**Term**	**Field Guide**
RS	Residual Soil *(Note 1)*	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.
XW	Extremely Weathered *(Note 1)*	Material is weathered to such an extent that is has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	Highly Weathered *(Note 2)*	The whole rock mass is discoloured, usually by iron staining or beaching to the extent that the colour of the original rock is not recognizable. 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.
MH	Moderately Weathered *(Note 2)*	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 recognizable, but shows little or no change in strength from fresh rock.
SW	Slightly Weathered	Pock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
FR	Fresh	Rock shows no signs of decomposition of individual minerals or colour change.
Note 1	The term 'Extremely Weathered rock' is misleading as the material has soil properties. The word 'rock' should be replaced with the name of the original rock of the word 'material', eg. Extremely Weathered granite or Extremely Weathered material.	
Note 2	Where it is not possible to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock the term 'Distinctly Weathered' may be used.	

DEFECT TYPE/DESCRIPTION			
B	Bedding Parting	V	Vein
J	Joint	HB/DB	Handling/Drilling Break
EW	Extremely Weathered Seam	C	Contact
FZ	Fracture Zone	L	Cleavage
CZ/S	Crushed Zone/Seam	X	Foliation
IS	Infilled Seam	S	Schistocity
SZ/S	Sheared Zone/Seam		

DEFECT PROFILE	
Symbol	**Description**
PL	Planar
St	Stepped
Un	Undulating

DEFECT INFILL DESCRIPTION	
Symbol	**Description**
Cn	Clean: No visible coating
Sn	Stain: Coated 1 to 3 mm
Vr	Veneer: < 1 mm
Ct	Coating: 1 to 3 mm

DEFECT ROUGHNESS DESCRIPTION	
Symbol	**Description**
Sl	Slickenside
Sm	Smooth
Ro	Rough

Vertical Boreholes - The dip (inclination from horizontal) for the defect is given.

Inclined Boreholes - The inclination is measured as the acute angle to the core axis.

Appendix C
Geotechnical Laboratory Test Certificates

Material Test Report

SQS www.sqs.net.au
SOIL QUALITY SERVICES
AMB Geotech SQS Pty Ltd
ABN 36 631 788 620

SQS
Brisbane Laboratory
105 Granite Street Geebung QLD 4034
Phone: (07) 3284 8766
Email: brisbane@sqs.net.au

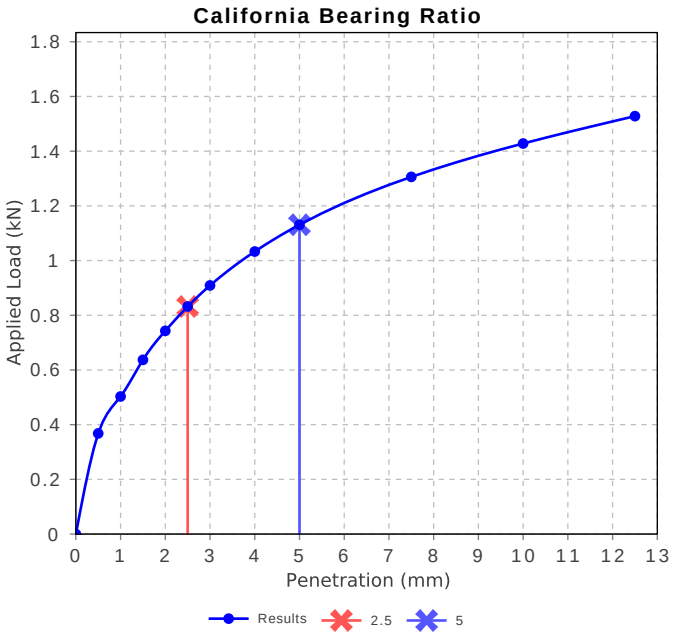
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488A
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 09/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **TP1, Depth: 0.5 - 1.0m**
Material Source: Onsite/Existing

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**6**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.45		
Optimum Moisture Content (%)	28.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.40		
Field Moisture Content (%)	32.4		
Moisture Content at Placement (%)	28.7		
Moisture Content Top 30mm (%)	34.8		
Moisture Content Rest of Sample (%)	28.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	196.9		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Sandy Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		
* Mineral Present	Carbonate		



Material Test Report

SQS www.sqs.net.au
SOIL QUALITY SERVICES
AMB Geotech SQS Pty Ltd
ABN 36 631 788 620

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Brisbane Laboratory
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Email: brisbane@sqs.net.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

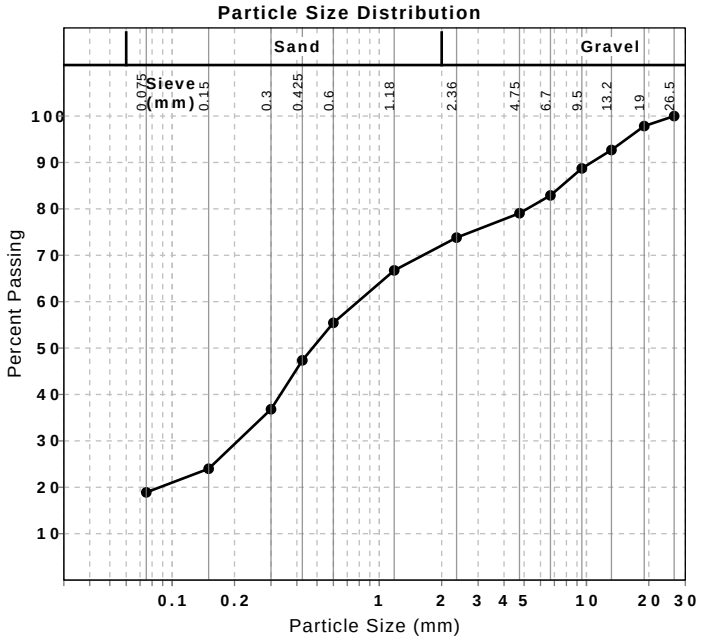
Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488B
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 08/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **TP2, Depth: 0.5 - 1.0m**
Material Source: Onsite/Existing

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**98**		
13.2 mm	**93**		
9.5 mm	**89**		
6.7 mm	**83**		
4.75 mm	**79**		
2.36 mm	**74**		
1.18 mm	**67**		
0.6 mm	**55**		
0.425 mm	**47**		
0.3 mm	**37**		
0.15 mm	**24**		
0.075 mm	**19**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	47		
Liquid Limit (%)	26		
Plastic Limit (%)	17		
Plasticity Index (%)	**9**		
Weighted Plasticity Index (%)	426		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**4.5**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Sandy Gravelly Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		
* Mineral Present	Carbonate		



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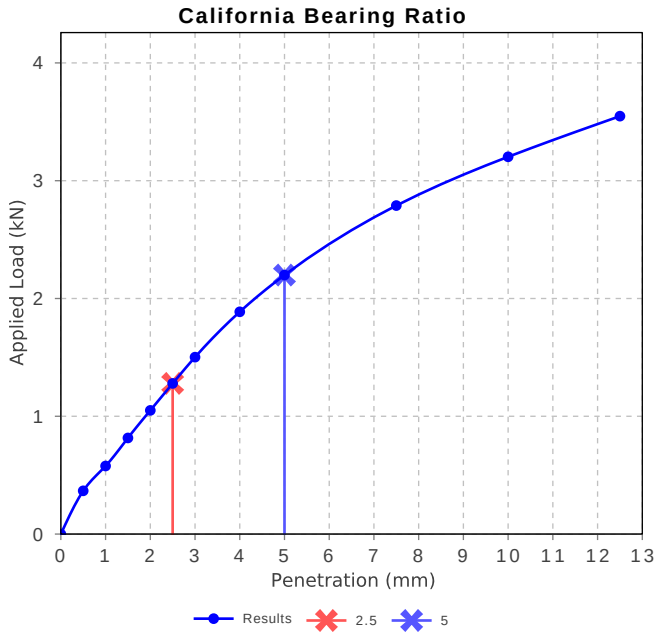
Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488C
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 06/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH2, Depth: 0.5 - 1.0m**
Material Source: Onsite/Existing

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS1289 5.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.91		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.87		
Field Moisture Content (%)	8.2		
Moisture Content at Placement (%)	12.8		
Moisture Content Top 30mm (%)	16.5		
Moisture Content Rest of Sample (%)	12.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	89.6		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.5		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Sandy Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		
* Mineral Present	Carbonate		



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Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

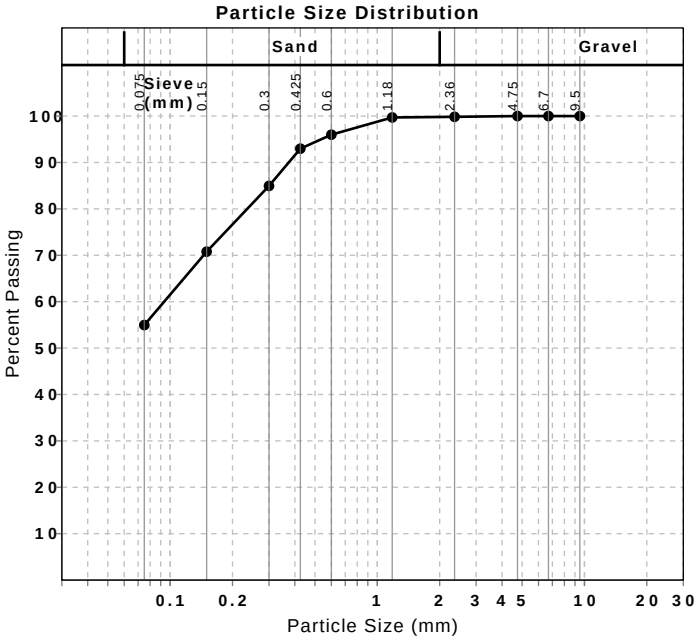
Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488D
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 05/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH4, Depth: 1.0 - 1.45m**
Material Source: Onsite/Existing

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**100**		
0.6 mm	**96**		
0.425 mm	**93**		
0.3 mm	**85**		
0.15 mm	**71**		
0.075 mm	**55**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	93		
Liquid Limit (%)	41		
Plastic Limit (%)	16		
Plasticity Index (%)	**25**		
Weighted Plasticity Index (%)	2324		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**10.5**		
Cracking Crumbling Curling	Curling		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	Sandy Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		



Material Test Report

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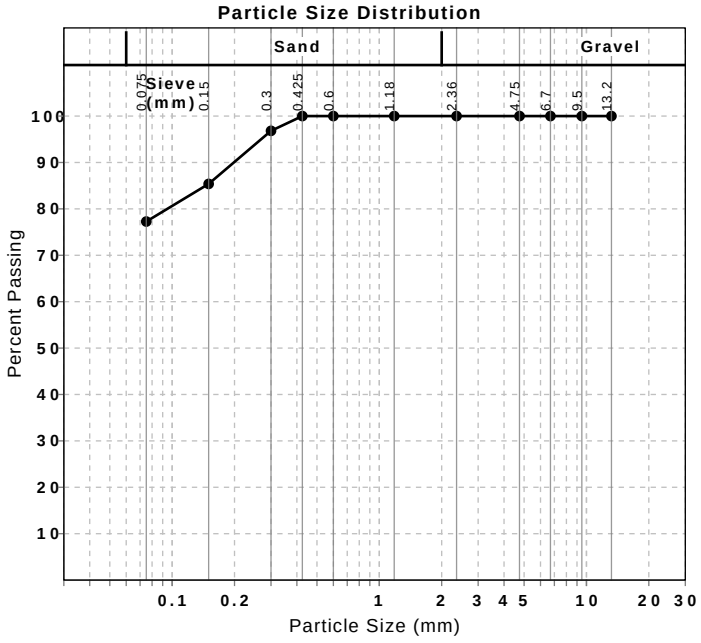
Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488E
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 06/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH6, Depth: 1.0 - 1.45m**
Material Source: Onsite/Existing

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**100**		
0.6 mm	**100**		
0.425 mm	**100**		
0.3 mm	**97**		
0.15 mm	**85**		
0.075 mm	**77**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	100		
Liquid Limit (%)	61		
Plastic Limit (%)	21		
Plasticity Index (%)	**40**		
Weighted Plasticity Index (%)	4000		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Curling		



Material Test Report

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SOIL QUALITY SERVICES
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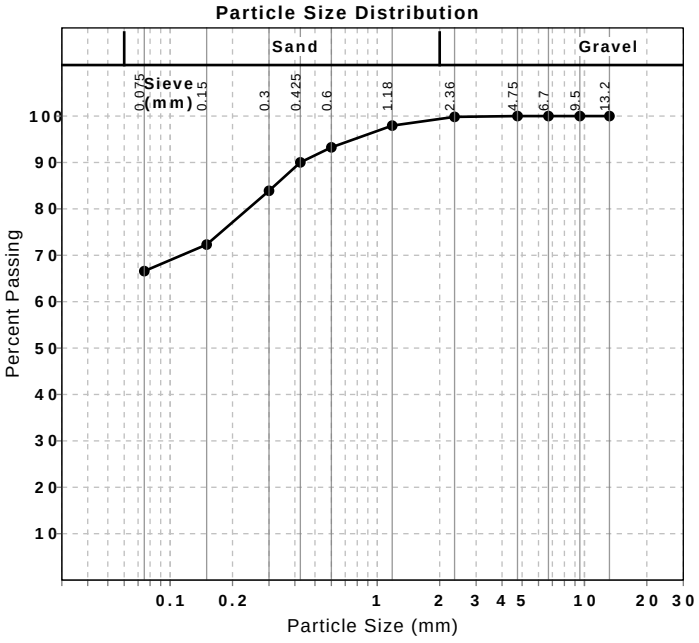
Approved Signatory: Torin Pegler
Senior Soil Technician
NATA Accredited Laboratory Number: 2911

Report Number: **B-24-599-1**
Issue Number: 1
Date Issued: 09/07/2024
Client: Core Consultants Pty Ltd
Unit 3/31 Londor Close, Hemmant Qld 4174
Contact: Andrew Middleton
Project Number: B-24-599
Project Name: Proposed Unit Development
Project Location: MacArthur Ave, Hamilton
Client Reference: J2466 - J2466
Work Request: 15488
Sample Number: B-15488F
Date Sampled: 25/06/2024
Dates Tested: 25/06/2024 - 06/07/2024
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH104, Depth: 1.0 - 1.45m**
Material Source: Onsite/Existing

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**98**		
0.6 mm	**93**		
0.425 mm	**90**		
0.3 mm	**84**		
0.15 mm	**72**		
0.075 mm	**67**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	90		
Liquid Limit (%)	53		
Plastic Limit (%)	19		
Plasticity Index (%)	**34**		
Weighted Plasticity Index (%)	3061		
Insufficient material for AS 1289.3.4.1. 250mm shrinkage. 125mm mould used.			

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Curling		
Insufficient material for AS 1289.3.4.1. 250mm shrinkage. 125mm mould used.			



AMB Geotech SQS Pty Ltd
15 Malduf Street
Chinchilla
Qld 4413

NATA Accredited
Accreditation Number 1261
Site Number 1254

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

Attention: **Michael Mauff**

Report **1112272-S**
Project name MacArthur Ave Hamilton
Project ID B-24-599
Received Date Jun 26, 2024

Client Sample ID			**B-15488E**	**B-15488F**
Sample Matrix			**Soil**	**Soil**
Eurofins Sample No.			**B24-Jn0070646**	**B24-Jn0070647**
Date Sampled			**Jun 25, 2024**	**Jun 25, 2024**
Test/Reference	LOR	Unit		
Chloride	5	mg/kg	47	350
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	200	990
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	7.9	8.3
Resistivity*	0.5	ohm.m	50	10
Sulphate (as SO4)	30	mg/kg	< 30	< 30
Sample Properties				
% Moisture	1	%	26	20

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Chloride	Melbourne	Jun 28, 2024	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Jun 28, 2024	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25 °C as rec.)	Melbourne	Jun 28, 2024	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Jun 28, 2024	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Jun 27, 2024	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins

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

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

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794 & 2780	Site# 25079 & 25289

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

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46-48 Banksia Road
Welshpool
WA 6106
+61 8 6253 4444
NATA# 2377
Site# 2370

Eurofins ProMicro Pty Ltd
ABN: 47 009 120 549

Perth ProMicro
46-48 Banksia Road
Welshpool
WA 6106
+61 8 6253 4444
NATA# 2561
Site# 2554

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland	Auckland (Focus)	Christchurch	Tauranga
35 O'Rorke Road	Unit C1/4 Pacific Rise,	43 Detroit Drive	1277 Cameron Road,
Penrose,	Mount Wellington,	Rolleston,	Gate Pa,
Auckland 1061	Auckland 1061	Christchurch 7675	Tauranga 3112
+64 9 526 4551	+64 9 525 0568	+64 3 343 5201	+64 9 525 0568
IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Company Name: AMB Geotech SQS Pty Ltd
Address: 15 Malduf Street
Chinchilla
Qld 4413

Project Name: MacArthur Ave Hamilton
Project ID: B-24-599

Order No.: AMB2831
Report #: 1112272
Phone: 07 4668 9716
Fax:

Received: Jun 26, 2024 5:00 PM
Due: Jul 3, 2024
Priority: 5 Day
Contact Name: Michael Mauff

Eurofins Analytical Services Manager : Ryan Gilbert

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	B-15488E	Jun 25, 2024		Soil	B24-Jn0070646	X	X
2	B-15488F	Jun 25, 2024		Soil	B24-Jn0070647	X	X
Test Counts						2	2

eurofins | Environment Testing

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

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

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ppm:** parts per million
µg/L: micrograms per litre	**ppb:** parts per billion	**%:** Percentage
org/100 mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100 mL:** Most Probable Number of organisms per 100 millilitres
CFU: Colony Forming Unit	**Colour:** Pt-Co Units (CU)	

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where moisture has been determined on a solid sample, the result is expressed on a dry weight basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples, these are performed on laboratory-certified clean sands and in the case of water samples, these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC represents the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a similar compound to the analyte target is reported as percentage recovery. See below for acceptance criteria.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment; however, free tributyltin was measured, and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 6.0
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

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

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

Results <10 times the LOR:	No Limit
Results between 10-20 times the LOR:	RPD must lie between 0-50%
Results >20 times the LOR:	RPD must lie between 0-30%

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

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%, VOC recoveries 50 – 150%

PFAS field samples containing surrogate recoveries above the QC limit designated in QSM 6.0, where no positive PFAS results have been reported or reviewed, and no data was affected.

QC Data General Comments

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

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 5			5	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 30			30	Pass	
LCS - % Recovery							
Chloride	%	121			70-130	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	%	115			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Chloride	M24-Jn0076645	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	K24-Jn0016715	NCP	uS/cm	130	140	4.3	30%	Pass	
pH (1:5 Aqueous extract at 25 °C as rec.)	K24-Jn0016715	NCP	pH Units	6.5	6.5	pass	30%	Pass	
Resistivity*	K24-Jn0016715	NCP	ohm.m	75	72	4.3	30%	Pass	
Sulphate (as SO4)	M24-Jn0076645	NCP	mg/kg	< 30	< 30	<1	30%	Pass	
Duplicate									
Sample Properties				Result 1	Result 2	RPD			
% Moisture	M24-Jn0070863	NCP	%	2.2	1.9	14	30%	Pass	

Comments

Sample Integrity

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

Authorised by:

Emily ONeill	Analytical Services Manager
Mary Makarios	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Sample Properties

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

Measurement uncertainty of test data is available on request or please click here.

Appendix D
Acid Sulfate Soil Laboratory Test Certificates

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Email: accounts@coreconsultants.com.au

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo
Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)	Remarks and or Other Details
BH1	0.0-0.25	1	1	19/06/2024	X		
	0.25-0.5	2	1	19/06/2024	X		
	0.5-0.75	3	1	19/06/2024	X		
	0.75-1.0	4	1	19/06/2024	X		
	1.0-1.25	5	1	19/06/2024	X		
	1.25-1.5	6	1	19/06/2024	X		
	1.5-1.75	7	1	19/06/2024	X		
	1.75-2.0	8	1	19/06/2024	X		
	2.0-2.25	9	1	19/06/2024	X		
	2.25-2.5	10	1	19/06/2024	X		
	2.5-2.75	11	1	19/06/2024	X		
	2.75-3.0	12	1	19/06/2024	X		
BH2	0.0-0.25	13	1	19/06/2024	X		
	0.25-0.5	14	1	19/06/2024	X		
	0.5-0.75	15	1	19/06/2024	X		
	0.75-1.0	16	1	19/06/2024	X		
	1.0-1.25	17	1	19/06/2024	X		
	1.25-1.5	18	1	19/06/2024	X		
	1.5-1.75	19	1	19/06/2024	X		
	1.75-2.0	20	1	19/06/2024	X		
	2.0-2.25	21	1	19/06/2024	X		
	2.25-2.5	22	1	19/06/2024	X		
	2.5-2.75	23	1	19/06/2024	X		
	2.75-3.0	24	1	19/06/2024	X		

SPLIT BATCH
Test
Assoc. Batch No.
EB2421233

Environmental Division
Brisbane
Work Order Reference
EB2421232

Telephone : + 61-7-3243 7222

Checked by:
Date Sent:

EM
20.06.24
1715

Date Received By ALS:

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugcolprasert/Christie Jo
Email Report to: eanugcolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH3	0.0-0.25	25	1	19/06/2024	X																	
	0.25-0.5	26	1	19/06/2024	X																	
	0.5-0.75	27	1	19/06/2024	X																	
	0.75-1.0	28	1	19/06/2024	X																	
	1.0-1.25	29	1	19/06/2024	X																	
	1.25-1.5	30	1	19/06/2024	X																	
	1.5-1.75	31	1	19/06/2024	X																	
	1.75-2.0	32	1	19/06/2024	X																	
	2.0-2.25	33	1	19/06/2024	X																	
	2.25-2.5	34	1	19/06/2024	X																	
	2.5-2.75	35	1	19/06/2024	X																	
	2.75-3.0	36	1	19/06/2024	X																	
BH4	0.0-0.25	37	1	19/06/2024	X																	
	0.25-0.5	38	1	19/06/2024	X																	
	0.5-0.75	39	1	19/06/2024	X																	
	0.75-1.0	40	1	19/06/2024	X																	
	1.0-1.25	41	1	19/06/2024	X																	
	1.25-1.5	42	1	19/06/2024	X																	
	1.5-1.75	43	1	19/06/2024	X																	
	1.75-2.0	44	1	19/06/2024	X																	
	2.0-2.25	45	1	19/06/2024	X																	
SN R	2.25-2.5	46	1	19/06/2024	X																	
	2.5-2.75	47	1	19/06/2024	X																	
	2.75-3.0	48	1	19/06/2024	X																	

Checked by: FH
Date Sent: 20.06.24 1715

Date Received By ALS:

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																	Remarks and or Other Details
BH5	0.0-0.25	49	1	19/06/2024	X																		
	0.25-0.5	50	1	19/06/2024	X																		
	0.5-0.75	51	1	19/06/2024	X																		
	0.75-1.0	52	1	19/06/2024	X																		
	1.0-1.25	53	1	19/06/2024	X																		
	1.25-1.5	54	1	19/06/2024	X																		
	1.5-1.75	55	1	19/06/2024	X																		
	1.75-2.0	56	1	19/06/2024	X																		
	2.0-2.25	57	1	19/06/2024	X																		
	2.25-2.5	58	1	19/06/2024	X																		
	2.5-2.75	59	1	19/06/2024	X																		
	2.75-3.0	60	1	19/06/2024	X																		
BH6	0.0-0.25	61	1	19/06/2024	X																		
	0.25-0.5	62	1	19/06/2024	X																		
	0.5-0.75	63	1	19/06/2024	X																		
	0.75-1.0	64	1	19/06/2024	X																		
	1.0-1.25	65	1	19/06/2024	X																		
	1.25-1.5	66	1	19/06/2024	X																		
	1.5-1.75	67	1	19/06/2024	X																		
	1.75-2.0	68	1	19/06/2024	X																		
	2.0-2.25	69	1	19/06/2024	X																		
	2.25-2.5	70	1	19/06/2024	X																		
	2.5-2.75	71	1	19/06/2024	X																		
	2.75-3.0	72	1	19/06/2024	X																		

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au;cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH101	0.0-0.25		1	20/04/2024	X																	
	0.25-0.5		1	20/06/2024	X																	
	0.5-0.75		1	20/06/2024	X																	
	0.75-1.0		1	20/06/2024	X																	
	1.0-1.25		1	20/06/2024	X																	
	1.25-1.5		1	20/06/2024	X																	
	1.5-1.75		1	20/06/2024	X																	
	1.75-2.0		1	20/06/2024	X																	
	2.0-2.25		1	20/06/2024	X																	
	2.25-2.5		1	20/06/2024	X																	
	2.5-2.75		1	20/06/2024	X																	
	2.75-3.0		1	20/06/2024	X																	
BH102	0.0-0.25		1	20/06/2024	X																	
	0.25-0.5		1	20/06/2024	X																	
	0.5-0.75		1	20/06/2024	X																	
	0.75-1.0		1	20/06/2024	X																	
	1.0-1.25		1	20/06/2024	X																	
	1.25-1.5		1	20/06/2024	X																	
	1.5-1.75		1	20/06/2024	X																	
	1.75-2.0		1	20/06/2024	X																	
	2.0-2.25		1	20/06/2024	X																	
	2.25-2.5		1	20/06/2024	X																	
	2.5-2.75		1	20/06/2024	X																	
	2.75-3.0		1	20/06/2024	X																	
TP1	0.0-1.0		1	20/06/2024	X																	
	1.0-2.0		1	20/06/2024	X																	
	2.0-3.0		1	20/06/2024	X																	
	3.0-4.0		1	20/06/2024	X																	

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au;cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH103	0.0-0.25		1	20/04/2024	X																	
	0.25-0.5		1	20/06/2024	X																	
	0.5-0.75		1	20/06/2024	X																	
	0.75-1.0		1	20/06/2024	X																	
	1.0-1.25		1	20/06/2024	X																	
	1.25-1.5		1	20/06/2024	X																	
	1.5-1.75		1	20/06/2024	X																	
	1.75-2.0		1	20/06/2024	X																	
	2.0-2.25		1	20/06/2024	X																	
	2.25-2.5		1	20/06/2024	X																	
	2.5-2.75		1	20/06/2024	X																	
	2.75-3.0		1	20/06/2024	X																	
BH104	0.0-0.25		1	20/06/2024	X																	
	0.25-0.5		1	20/06/2024	X																	
	0.5-0.75		1	20/06/2024	X																	
	0.75-1.0		1	20/06/2024	X																	
	1.0-1.25		1	20/06/2024	X																	
	1.25-1.5		1	20/06/2024	X																	
	1.5-1.75		1	20/06/2024	X																	
	1.75-2.0		1	20/06/2024	X																	
	2.0-2.25		1	20/06/2024	X																	
	2.25-2.5		1	20/06/2024	X																	
	2.5-2.75		1	20/06/2024	X																	
	2.75-3.0		1	20/06/2024	X																	
TP2	0.0-1.0		1	20/06/2024	X																	
	1.0-2.0		1	20/06/2024	X																	
	2.0-3.0		1	20/06/2024	X																	
	3.0-4.0		1	20/06/2024	X																	

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20.06.24
1715

CERTIFICATE OF ANALYSIS

Work Order	: **EB2421232**	Page	: 1 of 17
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024 17:15
Order number	: ----	Date Analysis Commenced	: 27-Jun-2024
C-O-C number	: TR01	Issue Date	: 28-Jun-2024 09:26
Sampler	: AD/EA		
Site	: Proposed Unit Development		
Quote number	: EN/222		
No. of samples received	: 72		
No. of samples analysed	: 72		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
~ = Indicates an estimated value.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1 0.0-0.25	BH1 0.25-0.5	BH1 0.5-0.75	BH1 0.75-1.0	BH1 1.0-1.25
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-001	EB2421232-002	EB2421232-003	EB2421232-004	EB2421232-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.8**	**7.6**	**8.1**	**8.2**	**8.4**
pH (Fox)	----	0.1	pH Unit	**5.4**	**5.1**	**6.3**	**6.2**	**6.1**
Reaction Rate	----	1	-	**3**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1 1.25-1.5	BH1 1.5-1.75	BH1 1.75-2.0	BH1 2.0-2.25	BH1 2.25-2.5
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-006	EB2421232-007	EB2421232-008	EB2421232-009	EB2421232-010
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**8.4**	**8.4**	**8.6**	**8.8**
pH (Fox)	----	0.1	pH Unit	**6.4**	**6.1**	**3.6**	**4.8**	**6.0**
Reaction Rate	----	1	-	**2**	**3**	**2**	**2**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1 2.5-2.75	BH1 2.75-3.0	BH2 0.0-0.25	BH2 0.25-0.5	BH2 0.5-0.75
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-011	EB2421232-012	EB2421232-013	EB2421232-014	EB2421232-015
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.8**	**8.8**	**8.7**	**8.4**	**8.4**
pH (Fox)	----	0.1	pH Unit	**3.7**	**8.9**	**6.3**	**6.5**	**6.5**
Reaction Rate	----	1	-	**4**	**4**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH2 0.75-1.0	BH2 1.0-1.25	BH2 1.25-1.5	BH2 1.5-1.75	BH2 1.75-2.0
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-016	EB2421232-017	EB2421232-018	EB2421232-019	EB2421232-020
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.5**	**8.4**	**8.4**	**8.3**	**8.3**
pH (Fox)	----	0.1	pH Unit	**6.7**	**6.8**	**7.9**	**6.6**	**6.0**
Reaction Rate	----	1	-	**2**	**2**	**4**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH2 2.0-2.25	BH2 2.25-2.5	BH2 2.5-2.75	BH2 2.75-3.0	BH3 0.0-0.25
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-021	EB2421232-022	EB2421232-023	EB2421232-024	EB2421232-025
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.1**	**9.0**	**8.7**	**9.1**	**7.2**
pH (Fox)	----	0.1	pH Unit	**6.4**	**4.2**	**4.6**	**3.8**	**4.8**
Reaction Rate	----	1	-	**2**	**4**	**2**	**4**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH3 0.25-0.5	BH3 0.5-0.75	BH3 0.75-1.0	BH3 1.0-1.25	BH3 1.25-1.5
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-026	EB2421232-027	EB2421232-028	EB2421232-029	EB2421232-030
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.8**	**8.2**	**8.5**	**8.4**	**8.6**
pH (Fox)	----	0.1	pH Unit	**5.5**	**6.2**	**6.1**	**6.0**	**6.1**
Reaction Rate	----	1	-	**2**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH3 1.5-1.75	BH3 1.75-2.0	BH3 2.0-2.25	BH3 2.25-2.5	BH3 2.5-2.75
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-031	EB2421232-032	EB2421232-033	EB2421232-034	EB2421232-035
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.4**	**8.5**	**8.7**	**8.8**	**8.8**
pH (Fox)	----	0.1	pH Unit	**5.9**	**5.9**	**6.4**	**5.3**	**6.3**
Reaction Rate	----	1	-	**2**	**2**	**3**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH3 2.75-3.0	BH4 0.0-0.25	BH4 0.25-0.5	BH4 0.5-0.75	BH4 0.75-1.0
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-036	EB2421232-037	EB2421232-038	EB2421232-039	EB2421232-040
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**8.0**	**8.1**	**8.5**	**9.1**
pH (Fox)	----	0.1	pH Unit	**6.0**	**6.1**	**8.1**	**6.4**	**6.7**
Reaction Rate	----	1	-	**4**	**2**	**4**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH4 1.0-1.25	BH4 1.25-1.5	BH4 1.5-1.75	BH4 1.75-2.0	BH4 2.0-2.25
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-041	EB2421232-042	EB2421232-043	EB2421232-044	EB2421232-045
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.9**	**8.8**	**8.7**	**8.9**	**9.0**
pH (Fox)	----	0.1	pH Unit	**6.2**	**7.0**	**6.8**	**6.6**	**6.2**
Reaction Rate	----	1	-	**3**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH4 2.5-2.75	BH4 2.75-3.0	BH5 0.0-0.25	BH5 0.25-0.5	BH5 0.5-0.75
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-047	EB2421232-048	EB2421232-049	EB2421232-050	EB2421232-051
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**8.6**	**8.7**	**8.6**	**8.9**
pH (Fox)	----	0.1	pH Unit	**6.6**	**4.7**	**5.7**	**6.3**	**5.6**
Reaction Rate	----	1	-	**4**	**4**	**2**	**3**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH5 0.75-1.0	BH5 1.0-1.25	BH5 1.25-1.5	BH5 1.5-1.75	BH5 1.75-2.0
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-052	EB2421232-053	EB2421232-054	EB2421232-055	EB2421232-056
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.9**	**8.9**	**9.0**	**9.0**	**8.6**
pH (Fox)	----	0.1	pH Unit	**6.2**	**6.5**	**4.8**	**6.4**	**6.4**
Reaction Rate	----	1	-	**2**	**2**	**4**	**2**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH5 2.0-2.25	BH5 2.25-2.5	BH5 2.5-2.75	BH5 2.75-3.0	BH6 0.0-0.25
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-057	EB2421232-058	EB2421232-059	EB2421232-060	EB2421232-061
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.8**	**8.9**	**8.7**	**8.6**	**8.8**
pH (Fox)	----	0.1	pH Unit	**4.2**	**6.2**	**5.5**	**5.9**	**6.1**
Reaction Rate	----	1	-	**4**	**3**	**4**	**4**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH6 0.25-0.5	BH6 0.5-0.75	BH6 0.75-1.0	BH6 1.0-1.25	BH6 1.25-1.5
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-062	EB2421232-063	EB2421232-064	EB2421232-065	EB2421232-066
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.9**	**8.0**	**8.4**	**8.2**	**8.5**
pH (Fox)	----	0.1	pH Unit	**6.0**	**5.9**	**6.4**	**6.7**	**3.6**
Reaction Rate	----	1	-	**2**	**3**	**2**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH6 1.5-1.75	BH6 1.75-2.0	BH6 2.0-2.25	BH6 2.25-2.5	BH6 2.5-2.75
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421232-067	EB2421232-068	EB2421232-069	EB2421232-070	EB2421232-071
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.4**	**8.6**	**8.7**	**8.8**	**8.8**
pH (Fox)	----	0.1	pH Unit	**4.9**	**4.9**	**4.6**	**3.6**	**6.2**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH6 2.75-3.0	BH4 2.25-2.5	----	----	----
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2421232-072	EB2421232-073	--------	--------	--------
				Result	Result	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**8.6**	**----**	**----**	**----**
pH (Fox)	----	0.1	pH Unit	**3.9**	**3.5**	**----**	**----**	**----**
Reaction Rate	----	1	-	**4**	**2**	**----**	**----**	**----**

QUALITY CONTROL REPORT

Work Order	: **EB2421232**	Page	: 1 of 3
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Order number	: ----	Date Analysis Commenced	: 27-Jun-2024
C-O-C number	: TR01	Issue Date	: 28-Jun-2024
Sampler	: AD/EA		
Site	: Proposed Unit Development		
Quote number	: EN/222		
No. of samples received	: 72		
No. of samples analysed	: 72		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA037: Ass Field Screening Analysis (QC Lot: 5886987)									
EB2421232-001	BH1 0.0-0.25	EA037: pH (F)	----	0.1	pH Unit	7.8	7.8	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.4	5.6	2.7	0% - 20%
EB2421232-011	BH1 2.5-2.75	EA037: pH (F)	----	0.1	pH Unit	8.8	8.8	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.7	3.6	3.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5886988)									
EB2421232-021	BH2 2.0-2.25	EA037: pH (F)	----	0.1	pH Unit	8.1	8.1	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.4	6.3	0.0	0% - 20%
EB2421232-031	BH3 1.5-1.75	EA037: pH (F)	----	0.1	pH Unit	8.4	8.4	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.9	5.9	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5886989)									
EB2421232-041	BH4 1.0-1.25	EA037: pH (F)	----	0.1	pH Unit	8.9	8.9	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.2	6.0	3.1	0% - 20%
EB2421232-052	BH5 0.75-1.0	EA037: pH (F)	----	0.1	pH Unit	8.9	8.8	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.2	6.3	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5886990)									
EB2421232-062	BH6 0.25-0.5	EA037: pH (F)	----	0.1	pH Unit	8.9	8.7	2.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.0	6.1	0.0	0% - 20%
EB2421232-072	BH6 2.75-3.0	EA037: pH (F)	----	0.1	pH Unit	8.7	8.7	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.9	3.8	0.0	0% - 20%

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

- **No Method Blank (MB) or Laboratory Control Spike (LCS) Results are required to be reported.**

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2421232**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Site	: Proposed Unit Development	Issue Date	: 28-Jun-2024
Sampler	: AD/EA	No. of samples received	: 72
Order number	: ----	No. of samples analysed	: 72

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis							
Snap Lock Bag - frozen (EA037)							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis - Continued								
BH1 0.0-0.25,	BH1 0.25-0.5,	**19-Jun-2024**	**27-Jun-2024**	16-Dec-2024	✓	**27-Jun-2024**	16-Dec-2024	✓
BH1 0.5-0.75,	BH1 0.75-1.0,							
BH1 1.0-1.25,	BH1 1.25-1.5,							
BH1 1.5-1.75,	BH1 1.75-2.0,							
BH1 2.0-2.25,	BH1 2.25-2.5,							
BH1 2.5-2.75,	BH1 2.75-3.0,							
BH2 0.0-0.25,	BH2 0.25-0.5,							
BH2 0.5-0.75,	BH2 0.75-1.0,							
BH2 1.0-1.25,	BH2 1.25-1.5,							
BH2 1.5-1.75,	BH2 1.75-2.0,							
BH2 2.0-2.25,	BH2 2.25-2.5,							
BH2 2.5-2.75,	BH2 2.75-3.0,							
BH3 0.0-0.25,	BH3 0.25-0.5,							
BH3 0.5-0.75,	BH3 0.75-1.0,							
BH3 1.0-1.25,	BH3 1.25-1.5,							
BH3 1.5-1.75,	BH3 1.75-2.0,							
BH3 2.0-2.25,	BH3 2.25-2.5,							
BH3 2.5-2.75,	BH3 2.75-3.0,							
BH4 0.0-0.25,	BH4 0.25-0.5,							
BH4 0.5-0.75,	BH4 0.75-1.0,							
BH4 1.0-1.25,	BH4 1.25-1.5,							
BH4 1.5-1.75,	BH4 1.75-2.0,							
BH4 2.0-2.25,	BH4 2.5-2.75,							
BH4 2.75-3.0,	BH5 0.0-0.25,							
BH5 0.25-0.5,	BH5 0.5-0.75,							
BH5 0.75-1.0,	BH5 1.0-1.25,							
BH5 1.25-1.5,	BH5 1.5-1.75,							
BH5 1.75-2.0,	BH5 2.0-2.25,							
BH5 2.25-2.5,	BH5 2.5-2.75,							
BH5 2.75-3.0,	BH6 0.0-0.25,							
BH6 0.25-0.5,	BH6 0.5-0.75,							
BH6 0.75-1.0,	BH6 1.0-1.25,							
BH6 1.25-1.5,	BH6 1.5-1.75,							
BH6 1.75-2.0,	BH6 2.0-2.25,							
BH6 2.25-2.5,	BH6 2.5-2.75,							
BH6 2.75-3.0,	BH4 2.25-2.5							

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
ASS Field Screening Analysis	EA037	8	72	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
ASS Field Screening Analysis	* EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

Preparation Methods	Method	Matrix	Method Descriptions
Drying only	EN020D	SOIL	In house

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo
Email Report to: anugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)	Remarks and or Other Details
BH1	0.0-0.25		1	19/06/2024	X		
	0.25-0.5		1	19/06/2024	X		
	0.5-0.75		1	19/06/2024	X		
	0.75-1.0		1	19/06/2024	X		
	1.0-1.25		1	19/06/2024	X		
	1.25-1.5		1	19/06/2024	X		
	1.5-1.75		1	19/06/2024	X		
	1.75-2.0		1	19/06/2024	X		
	2.0-2.25		1	19/06/2024	X		
	2.25-2.5		1	19/06/2024	X		
	2.5-2.75		1	19/06/2024	X		
	2.75-3.0		1	19/06/2024	X		
BH2	0.0-0.25		1	19/06/2024	X		
	0.25-0.5		1	19/06/2024	X		
	0.5-0.75		1	19/06/2024	X		
	0.75-1.0		1	19/06/2024	X		
	1.0-1.25		1	19/06/2024	X		
	1.25-1.5		1	19/06/2024	X		
	1.5-1.75		1	19/06/2024	X		
	1.75-2.0		1	19/06/2024	X		
	2.0-2.25		1	19/06/2024	X		
	2.25-2.5		1	19/06/2024	X		
	2.5-2.75		1	19/06/2024	X		
	2.75-3.0		1	19/06/2024	X		

SPLIT BATCH
Test
Assoc. Batch No.
EB2421232

Checked by:
Date Sent:

EH
20.06.24
1715

Date Received By ALS:

Environmental Division
Brisbane
Work Order Reference
EB2421233

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Email: accounts@coreconsultants.com.au

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo
Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH3	0.0-0.25		1	19/06/2024	X																	
	0.25-0.5		1	19/06/2024	X																	
	0.5-0.75		1	19/06/2024	X																	
	0.75-1.0		1	19/06/2024	X																	
	1.0-1.25		1	19/06/2024	X																	
	1.25-1.5		1	19/06/2024	X																	
	1.5-1.75		1	19/06/2024	X																	
	1.75-2.0		1	19/06/2024	X																	
	2.0-2.25		1	19/06/2024	X																	
	2.25-2.5		1	19/06/2024	X																	
	2.5-2.75		1	19/06/2024	X																	
	2.75-3.0		1	19/06/2024	X																	
BH4	0.0-0.25		1	19/06/2024	X																	
	0.25-0.5		1	19/06/2024	X																	
	0.5-0.75		1	19/06/2024	X																	
	0.75-1.0		1	19/06/2024	X																	
	1.0-1.25		1	19/06/2024	X																	
	1.25-1.5		1	19/06/2024	X																	
	1.5-1.75		1	19/06/2024	X																	
	1.75-2.0		1	19/06/2024	X																	
	2.0-2.25		1	19/06/2024	X																	
	2.25-2.5		1	19/06/2024	X																	
	2.5-2.75		1	19/06/2024	X																	
	2.75-3.0		1	19/06/2024	X																	

Checked by:
Date Sent:

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Date Received By ALS:

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52 Second Avenue
Maroochydore QLD 4558
Phone: 5475 5900
Email: accounts@corecconsultants.com.au

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																	Remarks and or Other Details
BH5	0.0-0.25		1	19/06/2024	X																		
	0.25-0.5		1	19/06/2024	X																		
	0.5-0.75		1	19/06/2024	X																		
	0.75-1.0		1	19/06/2024	X																		
	1.0-1.25		1	19/06/2024	X																		
	1.25-1.5		1	19/06/2024	X																		
	1.5-1.75		1	19/06/2024	X																		
	1.75-2.0		1	19/06/2024	X																		
	2.0-2.25		1	19/06/2024	X																		
	2.25-2.5		1	19/06/2024	X																		
	2.5-2.75		1	19/06/2024	X																		
	2.75-3.0		1	19/06/2024	X																		
BH6	0.0-0.25		1	19/06/2024	X																		
	0.25-0.5		1	19/06/2024	X																		
	0.5-0.75		1	19/06/2024	X																		
	0.75-1.0		1	19/06/2024	X																		
	1.0-1.25		1	19/06/2024	X																		
	1.25-1.5		1	19/06/2024	X																		
	1.5-1.75		1	19/06/2024	X																		
	1.75-2.0		1	19/06/2024	X																		
	2.0-2.25		1	19/06/2024	X																		
	2.25-2.5		1	19/06/2024	X																		
	2.5-2.75		1	19/06/2024	X																		
	2.75-3.0		1	19/06/2024	X																		

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Maroochydore QLD 4558
Phone: 5475 5900
Email: accounts@coreconsultants.com.au

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo
Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH101	0.0-0.25	1	1	20/04/2024	X																	
	0.25-0.5	2	1	20/06/2024	X																	
	0.5-0.75	3	1	20/06/2024	X																	
	0.75-1.0	4	1	20/06/2024	X																	
	1.0-1.25	5	1	20/06/2024	X																	
	1.25-1.5	6	1	20/06/2024	X																	
	1.5-1.75	7	1	20/06/2024	X																	
	1.75-2.0	8	1	20/06/2024	X																	
	2.0-2.25	9	1	20/06/2024	X																	
	2.25-2.5	10	1	20/06/2024	X																	
	2.5-2.75	11	1	20/06/2024	X																	
	2.75-3.0	12	1	20/06/2024	X																	
BH102	0.0-0.25	13	1	20/06/2024	X																	
	0.25-0.5	14	1	20/06/2024	X																	
	0.5-0.75	15	1	20/06/2024	X																	
	0.75-1.0	16	1	20/06/2024	X																	
	1.0-1.25	17	1	20/06/2024	X																	
	1.25-1.5	18	1	20/06/2024	X																	
	1.5-1.75	19	1	20/06/2024	X																	
	1.75-2.0	20	1	20/06/2024	X																	
	2.0-2.25	21	1	20/06/2024	X																	
	2.25-2.5	22	1	20/06/2024	X																	
	2.5-2.75	23	1	20/06/2024	X																	
	2.75-3.0	24	1	20/06/2024	X																	
TP1	0.0-1.0	25	1	20/06/2024	X																	
	1.0-2.0	26	1	20/06/2024	X																	
	2.0-3.0	27	1	20/06/2024	X																	
	3.0-4.0	28	1	20/06/2024	X																	

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Phone: 5475 5900
Email: accounts@coreconsultants.com.au

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH103	0.0-0.25	29	1	20/04/2024	X																	
	0.25-0.5	30	1	20/06/2024	X																	
	0.5-0.75	31	1	20/06/2024	X																	
	0.75-1.0	32	1	20/06/2024	X																	
	1.0-1.25	33	1	20/06/2024	X																	
	1.25-1.5	34	1	20/06/2024	X																	
	1.5-1.75	35	1	20/06/2024	X																	
	1.75-2.0	36	1	20/06/2024	X																	
	2.0-2.25	37	1	20/06/2024	X																	
	2.25-2.5	38	1	20/06/2024	X																	
	2.5-2.75	39	1	20/06/2024	X																	
	2.75-3.0	40	1	20/06/2024	X																	
BH104	0.0-0.25	41	1	20/06/2024	X																	
	0.25-0.5	42	1	20/06/2024	X																	
	0.5-0.75	43	1	20/06/2024	X																	
	0.75-1.0	44	1	20/06/2024	X																	
	1.0-1.25	45	1	20/06/2024	X																	
	1.25-1.5	46	1	20/06/2024	X																	
	1.5-1.75	47	1	20/06/2024	X																	
	1.75-2.0	48	1	20/06/2024	X																	
	2.0-2.25	49	1	20/06/2024	X																	
	2.25-2.5	50	1	20/06/2024	X																	
	2.5-2.75	51	1	20/06/2024	X																	
	2.75-3.0	52	1	20/06/2024	X																	
TP2	0.0-1.0	53	1	20/06/2024	X																	
	1.0-2.0	54	1	20/06/2024	X																	
	2.0-3.0	55	1	20/06/2024	X																	
	3.0-4.0	56	1	20/06/2024	X																	

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CERTIFICATE OF ANALYSIS

Work Order	: **EB2421233**	Page	: 1 of 14
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024 17:15
Order number	: ----	Date Analysis Commenced	: 26-Jun-2024
C-O-C number	: ----	Issue Date	: 26-Jun-2024 15:44
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 56		
No. of samples analysed	: 56		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
~ = Indicates an estimated value.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH101 0.0-0.25	BH101 0.25-0.5	BH101 0.5-0.75	BH101 0.75-1.0	BH101 1.0-1.25
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-001	EB2421233-002	EB2421233-003	EB2421233-004	EB2421233-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.7**	**8.9**	**8.8**	**8.4**	**8.7**
pH (Fox)	----	0.1	pH Unit	**5.5**	**8.8**	**7.0**	**6.2**	**6.7**
Reaction Rate	----	1	-	**2**	**4**	**3**	**2**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH101 1.25-1.5	BH101 1.5-1.75	BH101 1.75-2.0	BH101 2.0-2.25	BH101 2.25-2.5
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-006	EB2421233-007	EB2421233-008	EB2421233-009	EB2421233-010
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**9.0**	**8.8**	**9.1**	**8.9**	**8.9**
pH (Fox)	----	0.1	pH Unit	**4.4**	**4.8**	**5.1**	**5.6**	**4.4**
Reaction Rate	----	1	-	**4**	**4**	**4**	**3**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH101 2.5-2.75	BH101 2.75-3.0	BH102 0.0-0.25	BH102 0.25-0.5	BH102 0.5-0.75
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-011	EB2421233-012	EB2421233-013	EB2421233-014	EB2421233-015
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**8.8**	**7.7**	**7.5**	**8.2**
pH (Fox)	----	0.1	pH Unit	**7.1**	**5.6**	**4.6**	**4.7**	**6.0**
Reaction Rate	----	1	-	**4**	**4**	**3**	**3**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH102 0.75-1.0	BH102 1.0-1.25	BH102 1.25-1.5	BH102 1.5-1.75	BH102 1.75-2.0
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-016	EB2421233-017	EB2421233-018	EB2421233-019	EB2421233-020
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.4**	**8.7**	**8.5**	**8.6**	**8.5**
pH (Fox)	----	0.1	pH Unit	**7.1**	**7.1**	**5.3**	**3.6**	**5.1**
Reaction Rate	----	1	-	**4**	**4**	**3**	**3**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH102 2.0-2.25	BH102 2.25-2.5	BH102 2.5-2.75	BH102 2.75-3.0	TP1 0.0-1.0
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-021	EB2421233-022	EB2421233-023	EB2421233-024	EB2421233-025
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.9**	**8.9**	**8.9**	**8.7**	**8.1**
pH (Fox)	----	0.1	pH Unit	**4.3**	**5.3**	**4.3**	**5.0**	**7.1**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TP1 1.0-2.0	TP1 2.0-3.0	TP1 3.0-4.0	BH103 0.0-0.25	BH103 0.25-0.5
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-026	EB2421233-027	EB2421233-028	EB2421233-029	EB2421233-030
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.8**	**9.1**	**8.9**	**8.7**	**9.4**
pH (Fox)	----	0.1	pH Unit	**5.0**	**6.0**	**4.2**	**5.7**	**7.8**
Reaction Rate	----	1	-	**3**	**3**	**4**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH103 0.5-0.75	BH103 0.75-1.0	BH103 1.0-1.25	BH103 1.25-1.5	BH103 1.5-1.75
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-031	EB2421233-032	EB2421233-033	EB2421233-034	EB2421233-035
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**9.3**	**9.4**	**8.8**	**8.8**	**8.9**
pH (Fox)	----	0.1	pH Unit	**9.3**	**6.9**	**4.1**	**5.4**	**5.6**
Reaction Rate	----	1	-	**4**	**2**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH103 1.75-2.0	BH103 2.0-2.25	BH103 2.25-2.5	BH103 2.5-2.75	BH103 2.75-3.0
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-036	EB2421233-037	EB2421233-038	EB2421233-039	EB2421233-040
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**9.0**	**8.7**	**8.8**	**8.7**	**8.8**
pH (Fox)	----	0.1	pH Unit	**6.2**	**5.1**	**5.4**	**6.7**	**4.2**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH104 0.0-0.25	BH104 0.25-0.5	BH104 0.5-0.75	BH104 0.75-1.0	BH104 1.0-1.25
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-041	EB2421233-042	EB2421233-043	EB2421233-044	EB2421233-045
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.1**	**7.8**	**8.5**	**8.4**	**9.0**
pH (Fox)	----	0.1	pH Unit	**5.7**	**5.3**	**6.8**	**7.8**	**7.1**
Reaction Rate	----	1	-	**3**	**4**	**2**	**2**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH104 1.25-1.5	BH104 1.5-1.75	BH104 1.75-2.0	BH104 2.0-2.25	BH104 2.25-2.5
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-046	EB2421233-047	EB2421233-048	EB2421233-049	EB2421233-050
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.4**	**8.9**	**8.5**	**8.4**	**9.0**
pH (Fox)	----	0.1	pH Unit	**7.6**	**4.9**	**4.3**	**5.5**	**4.6**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH104 2.5-2.75	BH104 2.75-3.0	TP2 0.0-1.0	TP2 1.0-2.0	TP2 2.0-3.0
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2421233-051	EB2421233-052	EB2421233-053	EB2421233-054	EB2421233-055
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.6**	**8.8**	**8.6**	**9.0**	**9.0**
pH (Fox)	----	0.1	pH Unit	**6.3**	**3.7**	**6.1**	**6.5**	**5.5**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TP2 3.0-4.0	----	----	----	----
			Sampling date / time	20-Jun-2024 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2421233-056	--------	--------	--------	--------
				Result	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.7**	**----**	**----**	**----**	**----**
pH (Fox)	----	0.1	pH Unit	**3.8**	**----**	**----**	**----**	**----**
Reaction Rate	----	1	-	**4**	**----**	**----**	**----**	**----**

QUALITY CONTROL REPORT

Work Order	: **EB2421233**	Page	: 1 of 3
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Order number	: ----	Date Analysis Commenced	: 26-Jun-2024
C-O-C number	: ----	Issue Date	: 26-Jun-2024
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 56		
No. of samples analysed	: 56		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA037: Ass Field Screening Analysis (QC Lot: 5880820)									
EB2421233-001	BH101 0.0-0.25	EA037: pH (F)	----	0.1	pH Unit	7.7	7.7	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.5	5.5	0.0	0% - 20%
EB2421233-011	BH101 2.5-2.75	EA037: pH (F)	----	0.1	pH Unit	8.7	8.8	1.4	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	7.1	7.0	2.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5880821)									
EB2421233-021	BH102 2.0-2.25	EA037: pH (F)	----	0.1	pH Unit	8.9	9.0	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.3	4.3	0.0	0% - 20%
EB2421233-031	BH103 0.5-0.75	EA037: pH (F)	----	0.1	pH Unit	9.3	9.2	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	9.3	9.3	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5880822)									
EB2421233-041	BH104 0.0-0.25	EA037: pH (F)	----	0.1	pH Unit	8.1	8.0	2.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.7	5.9	2.4	0% - 20%
EB2421233-051	BH104 2.5-2.75	EA037: pH (F)	----	0.1	pH Unit	8.6	8.6	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.3	6.3	0.0	0% - 20%

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

- **No Method Blank (MB) or Laboratory Control Spike (LCS) Results are required to be reported.**

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2421233**	Page	: 1 of 4
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Site	: ----	Issue Date	: 26-Jun-2024
Sampler	: AD/EA	No. of samples received	: 56
Order number	: ----	No. of samples analysed	: 56

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen (EA037)								
BH101 0.0-0.25,	BH101 0.25-0.5,	**20-Jun-2024**	**26-Jun-2024**	17-Dec-2024	✓	**26-Jun-2024**	17-Dec-2024	✓
BH101 0.5-0.75,	BH101 0.75-1.0,							
BH101 1.0-1.25,	BH101 1.25-1.5,							
BH101 1.5-1.75,	BH101 1.75-2.0,							
BH101 2.0-2.25,	BH101 2.25-2.5,							
BH101 2.5-2.75,	BH101 2.75-3.0,							
BH102 0.0-0.25,	BH102 0.25-0.5,							
BH102 0.5-0.75,	TP1 0.0-1.0, BH102 0.75-1.0,							
BH102 1.0-1.25,	BH102 1.25-1.5,							
BH102 1.5-1.75,	BH102 1.75-2.0,							
BH102 2.0-2.25,	BH102 2.25-2.5,							
BH102 2.5-2.75,	BH102 2.75-3.0,							
TP1 1.0-2.0,								
TP1 2.0-3.0,	TP1 3.0-4.0,							
BH103 0.0-0.25,	BH103 0.25-0.5,							
BH103 0.5-0.75,	BH103 0.75-1.0,							
BH103 1.0-1.25,	BH103 1.25-1.5,							
BH103 1.5-1.75,	BH103 1.75-2.0,							
BH103 2.0-2.25,	BH103 2.25-2.5,							
BH103 2.5-2.75,	BH103 2.75-3.0,							
BH104 0.0-0.25,	BH104 0.25-0.5,							
BH104 0.5-0.75,	BH104 0.75-1.0,							
BH104 1.0-1.25,	BH104 1.25-1.5,							
BH104 1.5-1.75,	TP2 0.0-1.0, BH104 1.75-2.0,							
BH104 2.0-2.25,	BH104 2.25-2.5,							
BH104 2.5-2.75,	BH104 2.75-3.0,							
TP2 1.0-2.0,								
TP2 2.0-3.0,	TP2 3.0-4.0							

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
ASS Field Screening Analysis	EA037	6	56	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
ASS Field Screening Analysis	* EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

Preparation Methods	Method	Matrix	Method Descriptions
Drying only	EN020D	SOIL	In house

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TEST REQUEST FORM

Order No.:
Job No.: J002466
Job Name: Proposed Unit Development
C.O.C. No.: TR01 Quotation No.
Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo
Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au
Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)	Remarks and or Other Details
BH1	0.0-0.25		1	19/06/2024			
	0.25-0.5		1	19/06/2024		x	
	0.5-0.75		1	19/06/2024			
	0.75-1.0		1	19/06/2024			
	1.0-1.25		1	19/06/2024			
	1.25-1.5		1	19/06/2024			
	1.5-1.75		1	19/06/2024			
	1.75-2.0		1	19/06/2024		x	
	2.0-2.25		1	19/06/2024			
	2.25-2.5		1	19/06/2024			
	2.5-2.75		1	19/06/2024			
	2.75-3.0		1	19/06/2024			
BH2	0.0-0.25		1	19/06/2024			
	0.25-0.5		1	19/06/2024			
	0.5-0.75		1	19/06/2024			
	0.75-1.0		1	19/06/2024		x	
	1.0-1.25		1	19/06/2024			
	1.25-1.5		1	19/06/2024			
	1.5-1.75		1	19/06/2024			
	1.75-2.0		1	19/06/2024			
	2.0-2.25		1	19/06/2024			
	2.25-2.5		1	19/06/2024			
	2.5-2.75		1	19/06/2024			
	2.75-3.0		1	19/06/2024		x	

Checked by:
Date Sent:
Date Received By ALS:

Environmental Division
Brisbane
Work Order Reference
EB2422384

Telephone : + 61-7-3243 7222

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@corcconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
	0.0-0.25		1	19/06/2024		x																
	0.25-0.5		1	19/06/2024																		
	0.5-0.75		1	19/06/2024																		
	0.75-1.0		1	19/06/2024																		
	1.0-1.25		1	19/06/2024																		
BH3	1.25-1.5		1	19/06/2024																		
	1.5-1.75		1	19/06/2024																		
	1.75-2.0		1	19/06/2024																		
	2.0-2.25		1	19/06/2024																		
	2.25-2.5		1	19/06/2024																		
	2.5-2.75		1	19/06/2024																		
	2.75-3.0		1	19/06/2024																		
	0.0-0.25		1	19/06/2024																		
	0.25-0.5		1	19/06/2024																		
	0.5-0.75		1	19/06/2024																		
	0.75-1.0		1	19/06/2024		x																
	1.0-1.25		1	19/06/2024																		
BH4	1.25-1.5		1	19/06/2024																		
	1.5-1.75		1	19/06/2024																		
	1.75-2.0		1	19/06/2024																		
	2.0-2.25		1	19/06/2024																		
	2.25-2.5		1	19/06/2024		x																
	2.5-2.75		1	19/06/2024																		
	2.75-3.0		1	19/06/2024																		

Checked by:
Date Sent:

Date Received By ALS:

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Order No.:
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Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH5	0.0-0.25		1	19/06/2024																		
	0.25-0.5		1	19/06/2024																		
	0.5-0.75		1	19/06/2024		x																
	0.75-1.0		1	19/06/2024																		
	1.0-1.25		1	19/06/2024																		
	1.25-1.5		1	19/06/2024																		
	1.5-1.75		1	19/06/2024																		
	1.75-2.0		1	19/06/2024																		
	2.0-2.25		1	19/06/2024		x																
	2.25-2.5		1	19/06/2024																		
	2.5-2.75		1	19/06/2024																		
	2.75-3.0		1	19/06/2024																		
BH6	0.0-0.25		1	19/06/2024																		
	0.25-0.5		1	19/06/2024																		
	0.5-0.75		1	19/06/2024																		
	0.75-1.0		1	19/06/2024																		
	1.0-1.25		1	19/06/2024																		
	1.25-1.5		1	19/06/2024		x																
	1.5-1.75		1	19/06/2024																		
	1.75-2.0		1	19/06/2024																		
	2.0-2.25		1	19/06/2024																		
	2.25-2.5		1	19/06/2024																		
	2.5-2.75		1	19/06/2024																		
	2.75-3.0		1	19/06/2024																		

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)	Remarks and or Other Details
BH101	0.0-0.25		1	20/04/2024			
	0.25-0.5		1	20/06/2024			
	0.5-0.75		1	20/06/2024			
	0.75-1.0		1	20/06/2024			
	1.0-1.25		1	20/06/2024			
	1.25-1.5		1	20/06/2024			
	1.5-1.75		1	20/06/2024		x	
	1.75-2.0		1	20/06/2024			
	2.0-2.25		1	20/06/2024			
	2.25-2.5		1	20/06/2024			
	2.5-2.75		1	20/06/2024			
	2.75-3.0		1	20/06/2024			
BH102	0.0-0.25		1	20/06/2024			
	0.25-0.5		1	20/06/2024			
	0.5-0.75		1	20/06/2024		x	
	0.75-1.0		1	20/06/2024			
	1.0-1.25		1	20/06/2024			
	1.25-1.5		1	20/06/2024			
	1.5-1.75		1	20/06/2024			
	1.75-2.0		1	20/06/2024			
	2.0-2.25		1	20/06/2024			
	2.25-2.5		1	20/06/2024			
	2.5-2.75		1	20/06/2024			
	2.75-3.0		1	20/06/2024			
TP1	0.0-1.0		1	20/06/2024			
	1.0-2.0		1	20/06/2024			
	2.0-3.0		1	20/06/2024			
	3.0-4.0		1	20/06/2024			

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Order No.:
Job No.: J002466
Job Name: Proposed Unit Development

C.O.C. No.: TR01 Quotation No.

Sampled By: AD/EA Contact Name: Endoo Anugoolprasert/Christie Jo

Email Report to: eanugoolprasert@coreconsultants.com.au/cjonson@coreconsultants.com.au

Prior Storage: Iced Esky

SAMPLE ID	Sample Depth (m)	Media	No. of sample bags	SAMPLE DATE	pH f and pH fox [EA037]	Chromium Suite (Include and Exclude ANC)																Remarks and or Other Details
BH103	0.0-0.25		1	20/04/2024																		
	0.25-0.5		1	20/06/2024																		
	0.5-0.75		1	20/06/2024																		
	0.75-1.0		1	20/06/2024		x																
	1.0-1.25		1	20/06/2024																		
	1.25-1.5		1	20/06/2024																		
	1.5-1.75		1	20/06/2024																		
	1.75-2.0		1	20/06/2024																		
	2.0-2.25		1	20/06/2024																		
	2.25-2.5		1	20/06/2024																		
	2.5-2.75		1	20/06/2024																		
	2.75-3.0		1	20/06/2024		x																
BH104	0.0-0.25		1	20/06/2024																		
	0.25-0.5		1	20/06/2024																		
	0.5-0.75		1	20/06/2024																		
	0.75-1.0		1	20/06/2024																		
	1.0-1.25		1	20/06/2024																		
	1.25-1.5		1	20/06/2024																		
	1.5-1.75		1	20/06/2024																		
	1.75-2.0		1	20/06/2024		x																
	2.0-2.25		1	20/06/2024																		
	2.25-2.5		1	20/06/2024																		
	2.5-2.75		1	20/06/2024																		
	2.75-3.0		1	20/06/2024																		
TP2	0.0-1.0		1	20/06/2024																		
	1.0-2.0		1	20/06/2024																		
	2.0-3.0		1	20/06/2024																		
	3.0-4.0		1	20/06/2024																		

CERTIFICATE OF ANALYSIS

Work Order	: **EB2422384**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466 Proposed Unit Development	Date Samples Received	: 20-Jun-2024 17:15
Order number	: ----	Date Analysis Commenced	: 05-Jul-2024
C-O-C number	: TR01	Issue Date	: 08-Jul-2024 12:42
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA033 (CRS Suite): Analysis is performed as per the Acid Sulfate Soils Laboratory Methods Guidelines (2004) and the updated National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT (2018)
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1 0.25-0.5	BH1 1.75-2.0	BH2 0.75-1.0	BH2 2.75-3.0	BH3 0.0-0.25
			Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2422384-002	EB2422384-008	EB2422384-016	EB2422384-024	EB2422384-025
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**7.6**	**8.5**	**8.8**	**8.3**	**6.4**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.046**	**0.399**	**0.012**	**0.605**	**0.012**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**29**	**249**	<10	**378**	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**1.04**	**6.13**	**3.08**	**3.89**	**----**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**207**	**1220**	**615**	**777**	**----**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.33**	**1.96**	**0.98**	**1.25**	**----**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.05**	**0.40**	<0.02	**0.60**	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**29**	**249**	<10	**378**	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	**2**	**19**	<1	**28**	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH4 0.75-1.0	BH4 2.25-2.5	BH5 0.5-0.75	BH5 2.0-2.25	BH6 1.25-1.5
				Sampling date / time	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00	19-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		EB2422384-040	EB2422384-046	EB2422384-050	EB2422384-056	EB2422384-065
					Result	Result	Result	Result	Result
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit		**9.0**	**8.9**	**8.7**	**8.3**	**8.2**
Titratable Actual Acidity (23F)	----	2	mole H+ / t		<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S		**0.012**	**0.124**	**0.058**	**0.612**	**0.456**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t		<10	**77**	**36**	**382**	**284**
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3		**1.90**	**5.77**	**1.52**	**3.01**	**2.55**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t		**379**	**1150**	**304**	**602**	**510**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S		**0.61**	**1.85**	**0.49**	**0.96**	**0.82**
EA033-E: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t		<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	**0.12**	**0.06**	**0.61**	**0.46**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	**77**	**36**	**382**	**284**
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	**6**	**3**	**29**	**21**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH101 1.5-1.75	BH102 0.5-0.75	BH103 0.75-1.0	BH103 2.75-3.0	BH104 1.75-2.0
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00	20-Jun-2024 00:00
Compound	CAS Number	LOR	Unit	EB2422384-066	EB2422384-067	EB2422384-068	EB2422384-069	EB2422384-070
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**8.4**	**8.4**	**8.9**	**8.3**	**8.2**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.442**	**0.060**	**0.166**	**0.684**	**0.515**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**276**	**38**	**104**	**426**	**321**
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**2.82**	**1.75**	**2.65**	**3.04**	**2.49**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**563**	**350**	**529**	**607**	**497**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.90**	**0.56**	**0.85**	**0.97**	**0.80**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**0.04**	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	**22**	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	**2**	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.44**	**0.06**	**0.17**	**0.68**	**0.52**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**276**	**38**	**104**	**426**	**321**
Liming Rate excluding ANC	----	1	kg CaCO3/t	**21**	**3**	**8**	**32**	**24**

QUALITY CONTROL REPORT

Work Order	: **EB2422384**	Page	: 1 of 4
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466 Proposed Unit Development	Date Samples Received	: 20-Jun-2024
Order number	: ----	Date Analysis Commenced	: 05-Jul-2024
C-O-C number	: TR01	Issue Date	: 08-Jul-2024
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA033-A: Actual Acidity (QC Lot: 5902491)									
EB2422379-001	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	6.5	6.7	2.4	0% - 20%
EB2422384-065	BH6 1.25-1.5	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	8.2	8.2	0.0	0% - 20%
EA033-B: Potential Acidity (QC Lot: 5902491)									
EB2422379-001	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	0.008	23.8	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2422384-065	BH6 1.25-1.5	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.456	0.456	0.0	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	284	285	0.0	0% - 20%
EA033-C: Acid Neutralising Capacity (QC Lot: 5902491)									
EB2422379-001	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.08	0.06	32.6	No Limit
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.03	0.02	0.0	No Limit
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	17	12	32.6	No Limit
EB2422384-065	BH6 1.25-1.5	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	2.55	2.75	7.5	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.82	0.88	7.5	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA033-C: Acid Neutralising Capacity (QC Lot: 5902491) - continued									
EB2422384-065	BH6 1.25-1.5	EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	510	550	7.5	0% - 20%

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA033-A: Actual Acidity (QCLot: 5902491)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.7 pH Unit	101	80.0	120
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	102	80.0	120
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 5902491)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.283 % S	101	77.0	121
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 5902491)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	107	91.0	112
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2422384**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Telephone	: +61 7 3552 8616
Project	: J002466 Proposed Unit Development	Date Samples Received	: 20-Jun-2024
Site	: ----	Issue Date	: 08-Jul-2024
Sampler	: AD/EA	No. of samples received	: 15
Order number	: ----	No. of samples analysed	: 15

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-A: Actual Acidity							
80* dried soil (EA033)							
BH1 0.25-0.5, BH1 1.75-2.0, BH2 0.75-1.0, BH2 2.75-3.0, BH3 0.0-0.25, BH4 0.75-1.0, BH4 2.25-2.5, BH5 0.5-0.75, BH5 2.0-2.25, BH6 1.25-1.5, BH101 1.5-1.75, BH102 0.5-0.75, BH103 0.75-1.0, BH103 2.75-3.0, BH104 1.75-2.0	**20-Jun-2024**	**05-Jul-2024**	20-Jun-2025	✓	**05-Jul-2024**	03-Oct-2024	✓
EA033-B: Potential Acidity							
80* dried soil (EA033)							
BH1 0.25-0.5, BH1 1.75-2.0, BH2 0.75-1.0, BH2 2.75-3.0, BH3 0.0-0.25, BH4 0.75-1.0, BH4 2.25-2.5, BH5 0.5-0.75, BH5 2.0-2.25, BH6 1.25-1.5, BH101 1.5-1.75, BH102 0.5-0.75, BH103 0.75-1.0, BH103 2.75-3.0, BH104 1.75-2.0	**20-Jun-2024**	**05-Jul-2024**	20-Jun-2025	✓	**05-Jul-2024**	03-Oct-2024	✓
EA033-C: Acid Neutralising Capacity							
80* dried soil (EA033)							
BH1 0.25-0.5, BH1 1.75-2.0, BH2 0.75-1.0, BH2 2.75-3.0, BH3 0.0-0.25, BH4 0.75-1.0, BH4 2.25-2.5, BH5 0.5-0.75, BH5 2.0-2.25, BH6 1.25-1.5, BH101 1.5-1.75, BH102 0.5-0.75, BH103 0.75-1.0, BH103 2.75-3.0, BH104 1.75-2.0	**20-Jun-2024**	**05-Jul-2024**	20-Jun-2025	✓	**05-Jul-2024**	03-Oct-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-D: Retained Acidity							
80* dried soil (EA033)							
BH1 0.25-0.5, BH1 1.75-2.0, BH2 0.75-1.0, BH2 2.75-3.0, BH3 0.0-0.25, BH4 0.75-1.0, BH4 2.25-2.5, BH5 0.5-0.75, BH5 2.0-2.25, BH6 1.25-1.5, BH101 1.5-1.75, BH102 0.5-0.75, BH103 0.75-1.0, BH103 2.75-3.0, BH104 1.75-2.0	**20-Jun-2024**	**05-Jul-2024**	20-Jun-2025	✓	**05-Jul-2024**	03-Oct-2024	✓
EA033-E: Acid Base Accounting							
80* dried soil (EA033)							
BH1 0.25-0.5, BH1 1.75-2.0, BH2 0.75-1.0, BH2 2.75-3.0, BH3 0.0-0.25, BH4 0.75-1.0, BH4 2.25-2.5, BH5 0.5-0.75, BH5 2.0-2.25, BH6 1.25-1.5, BH101 1.5-1.75, BH102 0.5-0.75, BH103 0.75-1.0, BH103 2.75-3.0, BH104 1.75-2.0	**20-Jun-2024**	**05-Jul-2024**	20-Jun-2025	✓	**05-Jul-2024**	03-Oct-2024	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

EnviroMail 146 Australia - PFAS: Internal Standards, Surrogates & Isotope Dilutions
EnviroMail 147 Australia - PFAS: Emerged or emerging?
EnviroMail 148 Australia – Interpreting TOP Assay
EnviroMail 151 Australia - Expanding the scope of PFAS analysis in soils and waters

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From: Christie Johnson <cjohnson@coreconsultants.com.au>
Sent: Monday, July 8, 2024 5:14 PM
To: Carsten Emrich <Carsten.Emrich@alsglobal.com>
Cc: Cameron Kay <ckay@coreconsultants.com.au>; Endoo Anugoolprasert <eanugoolprasert@coreconsultants.com.au>
Subject: [EXTERNAL] - Fw: RESULTS & EDD for ALS Workorder : EB2422384 | Your Reference: J002466 Proposed Unit Development

CAUTION: This email originated from outside of ALS. Do not click links or open attachments unless you recognize the sender and are sure content is relevant to you.

Hi Carsten,

Can I please have additional testing on the following samples:

Analysis:
Chromium Suite (Including and excluding ANC)

Samples:
BH101 0-0.25 m (EB2421233-001)
BH2 0-0.25m (EB2421232-013)

Thanks,
Christie

Christie Johnson I B.Eng (Environmental) | Geo-Environmental Engineer

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Geotechnical Environmental
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CERTIFICATE OF ANALYSIS

Work Order	: **EB2423364**	Page	: 1 of 3
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024 17:15
Order number	: ----	Date Analysis Commenced	: 15-Jul-2024
C-O-C number	: ----	Issue Date	: 15-Jul-2024 15:46
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA033 (CRS Suite): Analysis is performed as per the Acid Sulfate Soils Laboratory Methods Guidelines (2004) and the updated National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT (2018)
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- Unless otherwise stated, analytical work for this work order will be conducted by ALS Brisbane.
- ASS: EA033 (CRS Suite): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH101 0-0.25m	BH2 0-0.25m	----	----	----
			Sampling date / time	20-Jun-2024 00:00	20-Jun-2024 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2423364-001	EB2423364-013	--------	--------	--------
				Result	Result	----	----	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**7.2**	**8.6**	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.014**	**0.042**	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	**26**	----	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**0.30**	**2.10**	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**60**	**420**	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.10**	**0.67**	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	**0.04**	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	**26**	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	**2**	----	----	----

QUALITY CONTROL REPORT

Work Order	: **EB2423364**	Page	: 1 of 3
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Contact	: Carsten Emrich
Address	: 55 KINGSFORD SMITH PARADE MAROOCHYDORE 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Order number	: ----	Date Analysis Commenced	: 15-Jul-2024
C-O-C number	: ----	Issue Date	: 15-Jul-2024
Sampler	: AD/EA		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA033-A: Actual Acidity (QC Lot: 5920554)									
EB2423364-001	BH101 0-0.25m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	7.2	7.0	1.8	0% - 20%
ES2422109-012	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.03	0.03	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	21	21	0.0	0% - 50%
		EA033: pH KCl (23A)	----	0.1	pH Unit	4.8	4.7	0.0	0% - 20%
EA033-B: Potential Acidity (QC Lot: 5920554)									
EB2423364-001	BH101 0-0.25m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.014	0.013	0.0	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
ES2422109-012	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.011	0.013	15.5	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 5920554)									
EB2423364-001	BH101 0-0.25m	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.30	0.27	9.4	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.10	0.09	0.0	No Limit
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	60	55	9.4	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA033-A: Actual Acidity (QCLot: 5920554)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.7 pH Unit	101	80.0	120
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	110	80.0	120
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 5920554)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.283 % S	98.8	77.0	121
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 5920554)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	110	91.0	112
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2423364**	Page	: 1 of 4
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: Endoo Anugoolprasert	Telephone	: +61 7 3552 8616
Project	: J002466	Date Samples Received	: 20-Jun-2024
Site	: ----	Issue Date	: 15-Jul-2024
Sampler	: AD/EA	No. of samples received	: 2
Order number	: ----	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-A: Actual Acidity							
80* dried soil (EA033)							
BH101 0-0.25m, BH2 0-0.25m	**20-Jun-2024**	**15-Jul-2024**	20-Jun-2025	✓	**15-Jul-2024**	13-Oct-2024	✓
EA033-B: Potential Acidity							
80* dried soil (EA033)							
BH101 0-0.25m, BH2 0-0.25m	**20-Jun-2024**	**15-Jul-2024**	20-Jun-2025	✓	**15-Jul-2024**	13-Oct-2024	✓
EA033-C: Acid Neutralising Capacity							
80* dried soil (EA033)							
BH101 0-0.25m, BH2 0-0.25m	**20-Jun-2024**	**15-Jul-2024**	20-Jun-2025	✓	**15-Jul-2024**	13-Oct-2024	✓
EA033-D: Retained Acidity							
80* dried soil (EA033)							
BH101 0-0.25m, BH2 0-0.25m	**20-Jun-2024**	**15-Jul-2024**	20-Jun-2025	✓	**15-Jul-2024**	13-Oct-2024	✓
EA033-E: Acid Base Accounting							
80* dried soil (EA033)							
BH101 0-0.25m, BH2 0-0.25m	**20-Jun-2024**	**15-Jul-2024**	20-Jun-2025	✓	**15-Jul-2024**	13-Oct-2024	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

Appendix E
Groundwater Analytical Results

			Lab Report Number	1113127	1113127	1113127	1113127
			Field ID	MW1	MW2	MW3	MW4
			Sample Type	Primary	Primary	Primary	Primary
			Date	26 Jun 2024	26 Jun 2024	26 Jun 2024	26 Jun 2024
	Unit	Brisbane River WQOs (Middle Esturine Waters)	EQL				
Field							
Temperature	°C	NA		24.1	25.2	24.5	23.9
pH	unit	7.0-8.4		6.51	7.09	7	6.97
DO	ppm			2.47	1.28	1.3	1.08
Conductivity	us/cm	NA		1924	4403	15884	22653
Redox	mV	NA		-61.4	-107.5	-33.9	-40.9
Odour	Observation			Nil	Nil	Nil	Nil
Turbidity	Observation			Low	Moderate	HIgh	Moderate to high
Inorganics							
Alkalinity (Bicarbonate as CaCO3)	mg/L		20	690	1400	1500	1900
Alkalinity (Carbonate as CaCO3)	mg/L		20	< 20	97	< 20	< 20
Alkalinity (Hydroxide as CaCO3)	mg/L		20	< 20	< 20	< 20	< 20
Alkalinity (total) as CaCO3	mg/L		20	590	1500	1500	1900
Chloride	mg/L		1	470	1300	5800	11000
Sodium	mg/L		0.5	230	2100	6600	10000
Sulphate	mg/L		5	360	26	16	26
Metals							
Aluminium (Total)	mg/L		0.05	75	19	11	13
Aluminium (dissolved)	mg/L		0.05	0.1	< 0.05	< 0.05	< 0.05
Calcium	mg/L		0.5	310	69	170	330
Iron (Total)	mg/L		0.05	130	27	26	23
Iron (dissolved)	mg/L		0.05	2.5	1.7	0.09	1.2
Magnesium	mg/L		0.5	110	110	400	840
Potassium	mg/L		0.5	37	76	160	240

Notes: Environmental Protection (Water and Wetland Biodiversity) Policy 2019, *Brisbane River Estuary Environmental Values and Water Quality Objectives - Part of Basin 143* .

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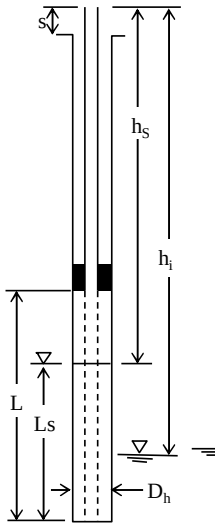
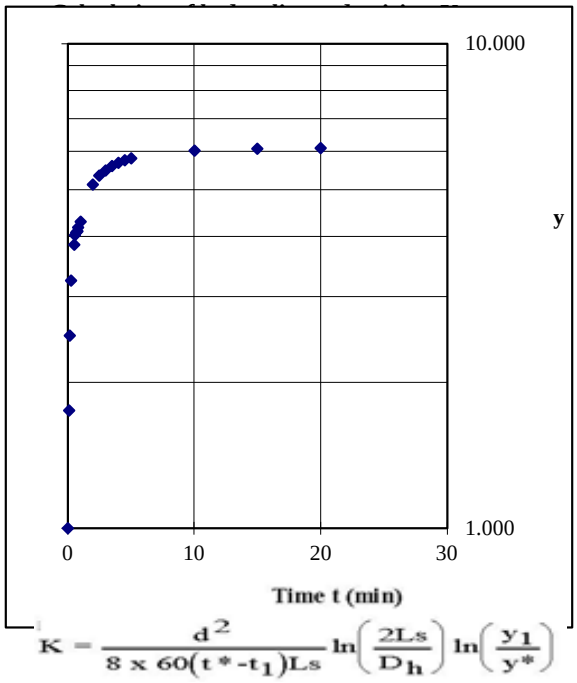
FALLING HEAD PERMEABILITY TEST

Client	Silverstone	**Bore No**	**BH2/MW1**
Project	Proposed unit development	**Test Date**	June 26, 2024
Location	MacArthur Ave, Hamilton	**Project No.**	J002466
Tested by	AD/EA	**Checked**	
Remarks			



Depth of borehole (H)	3.00	m	(measured from ground surface)
Depth to bottom of seal (Hb)	3.00	m	(measured from ground surface)
Test section length (L)	2.0	m	
Diameter of pipe (D_p)	0.05	m	Note **:
Diameter of test section (D_h)	0.10	m	1. d = D_p or D_h if no gravel pack
Dia. of water surface (d)**	0.069	m	
Static depth to gw (h_s) (tos)	0.00	m	
Depth of water in screen (Ls)	2.00	m	if water surface is within gravel pack
Bore inclination	0	°	
Stickup of pipe (s)	0.50	m	



$$K = \frac{d^2}{8 \times 60(t^* - t_1)Ls} \ln\left(\frac{2Ls}{D_h}\right) \ln\left(\frac{y_1}{y^*}\right)$$

where
t*, y*, t_1 = 0, y_1 = 1 define slope of a straight line fitted to the observations

t_1(min) =	2.00	t*(min) =	4.50
y_1(m) =	5.13	y*(m) =	5.750
K =	8.4E-07 m/sec		

i = 1, 2, 3, ...n

i	Time t (min)	Depth to water h_i (m)	Diff. in water levels $h_S - h_i$ (m)	$y = \frac{h_S - h_i}{h_S - h_1}$
1	0	0.400	0.400	1.000
2	0.08	0.700	0.700	1.750
3	0.17	1.000	1.000	2.500
4	0.25	1.300	1.300	3.250
5	0.50	1.540	1.540	3.850
6	0.58	1.610	1.610	4.025
7	0.67	1.630	1.630	4.075
8	0.75	1.640	1.640	4.100
9	0.83	1.670	1.670	4.175
10	1.00	1.720	1.720	4.300
11	2.00	2.050	2.050	5.125
12	2.50	2.140	2.140	5.350
13	3.00	2.190	2.190	5.475
14	3.50	2.240	2.240	5.600
15	4.00	2.270	2.270	5.675
16	4.50	2.300	2.300	5.750
17	5.00	2.320	2.320	5.800
18	10.00	2.410	2.410	6.025
19	15.00	2.430	2.430	6.075
20	20.00	2.435	2.435	6.088
21				
22				
23				
24				
25				
26				
27				

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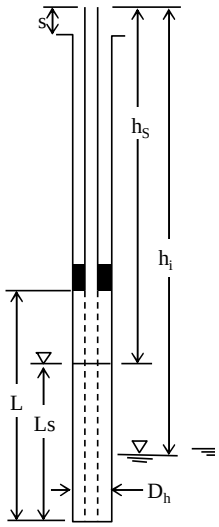
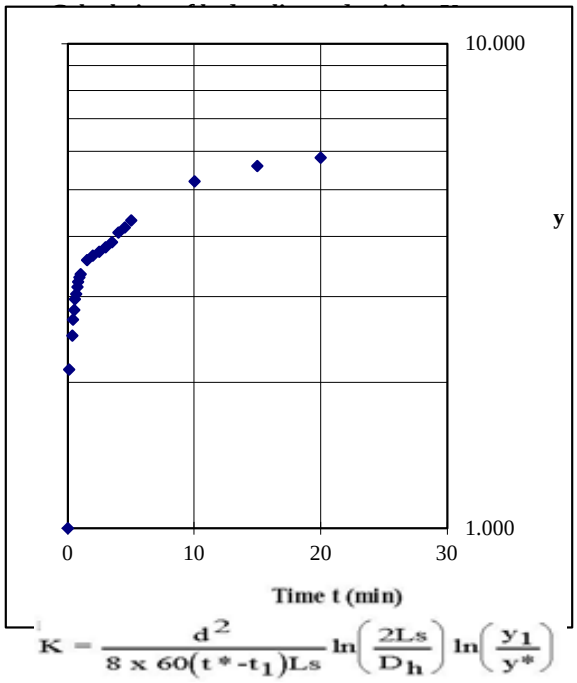
FALLING HEAD PERMEABILITY TEST

Client	Silverstone	**Bore No**	**BH6/MW2**
Project	Proposed unit development	**Test Date**	June 26, 2024
Location	MacArthur Ave, Hamilton	**Project No.**	J002466
Tested by	AD/EA	**Checked**	
Remarks			



Depth of borehole (H)	3.00	m	(measured from ground surface)
Depth to bottom of seal (Hb)	3.00	m	(measured from ground surface)
Test section length (L)	2.0	m	
Diameter of pipe (D_p)	0.05	m	Note **:
Diameter of test section (D_h)	0.10	m	1. d = D_p or D_h if no gravel pack
Dia. of water surface (d)**	0.069	m	
Static depth to gw (h_s) (tos)	0.00	m	
Depth of water in screen (Ls)	2.00	m	if water surface is within gravel pack
Bore inclination	0	°	
Stickup of pipe (s)	0.50	m	



$$K = \frac{d^2}{8 \times 60(t^* - t_1)Ls} \ln\left(\frac{2Ls}{D_h}\right) \ln\left(\frac{y_1}{y^*}\right)$$

where
t*, y*, t_1 = 0, y_1 = 1 define slope of a straight line fitted to the observations

t_1(min) =	0.67	t*(min) =	4.50
y_1(m) =	3.05	y*(m) =	4.175
K =	1.5E-06 m/sec		

i = 1, 2, 3, ...n

i	Time t (min)	Depth to water h_i (m)	Diff. in water levels $h_S - h_i$ (m)	$y = \frac{h_S - h_i}{h_S - h_1}$
1	0	0.400	0.400	1.000
2	0.08	0.850	0.850	2.125
3	0.33	1.000	1.000	2.500
4	0.42	1.080	1.080	2.700
5	0.50	1.130	1.130	2.825
6	0.58	1.190	1.190	2.975
7	0.67	1.220	1.220	3.050
8	0.75	1.260	1.260	3.150
9	0.83	1.290	1.290	3.225
10	0.92	1.320	1.320	3.300
11	1.00	1.340	1.340	3.350
12	1.50	1.430	1.430	3.575
13	2.00	1.460	1.460	3.650
14	2.50	1.490	1.490	3.725
15	3.00	1.520	1.520	3.800
16	3.50	1.560	1.560	3.900
17	4.00	1.630	1.630	4.075
18	4.50	1.670	1.670	4.175
19	5.00	1.730	1.730	4.325
20	10.00	2.080	2.080	5.200
21	15.00	2.240	2.240	5.600
22	20.00	2.330	2.330	5.825
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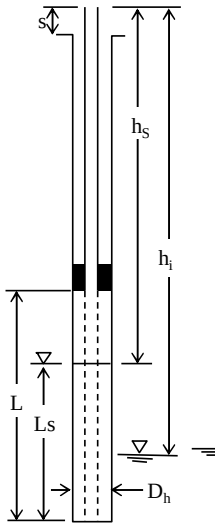
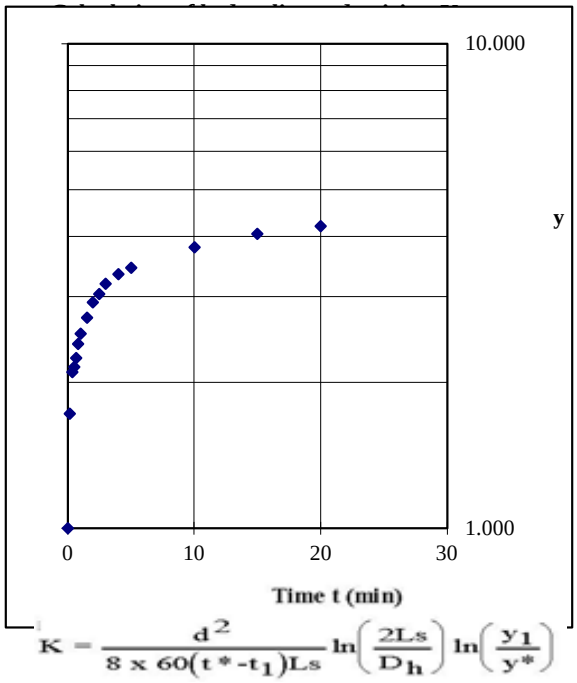
FALLING HEAD PERMEABILITY TEST

Client	Silverstone	**Bore No**	**BH101/MW3**
Project	Proposed unit development	**Test Date**	June 20, 2024
Location	MacArthur Ave, Hamilton	**Project No.**	J002466
Tested by	AD/EA	**Checked**	
Remarks			



Depth of borehole (H)	3.00	m	(measured from ground surface)
Depth to bottom of seal (Hb)	3.00	m	(measured from ground surface)
Test section length (L)	2.0	m	
Diameter of pipe (D_p)	0.05	m	Note **:
Diameter of test section (D_h)	0.10	m	1. d = D_p or D_h if no gravel pack
Dia. of water surface (d)**	0.069	m	
Static depth to gw (h_s) (tos)	0.00	m	
Depth of water in screen (Ls)	2.00	m	if water surface is within gravel pack
Bore inclination	0	°	
Stickup of pipe (s)	0.50	m	



$$K = \frac{d^2}{8 \times 60(t^* - t_1)Ls} \ln\left(\frac{2Ls}{D_h}\right) \ln\left(\frac{y_1}{y^*}\right)$$

where
t*, y*, t_1 = 0, y_1 = 1 define slope of a straight line fitted to the observations

t_1(min) =	0.83	t*(min) =	4.00
y_1(m) =	2.40	y*(m) =	3.350
K =	1.9E-06 m/sec		

i = 1, 2, 3, ...n

i	Time t (min)	Depth to water h_i (m)	Diff. in water levels $h_S - h_i$ (m)	$y = \frac{h_S - h_i}{h_S - h_1}$
1	0	0.400	0.400	1.000
2	0.17	0.690	0.690	1.725
3	0.33	0.840	0.840	2.100
4	0.50	0.860	0.860	2.150
5	0.67	0.900	0.900	2.250
6	0.83	0.960	0.960	2.400
7	1.00	1.010	1.010	2.525
8	1.50	1.090	1.090	2.725
9	2.00	1.170	1.170	2.925
10	2.50	1.220	1.220	3.050
11	3.00	1.280	1.280	3.200
12	4.00	1.340	1.340	3.350
13	5.00	1.380	1.380	3.450
14	10.00	1.520	1.520	3.800
15	15.00	1.620	1.620	4.050
16	20.00	1.680	1.680	4.200
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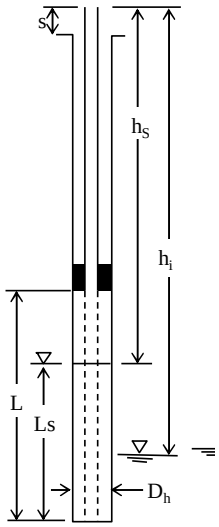
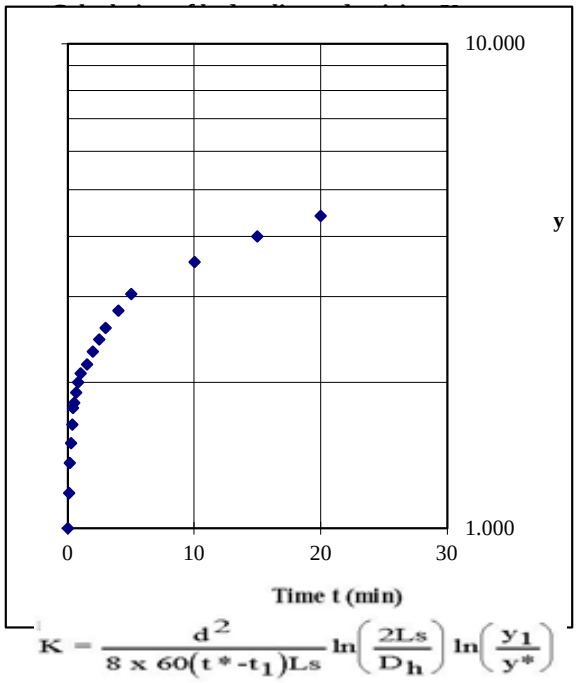
FALLING HEAD PERMEABILITY TEST

Client	Silverstone	**Bore No**	**BH104/MW4**
Project	Proposed unit development	**Test Date**	June 20, 2024
Location	MacArthur Ave, Hamilton	**Project No.**	J002466
Tested by	AD/EA	**Checked**	
Remarks			



Depth of borehole (H)	3.00	m	(measured from ground surface)
Depth to bottom of seal (Hb)	3.00	m	(measured from ground surface)
Test section length (L)	2.0	m	
Diameter of pipe (D_p)	0.05	m	Note **:
Diameter of test section (D_h)	0.10	m	1. d = D_p or D_h if no gravel pack
Dia. of water surface (d)**	0.069	m	
Static depth to gw (h_s) (tos)	0.00	m	
Depth of water in screen (Ls)	2.00	m	if water surface is within gravel pack
Bore inclination	0	°	
Stickup of pipe (s)	0.50	m	



$$K = \frac{d^2}{8 \times 60(t^* - t_1)Ls} \ln\left(\frac{2Ls}{D_h}\right) \ln\left(\frac{y_1}{y^*}\right)$$

where
t*, y*, t_1 = 0, y_1 = 1 define slope of a straight line fitted to the observations

t_1(min) =	5.00	t*(min) =	20.00
y_1(m) =	3.05	y*(m) =	4.409
K =	4.5E-07 m/sec		

i = 1, 2, 3, ...n

i	Time t (min)	Depth to water h_i (m)	Diff. in water levels $h_S - h_i$ (m)	$y = \frac{h_S - h_i}{h_S - h_1}$
1	0	0.220	0.220	1.000
2	0.08	0.260	0.260	1.182
3	0.17	0.300	0.300	1.364
4	0.25	0.330	0.330	1.500
5	0.33	0.360	0.360	1.636
6	0.42	0.390	0.390	1.773
7	0.50	0.400	0.400	1.818
8	0.67	0.420	0.420	1.909
9	0.83	0.440	0.440	2.000
10	1.00	0.460	0.460	2.091
11	1.50	0.480	0.480	2.182
12	2.00	0.510	0.510	2.318
13	2.50	0.540	0.540	2.455
14	3.00	0.570	0.570	2.591
15	4.00	0.620	0.620	2.818
16	5.00	0.670	0.670	3.045
17	10.00	0.780	0.780	3.545
18	15.00	0.880	0.880	4.000
19	20.00	0.970	0.970	4.409
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Appendix F
Limitations

LIMITATIONS

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