D&N Geotechnical

Concord Zone Substation

Geotechnical Investigation Report

Zinfra Pty Ltd

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1. Introduction

This report presents the findings of a geotechnical investigation carried out by D&N Geotechnical Pty Ltd (D&N) for the proposed switch building at Concord Zone Substation, located at 31 George Street, North Strathfield NSW.

The investigation was commissioned by Zinfra Pty Ltd (Zinfra) and carried out in general accordance with our fee proposal (D&N document reference C-0339.00 P1 Rev1, dated 3 September 2019) with the following exceptions:

- Exclusion of one (1) Cored Borehole to 10 m;
- Exclusion of advancing two (2) slit trenches to 3 m using an excavator;
- Drilling of two (2) auger boreholes in lieu of slit trenches; and
- Observation and logging of slit trenches (advanced by Non-Destructive Digging) where visible during our investigation.

The objective of the geotechnical investigation was to assess subsurface conditions to assist in structural design of the proposed two (2) storey switch building, which we understand will include a 1.5 to 2 m deep basement.

This report provides all factual information from our investigation, together with recommendations on foundation design parameters, excavation conditions/support requirements and potential effects on adjacent structures. A Preliminary Environmental Soil Contamination Assessment was carried out concurrently with the geotechnical investigation and is reported separately as Appendix C.

2. Background

A previous geotechnical investigation has been carried out in the vicinity by Coffey Geotechnics Pty Ltd, (refer report reference: GEOTLCOV24348AA-AB Rev.1 – FINAL, dated 13 January 2012). The investigation was in the context of a proposed under-bore, to run approximately east-west from the eastern extent of the proposed switch building footprint, across rail infrastructure before terminating within Queens Street.

The investigation comprised the drilling of three (3) boreholes, initially advanced by auger rotary drilling to depths of between 3.15 m 4.55 m, prior to recovery of rock core to depths of between 10.05 m and 10.4 m. Two boreholes (BH01 and BH02) were located within the site footprint of 31 George Street.

The results of the investigation indicated that the subsurface profile within the vicinity of the proposed switch building typically comprised varying FILL thicknesses to a depth of up to 1.6 m, overlying SHALE bedrock to the limit of the investigation. Within BH01 (located approximately within the eastern extent of the proposed switch building) a dolerite dyke was encountered at about 7.55 m, with a contact angle of about 70°. It was inferred to have been orientated broadly north south.

Groundwater was generally observed near the surface after preceding rainfall prior to the commencement of the investigation.

3. Method of Investigation

3.1. Planning

Prior to commencement of fieldwork, D&N prepared a safety management plan. The field supervisor was provided with a hard copy of the plant, which was utilised on site as a reference for emergency management.

Pre-start meetings were held at site, in consultation with Zinfra to assess specification hazards and update approaches to site works where the work activity/environment was observed to have changed.

Service plans were reviewed in detail prior to commencing intrusive fieldworks all borehole locations were cleared by Zinfra prior to commencement.

3.2. Fieldwork

Fieldwork for the geotechnical investigation was carried out between 26 and 28 November 2019, and comprised the following main site activities:

- Two (2) no. Cored Boreholes to a depth of 10 m;
- Three (3) no. Auger Boreholes to depths of between 1.1 m and 2.6 m;
- Recovery of three (3) U75 Push Tube Samples;
- Sampling and testing of subsurface materials;
- Installation of one groundwater level monitoring well;
- One round of groundwater level monitoring; and
- Visual logging of slit trenches, where observable/practicable.

All fieldwork was carried out under the fulltime direction of a D&N engineering geologist, who was responsible for coordination of sub-contractors, assisting in management of site safety, logging of subsurface conditions to AS1726-2017 and collection of soil and rock samples for subsequent laboratory analysis.

Boreholes were drilled using a track mounted Commachio 205 drilling rig and initially advanced through soil strength materials using solid flight augers with a Tungsten Carbide (TC) drill bit until refusal in weathered bedrock or upon reaching the nominated target depth(s) (1.1 m within BH05).

Standard Penetration Tests (SPT) were undertaken generally at 1.5 m intervals within soils and extremely weathered bedrock to aid logging of subsurface conditions, collect soil samples and to assess soil consistency/relative density.

BH01 and BH02 were extended to the final termination depth (10 m) using NMLC diamond rock coring methods.

On completion, BH01 was completed as a groundwater monitoring well using slotted screen from 2 m to 10 m deep, backfilled with clean sand and sealed with a bentonite plug and steel gatic. The well was subsequently monitored and sampled 24 hours after purging drilling fluids. The remaining boreholes were backfilled with cuttings to the surface.

Slit trenches were excavated prior to and during our site visit by a Zinfra engaged non-destructive digging contractor. The trenches were logged by D&N to observed soil classification, buried service depth and type, approximate dimension and apparent excavation sidewall stability.

Figure 1 shows the approximate borehole locations which were located using hand-held GPS equipment (accurate to ±3 m) and by using measurements from existing site features. Slit trenches were located by Zinfra, Figure 2 (site layout) shows trenches that were able to be logged at the time of our visit.

The Engineering Borehole Logs and core photographs are included as Appendix A.

A summary of our slit trench observations is included as Table 3.

3.3. Laboratory Testing

Selected soil samples were submitted to NATA accredited laboratories for a suite of tests (as defined in Table 1).

The results of laboratory testing are discussed in subsequent sections of this report. For detail, reference should be made to the laboratory test certificates, included as Appendix B.

Table 1 - Summary of Laboratory Testing

Test Type	No. of Tests
Atterberg Limits Including Linear Shrinkage	3
Ph, Chloride, Sulphates and Electrical Conductivity (Soil Aggressivity)	3
Thermal Resistivity Dry-out Curve	3

Following photography, Point Load Index (I_s50) Strength tests were carried out on selected rock core samples at approximately 1 m intervals (where practical) or due to changes in weathering/lithology. The test results are included on the Engineering Borehole Logs as Appendix A.

4. Results of Investigation

4.1. Site Description

The site is located at the eastern extent of at 31 George Street, Concord West NSW and occupies a footprint of approximately 600 m^2. The site is bound to the west by an existing Ausgrid substation, to the north by a multi-storey car park, to the east by existing rail infrastructure and to the south by a multi-storey residential dwelling.

The site surface was generally flat and dry at the time of our visit, with no evidence of ponded water or elevated moisture (other than from the vacuum truck).

Slit trenching works were on-going during our visit, resulting in five (5) excavations within the boundary fence trending north-south and two (2) east-west. Outside the northern boundary fence, the five (5) slit trenches trending north-south had been excavated perpendicular to a service easement.

Plate 1 below provides a general view of site conditions at time of our fieldwork.

Plate 1 - Showing general site layout, facing east

4.2. Regional Geology

The 1:100,000 scale Geological Map of Sydney (Sheet 9130, 1st edition, 1983), infers the site is underlain by black to dark grey shale and laminate of the Wianamatta Group.

4.3. Subsurface Conditions

Reference should be made to the Engineering Borehole Logs included as Appendix A for specific detail on encountered subsurface conditions.

A summary of the main geotechnical units encountered during our investigation is provided in Table 2 below.

Table 2 - Summary of Geotechnical Units at D&N Borehole Locations

Unit		Origin	Material Description	Depth Range to top of unit (m)	Range of Unit Thickness (m)
1	a	Fill	Trenches: (BH03) SAND, fine to medium grained, brown, trace fine, sub-angular gravel and roots	0	1.6
	b		Landscaped Areas: (BH01, BH02, BH04, BH05) Gravelly sandy CLAY, medium to high plasticity, dark brown, black, reddish-brown, fine to coarse sand, fine to coarse, sub-angular gravel	0	0.50 – 1.0
2		Residual	Silty CLAY: high plasticity, grey, mottled reddish-brown, typically very stiff to hard, less than plastic limit	0.50 – 1.0	0.55 - 0.75 (unproven in BH05)
3	a	Bedrock (Class V Shale)	SHALE, dark grey, reddish-brown, distinctly laminated, extremely to highly weathered, very low strength, defect spacing generally <20 mm	1.3 – 1.75	5.55
	b	Bedrock (Class III)	SHALE, dark grey, reddish-brown, indistinctly laminated, trace sandstone laminations, slightly weathered to fresh, low to medium strength, defect spacing generally >100 mm	7.1 – 7.24	Unproven

Table 2 Notes:
1. Units were not encountered at every borehole location, reference should be made to specific engineering borehole logs
2. The depths and unit thicknesses are based on information at the borehole locations and may not represent the maximum or the minimum values at other locations

A summary of our observations related to slit trench excavations is included as Table 3 below.

Table 3 - Summary of Slit Trench Excavations

Slit Trench ID	Summary of Services (Depth m)	Geotechnical Unit ID and Depth (m)	Other Comments/Approximate Dimensions (m)
1	None Observed within the boundary fence	Unit 1b (0 – 1.3) including possible high strength rock fill outside of boundary fence	Incomplete at time of visit (3.5 x 0.3

Slit Trench ID	Summary of Services (Depth m)	Geotechnical Unit ID and Depth (m)	Other Comments/Approximate Dimensions (m)
2	Electrical (0.3 – 0.6), Telstra (0.6), water (0.6), concrete cover (1.3)	Unit 1b (0 – 1.5)	Incomplete at the time of visit (6.4 x 0.3 & 1.7 x 0.3
3	Electrical (0.5), 2x 11kW (0.6), possible under-bore (0.9), 11kw (0.7), 300Ø water (0.7)	Unit 1b (0 – 1.3) overlying Unit 3a (1.3 – 1.5) Unit 2 (1.2 – 1.5)	(10.5 x 0.5 & 2 x 0.3)
4	Electrical (0.5), 2x 11kW (0.5), 11kw (0.5), 300Ø water (0.6)	Unit 1a, Unit 1b (0 – 1.2) overlying Unit 2 (1.2 – 1.5)	(9.1 x 0.5 & 2.1 x 0.4) Signs of instability and collapse within unit 1a
5	-	Unit 1a (0 – 1.5)	(1 x 5.5) Signs of instability and collapse within unit 1a
6	-	Unit 1a (0 – 1.5)	(1 x 5.5) Signs of instability and collapse within unit 1a
7	Electrical (0.6), 2x 11kW (0.6), 11kw (0.6), 300Ø water (0.6)	Unit 1a and Unit 1b (0 – 1.5)	(2.3 x 0.4)

Table 3 Notes:
1. Slit trenches were excavated using a vacuum truck, as such cuttings could not be observed, and clay smear obstructs the view of the excavation sidewall in places
2. The depths are based on information at the slit trench locations and may not represent the maximum or the minimum values at other locations

4.4. Groundwater Conditions

Groundwater inflow was not observed during auger drilling. Subsequent observation of groundwater inflows during diamond rock coring were not possible as water was added to the boreholes as part of the drilling process.

Following standpipe installation and purging, groundwater level monitoring was carried out within BH01 on 28 November 2019. Groundwater was recorded at 7.6 m below current surface levels.

4.5. Laboratory Testing

Laboratory test certificates are included as Appendix B and summarised in Tables 4 to 8 below.

Table 4 - Summary of Soil Classification Laboratory Test Results

BH ID	Depth (m)	LS (%)	PI (%)	LL (%)	PL (%)
BH01	1.5 – 1.78	10	18	41	23
BH04	1.0 – 1.1	13	29	56	27
BH05	0.3 – 0.6	17	35	65	30

Table 5 - Summary of Soil Aggressivity Laboratory Test Results

BH ID	Depth (m)	pH	Chloride (mg/kg)	Sulphate (mg/kg)	Electrical Conductivity (uS/cm)
BH01	0.2 – 0.4	7.3	130	180	140
BH02	1.5 – 1.73	4.9	160	35	38
BH05	0.3 – 0.5	7.1	330	140	67

Table 6 - Summary of Thermal Conductivity (BH02 0.75-1.0 m)

Specimen	Maximum Dry Density (t/m^3)	Mass (g)	Test Date	Moisture Content (%)	Test Time (s)	Initial Temp (°C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W)
A	1.49	1185	6/12/19	29.28	600	21.3	1.75	0.57
			11/12/19	20.62	600	19.3	1.56	0.64
			16/12/19	17.05	600	19.7	1.37	0.73
			18/12/19	13.37	600	19.5	1.19	0.84
			23/12/19	0.00	500	19.0	0.56	1.77
			9/01/19	6.63	600	19.4	0.85	1.18

Table 7 - Summary of Thermal Conductivity (BH05 0.75-1.0 m)

Specimen	Maximum Dry Density (t/m^3)	Mass (g)	Test Date	Moisture Content (%)	Test Time (s)	Initial Temp (°C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W)
A	156	1271	6/12/19	25.88	600	20.7	1.75	0.57
			11/12/19	18.35	600	19.2	1.61	0.62
			16/12/19	11.68	600	18.7	1.32	0.76
			18/12/19	8.24	600	19.1	1.12	0.89
			23/12/19	0.00	500	19.4	0.65	1.53
			9/01/19	5.32	600	19.4	0.93	1.07

Table 8 - Summary of Thermal Conductivity (BH05 0.75-1.0 m)

Specimen	Maximum Dry Density (t/m^3)	Mass (g)	Test Date	Moisture Content (%)	Test Time (s)	Initial Temp (°C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W)
A	1.50	1397	6/12/19	28.63	600	20.9	1.75	0.57
			11/12/19	19.59	600	19.1	1.61	0.62
			16/12/19	13.80	600	18.8	1.47	0.68

Specimen	Maximum Dry Density (t/m^3)	Mass (g)	Test Date	Moisture Content (%)	Test Time (s)	Initial Temp (°C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W)
			18/12/19	9.88	600	19.0	1.33	0.75
			20/12/19	6.28	600	19.4	1.12	0.89
			23/01/19	0.00	500	19.2	0.69	1.44

5. Discussions and Recommendations

5.1. Earthworks and Bulk Excavations

Earthworks and bulk excavations are expected to include minor box out for underground services/footings, and bulk excavation to a depth of up to 2 m for the proposed basement.

5.1.1. Presence of Fill

Fill was observed at all locations across the site, generally comprising fill for local site levelling, landscaping or underground services up to a depth of 1.6 m. Additional localised fill associated with service trenches/under-bores is may be present across the site footprint.

As part of the bulk earthworks, it is expected that all fill will be removed within the proposed building footprint, nevertheless, unless there are records confirming that the fill has been compacted in accordance with an engineering specification, the existing fill should be classified as 'uncontrolled' and should not be used as a foundation for structures or pavements due to the potential for differential settlement.

5.1.2. Subgrade Trafficability and Working Platforms

Site soils including fill and residual clayey soils are expected to behave poorly if exposed to heavy construction traffic, particularly when wet. A platform of granular material such as road base or crushed concrete may be needed to support construction plant. Where heavy plant such as piling rigs or mobile cranes are to traffic to site, specific analysis of working platform requirements may be required to assess working platform equipment. Such assessment could include the use of DCP testing or similar to confirm bearing capacity.

To help reduce, but not eliminate trafficability issues associated with wet weather, exposed subgrades should be sealed with a smooth drum roller and graded such that they promote surface drainage and prevent ponding.

5.1.3. Excavation Conditions

Bulk excavation for a single basement level will likely penetrate Unit 1 Fill, Unit 2 Residual and Unit 3a Bedrock. Excavation within site soils and extremely to highly weathered bedrock units should be possible using conventional earth moving plant such as hydraulic excavators fitted with rock teeth.

In any case, excavation contractors should be provided with the Engineering Borehole Logs and core photographs and be required to make their own assessment of the suitability and productivity of excavation plant.

5.1.4. Groundwater Conditions

The results of this geotechnical investigation indicate a standing groundwater level at the site of about 7.6 m depth (observed within BH01).

Based on the proposed basement level (1.5 m - 2 m), bulk excavations are not expected to encounter permanent standing groundwater. Excavations below this depth for building footings may extend to below this depth.

Due to the presence of highly permeable layers, particularly within the Unit 1 Fill, standing groundwater levels are expected to vary in response to climatic conditions and higher groundwater levels are likely to occur during and following significant rainfall events.

5.1.5. Unsupported Excavations

Unsupported excavations in fill and residual soil/bedrock may be practicable where there is sufficient space and where sensitive structures/underground services are not located within a distance from the crest equal to the depth of excavation.

For preliminary assessments, the batter slopes in Table 9 can be assumed for unsupported excavations required for a single basement level (up to 2m deep). Protection from erosion is expected for all site soils. Final selection of excavation batter slopes is ultimately the responsibility of the site operator.

Table 9 - Suggested Batter Slopes

Unit	Temporary Batters	Permanent Batters
Controlled FILL	1(H):1(V)	2(H):1(V)
Uncontrolled FILL	2(H):1(V)	3(H):1(V)
Unit 2 Residual	1.5(H):1(V)	2(H):1(V)
Unit 3a Bedrock	1(H):1(V)	1.5(H):1(V)

The above recommended maximum batters are based on there being no structures or surcharge (e.g.) excavation plant located at or near the crest of cuts/fills.

5.1.6. Supported Excavations

Where there is insufficient room to form the above recommended batters, or where excavations form part of the permanent structure, then a retention system will be required.

- Retaining wall systems that could be considered include:
  - Soldier pile walls with infill panels (usually shotcrete or precast concrete panels)
  - Sheet Piled Walls

Soldier pile walls would require installation of infill panels as excavation proceeds to reduce the potential for ground-loss particularly adjacent to existing structures and where previous NDD and subsequent sand backfill works have been completed.

For a sheet piled wall, overlapping or interlocking sheets would be vibrated or driven into the ground around the basement perimeter prior to excavation. As the excavation proceeds, the sheet pile wall would require stiffening with horizontal beams, cross struts and/or temporary anchors. The new structure would be built inside the sheet pile wall with temporary support measures progressively removed as basement walls are constructed in lifts. The steel sheet piles could be used to provide formwork for the permanent basement walls, but this would preclude their recovery. Sheet piles would likely refuse on the weathered bedrock, and groundwater seepage would be expected to occur through the clutches and toe of the wall following high rainfall events.

Dependant on the method of retention proposed, further studies will be required to assess the effects of any vibration during installation of the various wall types on neighbouring properties.

Design of shorting walls should be based on a triangular pressure distribution adopting the earth pressure coefficients recommended in Table 10 below. Coefficients are provided for the following cases:

- Case 1 = temporary retention, no adjacent footings
- Case 2 = permanent retention, no adjacent footings
- Case 3 = adjacent footings and hence need to limit movement

Table 10 - Earth Pressure Coefficients

Geotechnical Unit	Value of Lateral Earth Pressure Coefficient, Ka[1]			Passive Earth Pressure Coefficient, Kp[1]	Bulk Density (kN/m^3)
	Case 1	Case 2	Case 3		
Unit 1 and 2 Fill Residual Soil	0.4	0.45	0.5	2.5	20
Unit 3 XW to HW Bedrock	0.3	0.35	0.5	3	22

Table 8 Note:

1.These values are only applicable for a horizontal ground surface.

Where ground anchors are required to restrict retaining wall movement, or where there is a need to limit ground movement, higher earth pressure coefficients should be adopted. We recommend an earth pressure coefficient of 0.5 for propped or anchored retaining walls where movement are restrained, and trapezoidal earth pressure distribution adopted.

If the above wall types are used to support the Unit 1 Fill, and Unit 2 Residual, we recommend piles be uniformly socketed into the underlying Unit 3a/3b Bedrock to provide uniformity of founding conditions and additional toe stability to the wall.

It is recommended that detailed analysis be undertaken to develop a cost-effective retention system. As a guide, Table 11 below presents typical design parameters that can be adopted for the design of retaining walls.

Table 11 - Design Parameters for Retaining Wall Design

Material	Bulk density, γb (kN/m^3)	Effective Cohesion c' (kPa)	Effective Friction Angle Φ' (degrees)	Elastic Modulus (MPa)	Poison's Ratio
Unit 1 Fill	20	0	25	15	0.3
Unit 2 Residual	20	7	25	40	0.3
Unit 3a XW - HW Bedrock	21	10	30	100	0.3
Unit 3b SW - FR Bedrock	22	20	32	300	0.25

Within the retained fill/soil profile, the magnitude of adjacent ground movements will depend on the ground conditions, design lateral pressure, shoring system adopted, construction sequence and workmanship. Documented data has shown that for well-designed and constructed shoring, vertical and lateral movements may be in the order of 0.1% to 0.3% of the retained thickness of stiff clay soils. If this aspect is critical, further appraisal should be carried out to assess likely ground movements when designing the shoring system.

Where it is important to limit adjacent ground movements due to the presence of nearby sensitive structures or services, the use of relatively stiff shoring with bracing and/or tie-back anchors designed to resist pressures higher than active earth pressures may be required.

A permanent groundwater table is unlikely to be encountered for excavations of less than 2 m depth; however, seepage through more permeable layers within the fill soil profile may occur. Furthermore, the potential for ground saturation due to leaking or broken services should be considered. Retaining walls should be designed for applicable surcharge loads and should be designed to resist hydrostatic pressures unless permanent drainage is provided.

Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures, and hydrostatic pressure. If drained walls are to be used then adequate drainage will need to be provided behind the walls, and a permanent water collection system will be required together with flushing points for drainage system periodic maintenance. Nevertheless, an allowance of potential water pressure build-up equivalent to one-third the wall height is considered to be prudent with such drainage measures installed.

5.1.7. Potential Effect on Adjacent Structures

The location, footing type, layout and founding depth for adjacent structures should be determined before excavation commences. Where adjacent structures are located within the zone of influence of the excavation (nominally a line extending at a slope of 1(H):1(V) up from the base of the proposed excavation), the foundation stratum may experience horizontal and vertical movements from excavation induced ground movements due to retention deformation and this should be adequately assess as part of excavation retention design.

Additionally, the potential effects of noise and vibration on adjacent structures resulting from excavation equipment/pile driving and methods will need to be carefully considered by the contractor as part of the construction management plan.

We recommend that prior to the commencement of the bulk excavation works dilapidation survey of the adjacent structures are carried out as a baseline for excavation monitoring and management works. Vibration monitoring should be carried out to project specification levels to manage possible effects of the works on adjacent sensitive receptors.

5.2. Building Foundations

The findings of our investigation indicate that bulk excavation for a one (1) basement level is likely expose Unit 3a Shale.

Column loads are not currently known to D&N. The structure may be supported on shallow spread footings or deepened piled footings.

5.2.1. Spread Foundations

Pad or strip footings may be proportioned based on the following allowable bearing pressures:

Table 12 - Recommend Allowable Bearing Pressures for Pad/Strip Footings

Unit	Material Origin	Allowable Bearing Pressure (kPa)
-	Controlled Fill	100
2	Residual	150
3a	Bedrock	700

The above values assume all footings extend a minimum of 0.5 m below the prepared subgrade surface levels. Isolated footings will need to be dimensioned to consider uplift and lateral loads.

To reduce the potential for differential settlement between building footings, we recommend that all footings be founded within the same geotechnical unit. Footings proportioned in accordance with the above recommendation should have load induced settlements of no greater than 1% of the footing width. Footing design will need to consider the presence of existing site services (including under-bores), which may require some form of spanning and/or localised deepening of footings.

The recommended allowable bearing pressures provided above assume that the bearing surfaces are clean and free from spoil and other soft and loose material, and free of water at the time of placement of concrete. We recommend that concrete for pad or strip footings be poured or a blinding layer of concrete be placed on any founding surfaces as soon as practical to limit the disturbance to the surface and any likely degradation of the exposed materials.

On excavation, should the ground conditions differ from those outlined above, further advice should be sought from D&N.

5.2.2. Deep Foundations

Where design loads exceed the above provided allowable bearing pressures; piled footings may be required to transfer column loads to the underlying Unit 3a Bedrock or Unit 3b Bedrock.

Groundwater may be encountered, and provision would need to be made for temporary support and for dewatering of open bored piles. Alternatively, Continuous Flight Auger (CFA) piles could be adopted that would not need casing or other support.

For limit state design, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (ϕ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 13 below for Unit 3 bedrock.

Table 13 - Recommended Geotechnical Parameters for Piled Foundations

Unit / Origin	Unit Weight (kN/m^3)	Ultimate End Bearing Capacity (MPa)	Ultimate Skin Friction (kPa)	Elastic Modulus (MPa)
Unit 3a – Class V Shale	21	3	75	100
Unit 3b – Class III Shale	22	8	400	300

For uplift loads the shaft adhesion value above should multiplied by a factor of 0.6, in addition to the geotechnical strength reduction factor.

The recommended design parameters assume that the bearing surfaces are clean and free from spoil and other soft and loose material and free of water at the time of placement of concrete. On excavation, should the ground conditions differ from those outlined above then further advice should be sought from D&N. The above values for shaft adhesion assume that the walls of the shaft are suitably roughened and cleaned of smear. If the pile holes cannot be dewatered sufficiently then tremmie grouting should be employed to displace the water from the pile hole.

Where rock sockets are required to resist compression and uplift loads allowance should be made for high capacity piling rigs fitted with rock teeth and coring buckets, as required.

For limit state design, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (ϕ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 13.

In accordance with AS2159-2009, ϕ_g is dependent on an Average Risk Rating (ARR) which considers various geotechnical uncertainties, foundation system redundancy, construction supervision, quantity and type of pile testing.

We've conducted a preliminary assessment of ARR and ϕ_g values given the extent of geotechnical investigations performed and findings at this site, based on the following assumptions:

- Moderate redundancy foundation system.
- The design will be carried out by an experienced engineering professional using well-established and soundly based methods.
- Well established construction processes will be adopted, and detailed professional geotechnical supervision will be provided during pile construction.
- Performance of the supported structure is not monitored.

Based on our current understanding of the project and the above assumptions, the following preliminary values have been assessed:

- Average Risk Rating = 2.8
- Geotechnical strength reduction factor, ϕ_g, 0.55 assuming no pile testing is undertaken.

Testing may provide the degree of confidence required to achieve a higher ϕ_g value and more economical design.

Final ϕ_g selection should be reviewed by the project geotechnical consultant at the detailed design stage.

Limit state design also requires assessment of the serviceability performance of the foundation system, including pile group interaction effects. This should be carried out by experienced geotechnical professional using well-established and soundly based methods. The modulus value given in Table 13 can be used, though the accuracy of settlement prediction is dependent on construction methods as well as material stiffness, both of which can involve considerable uncertainty. Settlement predictions can have a large margin for error, and in some cases serviceability pile load testing should be completed when foundation settlement is critical to the structure's performance.

5.3. Earthquake Design

Based on AS1170.4-2007 the following parameters should be adopted for seismic design:

- Seismic Hazard Factor (Z) 0.08
- Sub-Soil Class Be

5.4. Soil Aggressivity

The results of Soil Aggressivity testing were assessed in accordance with Australian Standard AS2159-2009 Piling – "Design and Installation". Chemical tests and the results of our investigation indicate that Unit 1 Fill and Unit 2 Residual soils can be considered non-aggressive and Unit 3a Shale could be considered mildly aggressive.

However, following a rainfall event prior to Coffey's geotechnical investigation, groundwater seepage was observed at the surface, therefore site soils should be considered mildly aggressive.

5.5. Presence of the Dyke Feature

The Dolerite dyke feature as identified in Coffey's previous geotechnical report at the site was not encountered during our investigation, as such the orientation, width, weathering, strength and effect on the country bedrock (shale) was not able to be assessed. As such, the following considerations should be made:

- Dykes can be problematic for footing design due to differential weathering, strength and fracturing across the dyke itself and the surrounding bedrock. However, given the proposed structure is likely to consist of slab on grade, the upper weathered shale is expected to be generally similar (or better) to the altered dyke materials in terms of engineering properties for both retention and shallow footings.
- Where deep piled footings are proposed, the presence of weathered dyke material becomes more important. The Coffey report indicates the dyke material tends to be more weathered than the

surrounding bedrock which results in potential issues for piling works due to lower geotechnical design parameters. The Coffey report shows the dolerite dyke then becoming high strength and slightly weathered to fresh. However, no Point Load Index Strength testing data is available for the core, therefore D&N are unable to provide geotechnical design parameters for this unit.

- If the dyke is encountered within the depth of the excavation, the presence of weathered dyke material becomes may result in potential issues for retention design where the dyke provides a preferential pathway for groundwater ingress (particularly following periods of wet weather).

We therefore recommend provision be made for geotechnical supervision of the bulk excavation, retention system and footing excavation(s).

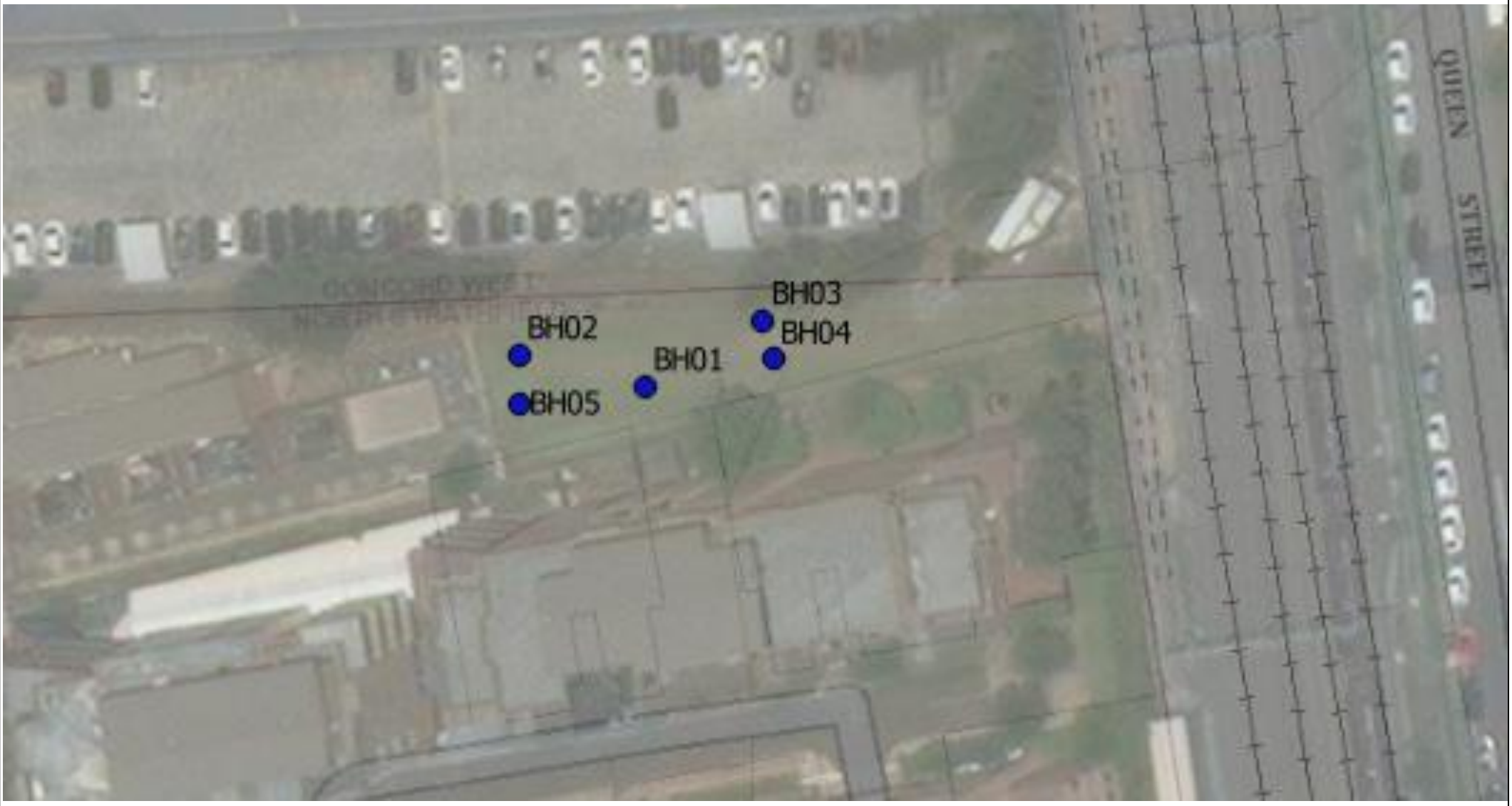
Provision should be made in the retention system design for encountering groundwater seepage through the upper fill or dyke.

6. Limitations

Subsurface conditions can be complex and may vary over relatively short distances – and over time. The inferred geotechnical model and recommendations in this report are based on limited subsurface investigations at discrete locations. The engineering logs describe subsurface conditions only at the investigation locations.

Further investigations may be required to support detailed design if there are scope limitations or changes to the nature of the project.

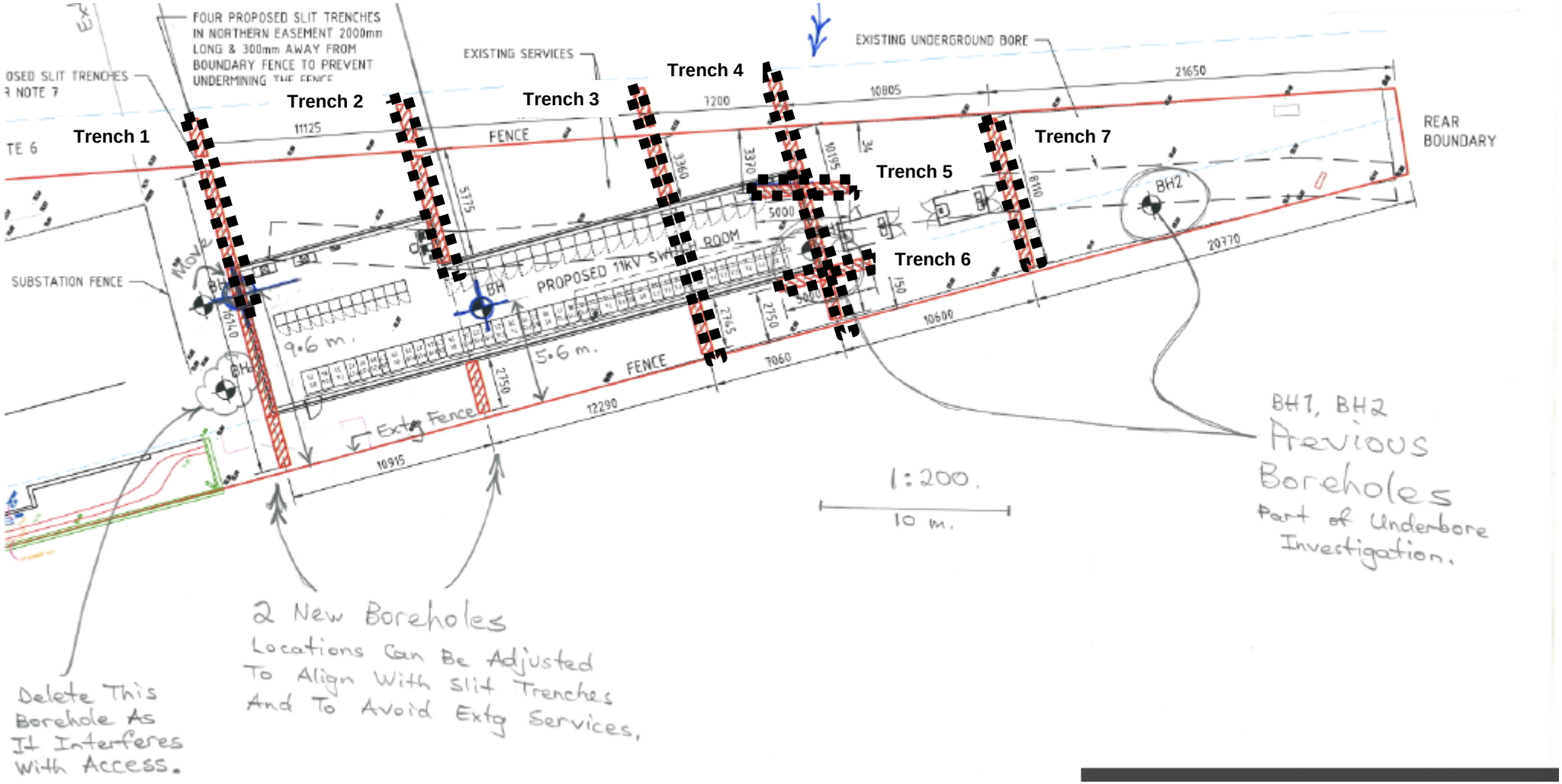
Figures



drawn	LC
approved	DB
date	17.12.2019
scale	NTS
original size	A4

D&N Geotechnical

client:	Zinfra Pty Ltd
project:	Concord West Substation
title:	Borehole Location Plan
project no:	C-0339.00 R1
figure no:	Figure 1



drawn	LC	D&N Geotechnical	client:	Zinfra Pty Ltd
approved	DB		project:	Concord West Substation
date	17.12.2019		title:	Slit Trench Extents
scale	NTS		project no: C-0339.00 R1	figure no: Figure 2
original size	A4			

Appendix A - Engineering Borehole Logs and Core Photographs

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**BH01**
sheet:	1 of 3
project no.	**C-0339.00**
client:	**Zinfra Pty Ltd**
date started:	**26 Nov 2019**
principal:	**Ausgrid**
date completed:	**26 Nov 2019**
project:	**Concord West Substation**
logged by:	**LC**
location:	**31 George Steet, NSW**
checked by:	**DB**

position: E: 322860; N: 6252717 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
NDD; AD/T; NW casing		Not Observed	E; E; U75; SPT 9, 30/130mm N=R; E		1.0; 2.0; 3.0		CH	**FILL: Gravelly Sandy CLAY**: medium to high plasticity, dark brown, black, reddish-brown, fine to coarse sand, fine to coarse, sub-angular gravel.	M			**FILL**
								Silty CLAY: high plasticity, grey, mottled reddish-brown.	<Wp	VSt to H	>>	**RESIDUAL SOIL** HP 550 - 600 kPa
								SHALE: pale grey mottled reddish-brown, re-moulds to silty CLAY, high plasticity.				**BEDROCK**
								SHALE: pale grey mottled reddish-brown, re-moulds to silty CLAY, high plasticity, highly weathered, very low strength.				
					4.0; 5.0; 6.0; 7.0			Borehole BH01 continued as cored hole				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- NDD non destructive drilling
- PT push tube

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

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

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

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	2 of 3
project no.	**C-0339.00**
client:	***Zinfra Pty Ltd***
date started:	***26 Nov 2019***
principal:	***Ausgrid***
date completed:	***26 Nov 2019***
project:	***Concord West Substation***
logged by:	***LC***
location:	***31 George Steet, NSW***
checked by:	***DB***

position: E: 322860; N: 6252717 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
			1.0								
			2.0								
			3.0		start coring at 3.30m						
NMLC	Not Observed		4.0		**SHALE**: dark grey, reddish-brown, indistinctly laminated at 0° - 5°, re-moulds to silty CLAY, high plasticity.	XW to HW	O	d=0.05	35%		JT, 45 - 80°, IR, SO, Fe SN
					SHALE: dark grey, black, reddish-brown, distinctly laminated at 0°.	HW	O	d=0.04			SM, 0°, CH Clay, 50 mm
			5.0		**IRONSTONE**: vesicular, reddish-brown.			a=0.07			multiple partings
					SHALE: dark grey, black, reddish-brown, distinctly laminated at 0°.	HW	X		0%		SM, 0°, CH Clay, 20 mm SM, 0°, CH Clay, 20 mm JT, 45 - 80°, IR, SO, Fe SN
					NO CORE: 0.20 m	XW					SM, 0°, CH Clay, 70 mm
			6.0		**SHALE**: dark grey, black, reddish-brown, distinctly laminated at 0°.	HW to MW	O	d=0.21			multiple partings
			7.0		**SHALE**: dark grey, indistinctly laminated at 0°, trace SANDSTONE laminations.	SW	O	a=0.44 d=0.43	21%		PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN

Defects are: PT, 0 - 5°, PL, SO, Fe SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- NDD non destructive drilling
- PT push tube

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn
- RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	3 of 3
project no.	**C-0339.00**
date started:	**26 Nov 2019**
date completed:	**26 Nov 2019**
logged by:	**LC**
checked by:	**DB**

client: ***Zinfra Pty Ltd***

principal: ***Ausgrid***

project: ***Concord West Substation***

location: ***31 George Steet, NSW***

position: E: 322860; N: 6252717 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC	Not Observed		9.0		**NO CORE:** 0.12 m	SW			21%		PT, 0 - 5°, PL, SO, CN
					SHALE: dark grey, indistinctly laminated at 0°, trace SANDSTONE laminations.	SW to FR		a=0.20 d=0.24			PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN JT, 60°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN
								a=0.46 a=0.31 d=0.56	92%		PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN PT, 0 - 5°, PL, SO, CN
			10.0		Borehole BH01 terminated at 10.00 m Target depth						PT, 0 - 5°, PL, SO, CN
			11.0								
			12.0								
			13.0								
			14.0								
			15.0								

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- NDD non destructive drilling
- PT push tube

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

D&N Geotechnical

BH01

Core Photograph

Job No: C-0339.00 Sheet 1 of 1
Office: Canberra

Client: Zinfra Pty Ltd	Date: 26 November 2019
Principal: Ausgrid	By: LC
Project: Concord West Substation	Location: 31 George St, NSW

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**BH02**
sheet:	1 of 3
project no.	**C-0339.00**
client:	**Zinfra Pty Ltd**
date started:	**27 Nov 2019**
principal:	**Ausgrid**
date completed:	**27 Nov 2019**
project:	**Concord West Substation**
logged by:	**LC**
location:	**31 George Steet, NSW**
checked by:	**DB**

position: E: 322847; N: 6252721 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
NDD			E					**FILL: Gravelly Sandy CLAY**: medium to high plasticity, dark grey, brown, black, fine to coarse sand, fine to coarse, sub-angular gravel.	M			**FILL**
AD/T, NW casing		Not Observed	D		1.0		CH	**Silty CLAY**: high plasticity, grey, mottled reddish-brown.	<Wp	VSt to H		**RESIDUAL SOIL**
			D					**SHALE**: pale brown, dark brown, re-moulds to sandy silty CLAY, high plasticity, very low strength.			>>	**BEDROCK** HP 600 kPa
			D		2.0			**SHALE**: grey, re-moulds to sandy silty CLAY, high plasticity, highly weathered, very low strength.				
			E		3.0							
								Borehole BH02 continued as cored hole				
					4.0							
					5.0							
					6.0							
					7.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- NDD non destructive drilling
- PT push tube

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

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

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

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH02**
sheet:	2 of 3
project no.	**C-0339.00**
client:	***Zinfra Pty Ltd***
date started:	***27 Nov 2019***
principal:	***Ausgrid***
date completed:	***27 Nov 2019***
project:	***Concord West Substation***
logged by:	***LC***
location:	***31 George Steet, NSW***
checked by:	***DB***

position: E: 322847; N: 6252721 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
			1.0								
			2.0								
			3.0		start coring at 3.35m						
NMLC	Not Observed		4.0		**SHALE**: pale brown, re-moulds to sandy silty CLAY, high plasticity.	XW		a=0.03 d=0.07			extremely weathered material
					SHALE: grey, distinctly laminated at 0° (<20mm), re-moulds to gravelly CLAY, high plasticity.	XW to HW		a=0.06 d=0.06	0%		SM, 0°, PL, CH Clay, 50 mm extremely weathered material
						XW					
			5.0		**SHALE**: dark grey, black, reddish-brown, distinctly laminated at 0° (<20mm), trace SANDSTONE laminations.	MW		a=0.14 d=0.09	0%		multiple partings
			6.0					a=0.12 d=0.09			multiple partings
						XW to MW			40%		extremely weathered material and multiple partings
			7.0		**NO CORE:** 0.24 m						
					SHALE: dark grey, indistinctly laminated at 0°, trace SANDSTONE laminations.	SW		a=0.35 d=0.39 d=0.49			

Defects are: PT, 0°, PL, SO, Fe SN, multiple partings unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- NDD non destructive drilling
- PT push tube

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn
- RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**BH02**
sheet:	3 of 3
project no.	**C-0339.00**
client:	***Zinfra Pty Ltd***
date started:	***27 Nov 2019***
principal:	***Ausgrid***
date completed:	***27 Nov 2019***
project:	***Concord West Substation***
logged by:	***LC***
location:	***31 George Steet, NSW***
checked by:	***DB***

position: E: 322847; N: 6252721 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: Water | casing diameter : NW | vane id.:

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC	Not Observed		9.0		**SHALE**: dark grey, indistinctly laminated at 0°, trace SANDSTONE laminations. *(continued)*	SW		a=0.23 d=0.14	40%		JT, 80°, PL, SO, Cn
									41%		JT, 50°, PL, SO, Cn
					NO CORE: 0.34 m			a=0.38 d=0.12			
			10.0		**SHALE**: dark grey, indistinctly laminated at 0°, trace SANDSTONE laminations.	SW to FR					
					Borehole BH02 terminated at 10.00 m Target depth						
			11.0								
			12.0								
			13.0								
			14.0								
			15.0								

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- NDD non destructive drilling
- PT push tube

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

D&N Geotechnical

BH02

Core Photograph

Job No: C-0339.00 Sheet 1 of 1
Office: Canberra

Client: Zinfra Pty Ltd	Date: 27 November 2019
Principal: Ausgrid	By: LC
Project: Concord West Substation	Location: 31 George St, NSW

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**BH03**
sheet:	1 of 1
project no.	**C-0339.00**
client:	**Zinfra Pty Ltd**
date started:	**28 Nov 2019**
principal:	**Ausgrid**
date completed:	**28 Nov 2019**
project:	**Concord West Substation**
logged by:	**LC**
location:	**31 George Steet, NSW**
checked by:	**DB**

position: E: 322871; N: 6252721 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
AD/T		Not Observed	D + E		0.0		SP	**FILL: SAND**: fine to medium grained, brown, trace fine, sub-angular gravel and roots.	D to M			**FILL**
			D + E		0.5							
			D + E		1.0							
			D + E		1.5			**SHALE**: pale grey, extremely weathered, appears as silty CLAY, medium plasticity.				**BEDROCK**
					2.0							
					2.5							
					3.0			Borehole BH03 terminated at 3.0 m Refusal				
					3.5							

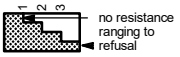
D&N_AU_LIBRARY.GLB rev:AM Log COF BOREHOLE: NON CORED LOGS.GPJ <<DrawingFile>> 17/12/2019 14:53

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- NDD non destructive drilling
- PT push tube

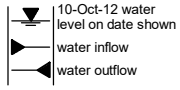
* bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration



water



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

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**BH04**
sheet:	1 of 1
project no.	**C-0339.00**
client:	**Zinfra Pty Ltd**
date started:	**28 Nov 2019**
principal:	**Ausgrid**
date completed:	**28 Nov 2019**
project:	**Concord West Substation**
logged by:	**LC**
location:	**31 George Steet, NSW**
checked by:	**DB**

position: E: 322876; N: 6252721 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T		Not Observed	D + E		0.0		CI-CH	**FILL: Gravelly Sandy CLAY**: medium to high plasticity, dark brown, black, fine to coarse sand, fine to medium, sub-angular gravel.	~Wp			**FILL**
			E		0.5		CH	**Silty CLAY**: high plasticity, grey mottled reddish-brown.	<Wp	VSt to H		**RESIDUAL SOIL**
			D		1.0			**SHALE**: pale grey, extremely weathered, appears as silty CLAY, medium plasticity.				**BEDROCK**
					1.5							
					2.0							
					2.5			Borehole BH04 terminated at 2.6 m Refusal				
					3.0							
					3.5							

D&N_AU_LIBRARY.GLB rev:AM Log COF BOREHOLE: NON CORED LOGS.GPJ <<DrawingFile>> 17/12/2019 14:53

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- NDD non destructive drilling
- PT push tube

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

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

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

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**BH05**
sheet:	1 of 1
project no.	**C-0339.00**
client:	**Zinfra Pty Ltd**
date started:	**28 Nov 2019**
principal:	**Ausgrid**
date completed:	**28 Nov 2019**
project:	**Concord West Substation**
logged by:	**LC**
location:	**31 George Steet, NSW**
checked by:	**DB**

position: E: 322845; N: 6252713 (WGS84) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 210, Track mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
AD/T		Not Observed	E		0.0		Cl	**FILL: Sandy Silty CLAY**: medium plasticity, brown, black, fine to coarse sand.	~Wp			**FILL**
					0.5		CH	**Silty CLAY**: high plasticity, grey mottled reddish-brown.	<Wp	VSt to H		**RESIDUAL SOIL**
PT			U75		1.0							
								Borehole BH05 terminated at 1.1 m Target depth				HP 600 kPa
					1.5							
					2.0							
					2.5							
					3.0							
					3.5							

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- NDD non destructive drilling
- PT push tube

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

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

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

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

Appendix B - Laboratory Test Certificates

STS Geotechnics Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

Atterberg Limits and Linear Shrinkage Report

Project: JOB NO.C-0339.00 - CONCORD WEST SUBSTATION — Project No.: 30169/3249D-L

Client: D & N GEOTECHNICAL — Report No.: 19/3439

Address: 16 BROADSMITH STREET SCULLIN, A.C.T 2614 — Report Date: 5/12/2019

Test Method: AS 1289 3.1.1, 3.2.1, 3.3.1, 3.4.1, 2.1.1 — Page: 1 OF 1

Sampling Procedure: Samples Supplied By Client (Not covered under NATA Scope of Accreditation)

STS / Sample No.	3249D-L/ 1	3249D-L/ 2	3249D-L/ 3			
Sample Location	Borehole 1 Refer to Drawing	Borehole 4 Refer to Drawing	Borehole 5 Refer to Drawing			
Material Description	Silty Clay, grey, pale brown, trace of gravel	Silty Clay, orange, brown, trace of gravel	Silty Clay, orange, dark brown, trace of gravel			
Depth (m)	1.5 - 1.78	1.0 - 1.1	0.3 - 0.6			
Sample Date	28/11/2019	28/11/2019	28/11/2019			
Sample History	Oven Dried	Oven Dried	Oven Dried			
Method of Preparation	Dry Sieved	Dry Sieved	Dry Sieved			
Liquid Limit (%)	**41**	**56**	**65**			
Plastic Limit (%)	**23**	**27**	**30**			
Plasticity Index	**18**	**29**	**35**			
Linear Shrinkage (%)	**10**	**13**	**17**			
Mould Size (mm)	126	126	126			
Crumbing	N	N	N			
Curling	N	N	N			

Remarks:

NATA
Accredited for compliance with ISO/IEC 17025 - Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards
NATA Accreditation Number 2750

Approved Signatory..... .....

Technician: NP

Orlando Mendoza - Laboratory Manager

Test Report

Client : D & N Geotechnical	**Project Number :** 1679
	Project Details : Concord Substation
	Order/Request Number :
Report Date : 9th January 2020	**Report Number :** 167901 rev2

Sample Details

Sample ID / Name / Number	BH 02 - 0.75-1.0m
Sample Description	
Sampled by	Client
Sample Type	Push Tube
Date Sampled	

Thermal Conductivity (ASTM D5334)

Test Date	Preparation Method	Specimen	Moisture Content (%)	Test Time (s)	Initial Temp. (^{O}C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W) *
6/12/2019	Probe inserted into sample. As found moisture content.	A	29.28%	600	21.3	1.75	0.57
11/12/2019	Probe inserted into sample. Partially dry.	A	20.62%	600	19.3	1.56	0.64
16/12/2019	Probe inserted into sample. Partially dry.	A	17.05%	600	19.7	1.37	0.73
18/12/2019	Probe inserted into sample. Partially dry.	A	13.37%	600	19.5	1.19	0.84
23/12/2019	Probe inserted into sample. Fully dry	A	0.00%	500	19.0	0.56	1.77
9/01/2020	Probe inserted into sample. Partially dry.	A	6.63%	600	19.4	0.85	1.18

Specimen	Length (mm)	Diameter (mm)	Mass (g)	Dry Density (t/m$^{3)}$
A	190	73	1185.46	1.49

Notes

- *Thermal resistivity calculation = 1 / Thermal Conductivity.
- 2 specimens from this sample were prepared and tested as part of this report.
- All testing undertaken at Geotherm's Hornsby Laboratory, unless noted.
- Specimens prepared by BH. Wet specimens tested by BH. Dry and partially dry specimens tested by BH, BL,
- The above samples will be discarded after 2 weeks.

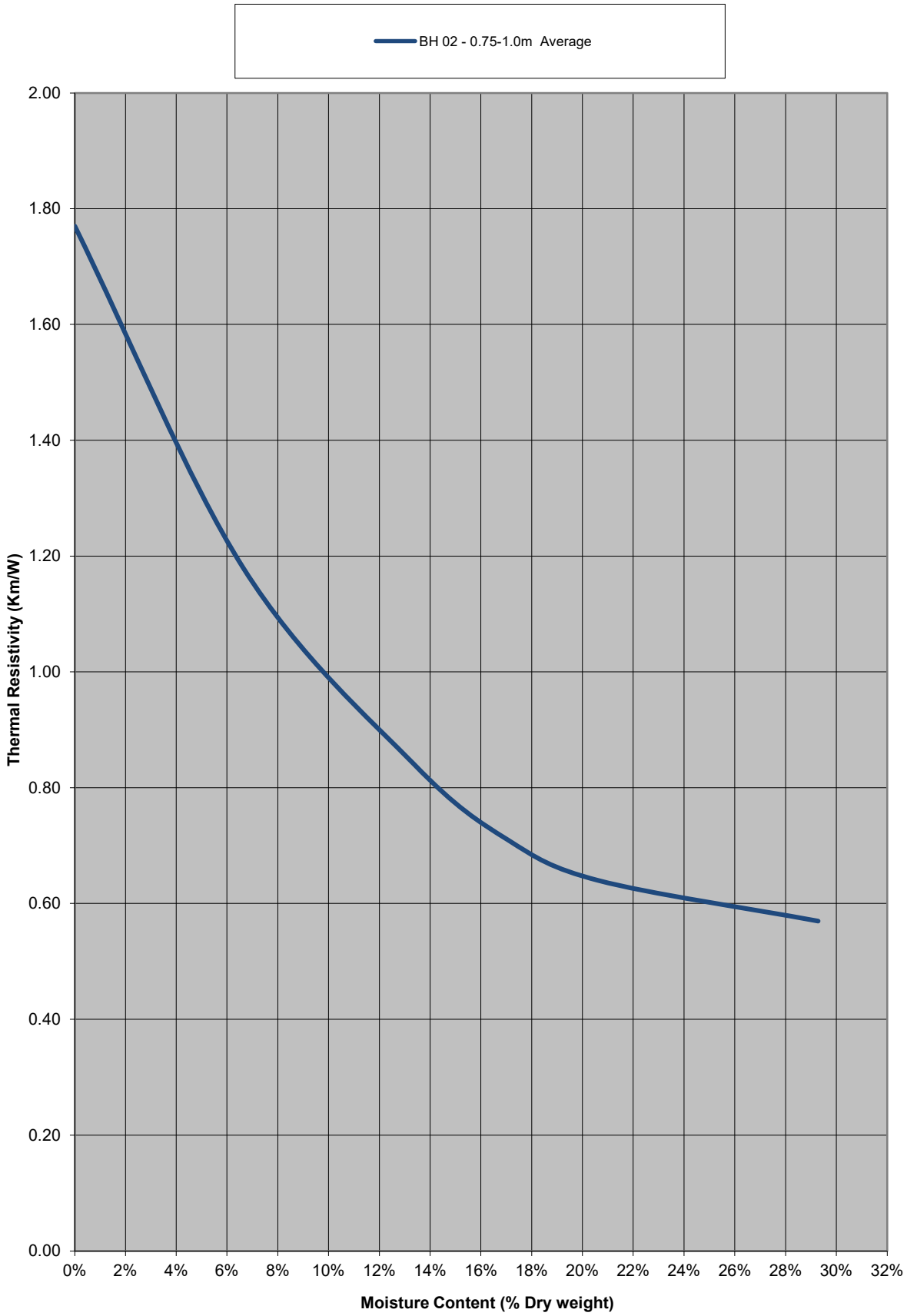
Brett Hobson
Approved Signatory

Geotherm Australasia Pty Ltd
Unit 9, 35 Leighton Place, Hornsby, NSW, 2077
Phone: 02 **9482 9839** Email: brett@geothermaust.com.au
Website: www.geothermaust.com.au
ABN 35 097 576 611

NATA Accreditation Number 20321 – Site 24277

Geotherm Australasia

Dry-out Curve



Test Report

Client : D & N Geotechnical	**Project Number :** 1679
	Project Details : Concord Substation
	Order/Request Number :
Report Date : 9th January 2020	**Report Number :** 167902 rev2

Sample Details

Sample ID / Name / Number	BH 05 - 0.75-1.0m
Sample Description	
Sampled by	Client
Sample Type	Push Tube
Date Sampled	

Thermal Conductivity (ASTM D5334)

Test Date	Preparation Method	Specimen	Moisture Content (%)	Test Time (s)	Initial Temp. (^{O}C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W) *
6/12/2019	Probe inserted into sample. As found moisture content.	A	25.88%	600	20.7	1.75	0.57
11/12/2019	Probe inserted into sample. Partially dry.	A	18.35%	600	19.2	1.61	0.62
16/12/2019	Probe inserted into sample. Partially dry.	A	11.68%	600	18.7	1.32	0.76
18/12/2019	Probe inserted into sample. Partially dry.	A	8.24%	600	19.1	1.12	0.89
23/12/2019	Probe inserted into sample. Fully dry	A	0.00%	500	19.4	0.65	1.53
9/01/2020	Probe inserted into sample. Partially dry.	A	5.32%	600	19.4	0.93	1.07

Specimen	Length (mm)	Diameter (mm)	Mass (g)	Dry Density (t/m$^{3)}$
A	195	73	1271.90	1.56

Notes

- *Thermal resistivity calculation = 1 / Thermal Conductivity.
- 2 specimens from this sample were prepared and tested as part of this report.
- All testing undertaken at Geotherm's Hornsby Laboratory, unless noted.
- Specimens prepared by BH. Wet specimens tested by BH. Dry and partially dry specimens tested by BH, BL,
- The above samples will be discarded after 2 weeks.

Brett Hobson
Approved Signatory

Geotherm Australasia Pty Ltd
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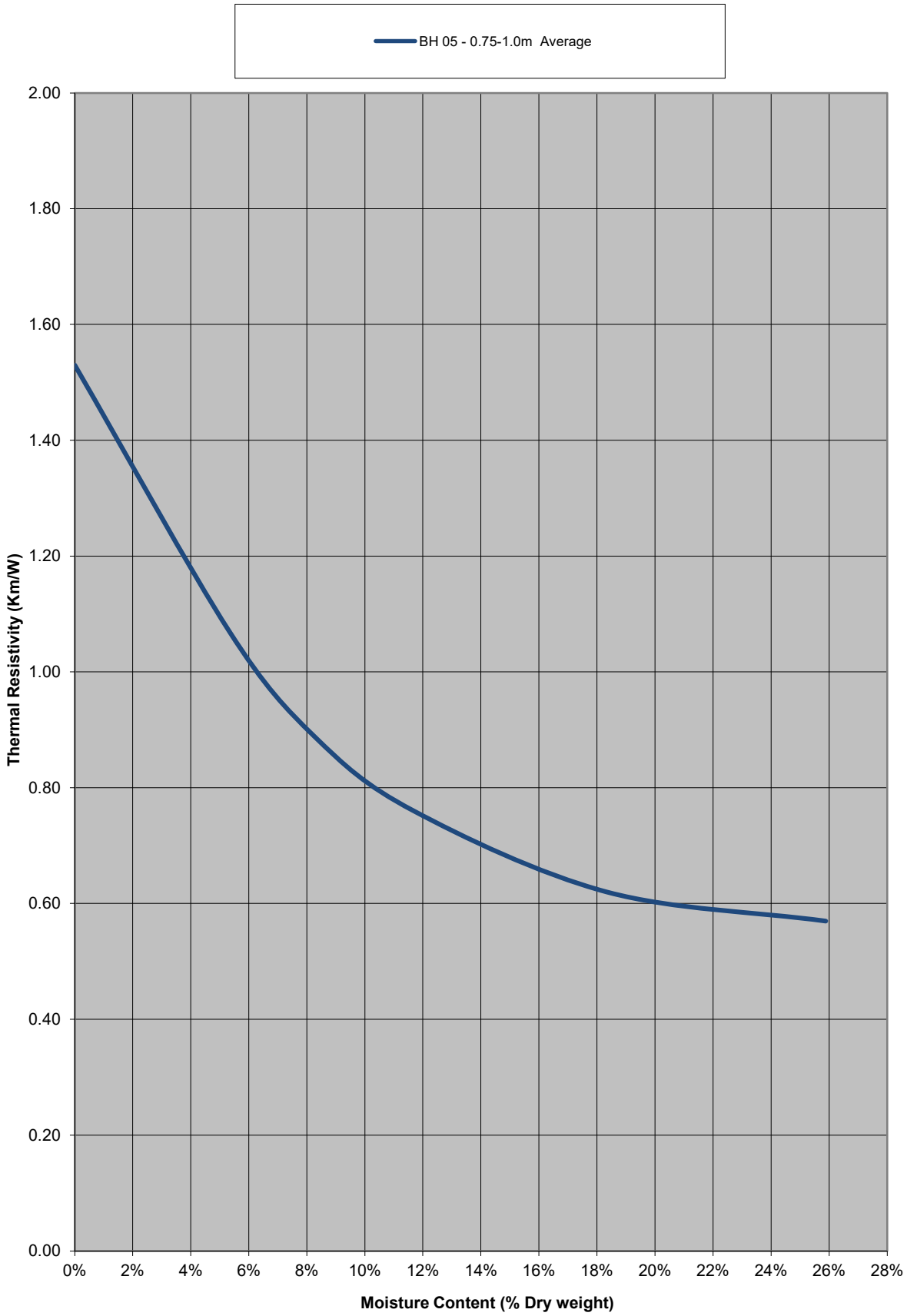
Phone: 02 **9482 9839** Email: brett@geothermaust.com.au
Website: www.geothermaust.com.au
ABN 35 097 576 611

NATA Accreditation Number 20321 – Site 24277

Geotherm Australasia

Dry-out Curve



Test Report

Client : D & N Geotechnical	**Project Number :** 1679
	Project Details : Concord Substation
	Order/Request Number :
Report Date : 23rd December 2019	**Report Number :** 167903

Sample Details

Sample ID / Name / Number	BH 01 - 0.75-1.0m
Sample Description	
Sampled by	Client
Sample Type	Push Tube
Date Sampled	

Thermal Conductivity (ASTM D5334)

Test Date	Preparation Method	Specimen	Moisture Content (%)	Test Time (s)	Initial Temp. (^{O}C)	Thermal Conductivity (W/m.K)	Thermal Resistivity (Km/W) *
6/12/2019	Probe inserted into sample. As found moisture content.	A	28.63%	600	20.9	1.75	0.57
11/12/2019	Probe inserted into sample. Partially dry.	A	19.59%	600	19.1	1.61	0.62
16/12/2019	Probe inserted into sample. Partially dry.	A	13.80%	600	18.8	1.47	0.68
18/12/2019	Probe inserted into sample. Partially dry.	A	9.88%	600	19.0	1.33	0.75
20/12/2019	Probe inserted into sample. Partially dry.	A	6.28%	600	19.4	1.12	0.89
23/12/2019	Probe inserted into sample. Fully dry	A	0.00%	500	19.2	0.69	1.44

Specimen	Length (mm)	Diameter (mm)	Mass (g)	Dry Density (t/m$^{3)}$
A	222	73	1397.80	1.50

Notes

- *Thermal resistivity calculation = 1 / Thermal Conductivity.
- 2 specimens from this sample were prepared and tested as part of this report.
- All testing undertaken at Geotherm's Hornsby Laboratory, unless noted.
- Specimens prepared by BH. Wet specimens tested by BH. Dry and partially dry specimens tested by BH, BL,
- The above samples will be discarded after 2 weeks.

Brett Hobson
Approved Signatory

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Unit 9, 35 Leighton Place, Hornsby, NSW, 2077
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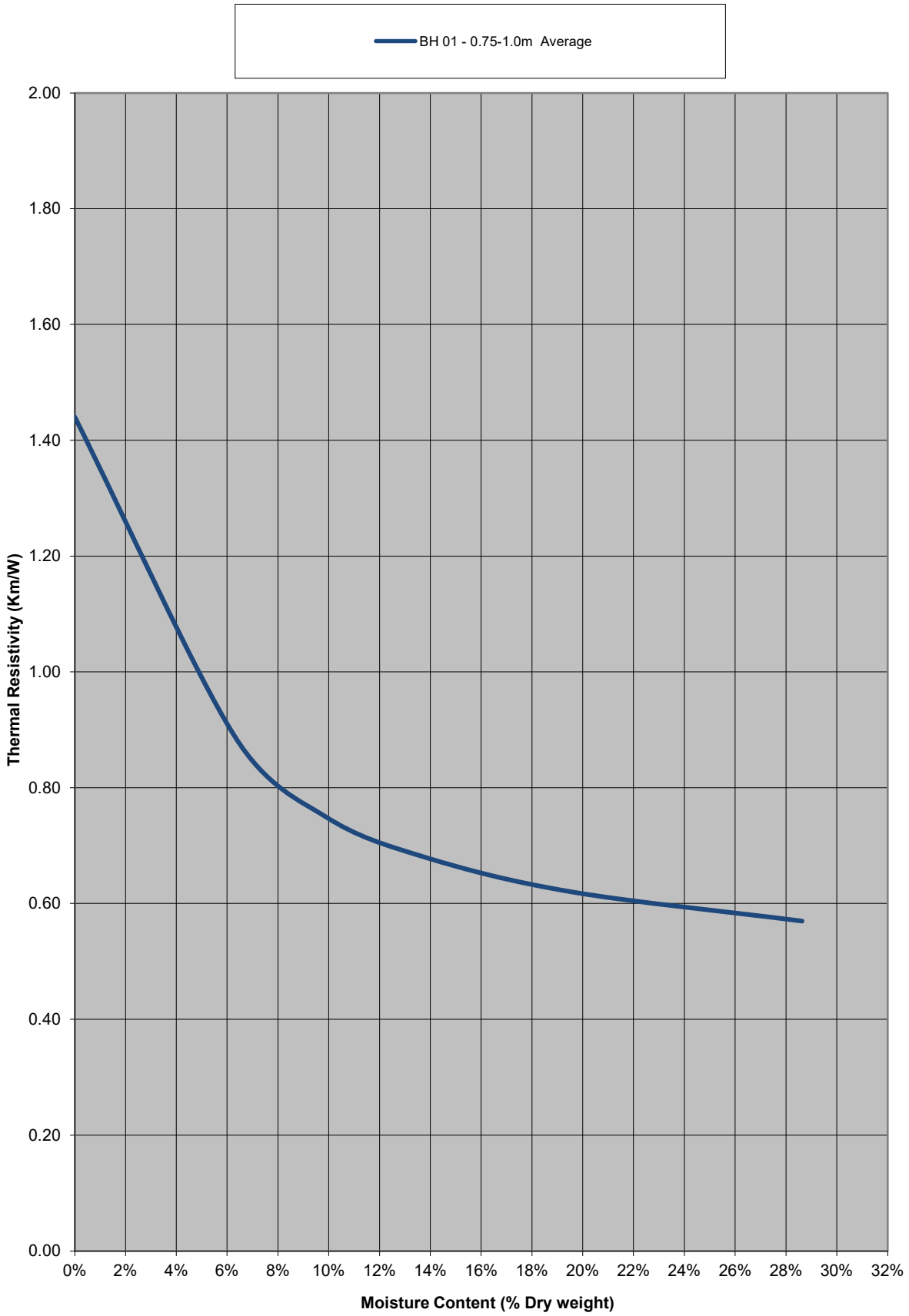
ABN 35 097 576 611

NATA Accreditation Number 20321 – Site 24277

Geotherm Australasia

Dry-out Curve



D & N Geotechnical Pty Ltd
16 Boradsmith Street
Scullin
ACT 2614

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Liam Crosby**

Report **690674-S**
Project name CONCORD WEST SUBSTATION
Project ID C0334.00
Received Date Nov 28, 2019

Client Sample ID			**C0334.00 BH01 0.2-0.4**	**C0334.00 BH05 0.3-0.5**	**C0334.00 BH02 1.5-1.73**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S19-No40227**	**S19-No40228**	**S19-No40229**
Date Sampled			**Nov 26, 2019**	**Nov 26, 2019**	**Nov 26, 2019**
Test/Reference	LOR	Unit			
Chloride	5	mg/kg	130	330	160
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	140	67	38
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	7.3	7.1	4.9
Sulphate (as SO4)	30	mg/kg	180	140	35
% Moisture	1	%	20	21	7.5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

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	Dec 03, 2019	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	Dec 03, 2019	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Melbourne	Dec 03, 2019	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Dec 03, 2019	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Nov 28, 2019	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

ABN – 50 005 085 521
e.mail : EnviroSales@eurofins.com
web : www.eurofins.com.au

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: D & N Geotechnical Pty Ltd
Address: 16 Boradsmith Street
Scullin
ACT 2614

Project Name: CONCORD WEST SUBSTATION
Project ID: C0334.00

Order No.:
Report #: 690674
Phone:
Fax:

Received: Nov 28, 2019 11:23 AM
Due: Dec 5, 2019
Priority: 5 Day
Contact Name: Liam Crosby

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25°C as rec.)	pH (1:5 Aqueous extract at 25°C as rec.)	Sulphate (as SO4)	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	C0334.00 BH01 0.2-0.4	Nov 26, 2019		Soil	S19-No40227	X	X	X	X	X
2	C0334.00 BH05 0.3-0.5	Nov 26, 2019		Soil	S19-No40228	X	X	X	X	X
3	C0334.00 BH02 1.5-1.73	Nov 26, 2019		Soil	S19-No40229	X	X	X	X	X
Test Counts						3	3	3	3	3

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - 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.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

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%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. 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.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. 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	%	95			70-130	Pass	
Sulphate (as SO4)	%	101			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	M19-De00501	NCP	mg/kg	59	42	32	30%	Fail	Q15
Conductivity (1:5 aqueous extract at 25°C as rec.)	M19-No41178	NCP	uS/cm	100	110	3.9	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	M19-No41178	NCP	pH Units	7.7	7.7	pass	30%	Pass	
Sulphate (as SO4)	M19-De00501	NCP	mg/kg	93	87	7.0	30%	Pass	
% Moisture	S19-No39737	NCP	%	< 1	< 1	<1	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

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Ursula Long	Analytical Services Manager
Julie Kay	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

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

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

Appendix C - Preliminary Soil Contamination Assessment

1. Preliminary Soil Contamination Assessment (SCA)

A preliminary soil contamination assessment (SCA) was undertaken concurrently with the geotechnical investigation for the Concord Zone Substation site located on the eastern portion of Lot A DP382070, 31 George Street, Concord NSW. D&N Geotechnical asked Ballpark Environmental Pty Ltd to review the preliminary SCA test results and to prepare this factual summary.

The objective of the preliminary SCA is to provide a preliminary assessment of soil and groundwater contamination and, if required, provide a basis for a more Detailed Site Investigation.

The scope of work carried out for preliminary SCA is summarised below.

- The preliminary SCA was undertaken concurrently with the geotechnical investigation. A site walkover, observations and photographs were taken during the field investigation.
- Field investigation for the preliminary SCA included the drilling of 2 deep boreholes (BH01 & BH02) to target depth of 10m below ground surface (mbgs) and 3 shallow boreholes (BH03, BH04 & BH05) across the balance of the site, see Figure 1. D&N Geotechnical Engineering Geologist observed earthworks activities for signs of potential contamination, including staining of soils, changes in soil media or presence of foreign material.
- Soil samples collected for the preliminary SCA targeted the upper soil profile where minor fill/ reworked soils were observed in boreholes; BH01, BH02, BH03 & BH04.
- Selected soil samples (7 samples) were submitted to a National Association of Testing Authorities (NATA) certified laboratory for testing for the following contaminants of potential concern (CoPC):
  - Metals screen (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
  - Total recoverable hydrocarbons (TRH);
  - Benzene, toluene, ethylbenzene and xylene compounds (BTEX);
  - Polycyclic aromatic hydrocarbons (PAH);
  - Polychlorinated Biphenyls (PCB);
  - Organochlorine Pesticides (OCP); and
  - Asbestos identification in soils (ACM).
- The laboratory results were compared with the investigation levels and acceptance criteria discussed in the below Section 1.1, with any exceedance highlighted and discussed in Sections 1.4 & 1.5.

1.1. Preliminary SCA Assessment Criteria

Assessment criteria for soils and groundwater were selected for relevance to the proposed commercial/industrial use of this electrical substation site.

The criteria discussed below are intended to apply as Tier 1 risk assessment criteria based on certain site-specific characteristics. Where concentrations of a contaminant exceed the adopted assessment criteria, then further consideration of the specific exposure pathway is required which may warrant further investigation, assessment or the development of a strategy to mitigate the potential risks identified.

1.1.1. Health and Ecological Investigation Levels (Soils)

Health and ecological investigation and screening levels for soil presented in Schedule B1 of the ASC NEPM are generally used in NSW when selecting investigation levels for chemical contaminants in soil, (NEPC 2013). Health and ecological investigation and screening levels are applicable to the first stage (Tier 1) of site assessment.

Health Investigation Levels (HILs) are applicable for assessing human health risk via relevant exposure pathways. HILs were developed for a broad range of metals and organic substances. These are generic to all soil types in Australia and apply generally to a depth of 3m below the soil surface for residential sites. For other land uses no specific guidance is provided on depth of application and site-specific conditions are to be used to determine the depth to which HILs apply. For the purpose of this preliminary SCA the HILs are applied to the likely maximum depth of soil disturbance from surface to <2.0mbgs.

Ecological Investigation Levels (EILs) are associated with selected metals and organic compounds and have been developed for assessing risk to terrestrial ecosystems under residential, open space and commercial/industrial land use scenarios. They apply to the top 2m of accessible soil, which corresponds to the root zone and habitation zone of many plant species.

Ecological Screening Levels (ESLs) are provided in the ASC NEPM for petroleum hydrocarbons in soil to provide Tier 1 ESLs for; benzene, toluene, ethylbenzene, xylene (BTEX) compounds, benzo(a)pyrene and F1 (C_6-C_{10}) and F2 (>C_{10}-C_{16}) total petroleum hydrocarbon (TPH) fractions. Similar to EILs the application of ESLs is from the ground surface to a depth of 2m, which generally corresponds with the root zone and habitation zone of plant species in temperate Australia. This industrial site is assessed to have limited ecological value based on its location within an electrical substation. The development will involve construction of new industrial infrastructure, including paved surfaces and roadways. Therefore, EILs and ESLs were not assessed for this preliminary SCA and are not considered further.

Health screening levels (HSLs) have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via inhalation after vapour intrusion into indoor air and direct contact with soil and groundwater. These HSLs depend on general soil type (sand, silt and clay mixture), building configurations and land use scenarios.

1.1.2. Management Limits

In accordance with section 2.9 of Schedule B1 of the ASC NEPM, consideration of Management Limits for petroleum hydrocarbons has been included to assess the potential for accumulation of explosive vapours, the potential risk to buried infrastructure, or the formation of phase separated hydrocarbons (PSH). Management limits for commercial/industrial use are considered relevant for this site and are shown in Table LR2.

1.1.3. Adopted SILs & GILs

The ASC NEPM presents health investigation levels for different land uses (e.g. commercial/industrial, residential, recreational etc.) as well as ecological investigation levels.

As the planned future use for land within this area of the site is an industrial electrical substation within an urban setting, we have adopted the guideline criteria for commercial/industrial use as appropriate soil investigation levels (SILs) and groundwater investigation levels (GILs) for the respective contaminants of potential concern (CoPC).

In summary the following ASC NEPM guideline values are adopted as SILs:

- Health investigation level (HIL) for Commercial/Industrial D (see Table 1A(1) HIL D)
- Soil HSLs for vapour intrusion of clay soils for Commercial/Industrial (see Table 1A(3) HSL D)

- Management Limits for TRH fractions F1-F4 in clay (fine) soil for Commercial/Industrial (see Table 1 B(7))

We have adopted the following ASC NEPM guideline values as GILs, see Table LR3:

- Groundwater investigation levels (GILs) for fresh waters (see Table 1C)
- Groundwaters HSL for vapour intrusion (see Table 1A(4)

The adopted SILs and GILs are presented in the attached Table LR2 with a summary of the laboratory results.

1.1.4. Waste Classification

To prepare the interim waste classification of the *in-situ* soils on this site selected soil samples were analysed, and the laboratory results compared with the contaminant threshold values (CT1) provide in Table 1 of the NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying Waste*.

1.2. Site Investigation

Fieldwork for the geotechnical investigation included the drilling of 5 boreholes across the site. The field investigation was undertaken on Thursday 28 November 2019 by a D&N Geotechnical Engineering Geologist. The sampling methodology followed is summarised in Table 1.

Table 1: Sampling Methodology

Activity	Detail / Comments
Borehole Drilling Program	Boreholes (5) were located across the site, see Figure 1. Boreholes were extended to a maximum depth of 10mbgs (BH01 & BH02). The remaining three shallower boreholes were drilled to depths of: BH03 (3mbgs), BH04 (2.6mbgs), & BH05 (1.1mbgs).
Sample Handling and Transportation	A clean pair of disposable nitrile gloves was used to collect each sample. Soil samples were immediately placed into laboratory supplied glass jars with Teflon lined screw lids to avoid the loss of volatile organic compounds and placed into a chilled insulated container. The soil samples were couriered to NATA certified laboratory (Eurofins mgt laboratory in Sydney) under chain of custody documentation, refer to Appendix A.
Decontamination of sampling equipment	Soil samples were collected by hand directly from the auger of the drill rig using a clean pair of disposable gloves. No sampling tools were used during field investigation avoiding the need for decontamination of sampling equipment. For the groundwater sample a dedicated, single use disposable sampling equipment was used to collect the sample from the monitoring well which does not require decontamination.

Activity	Detail / Comments
Groundwater Sampling Method	A groundwater sample was collected from a monitoring well installed in BH01 using a new dedicated disposable bailer and a clean pair of disposable nitrile gloves. The groundwater sample was immediately placed into laboratory supplied bottles with appropriate preservatives and placed into a chilled cooler. The groundwater sample was couriered to NATA certified laboratory (Eurofins mgt laboratory in Sydney) under chain of custody documentation, refer to Appendix A.
Quality Assurance / Quality Control (QA/QC)	Additional soil samples were collected for QA/QC purposes. These samples were analysed for duplicate samples at a rate of 1 in 10 samples.

1.3. Quality Assurance / Quality Control

Samples were transported under chain of custody (CoC) documentation and in chilled insulated containers to Eurofins mgt Environmental Laboratory which is NATA certified for the analysis performed. A copy of the CoC is included with the laboratory analytical reports presented in as Attachment A.

The laboratory conducted internal quality control using laboratory duplicates, spikes and method blanks. The results are shown with laboratory analytical report, attached. Analytical methods used for the laboratory testing are also indicated on the laboratory report sheets. The results of laboratory quality control testing are assessed to be within acceptable limits.

For QA/QC purposes 1 duplicate soil sample was submitted for analysis. The QA/QC samples were analysed for a suite of CoPC. The results of the duplicate testing for this soil sample are summarised in Table LR1.

There were no reported exceedances of the relative percentage difference (RPD) 50% control limit for the duplicate sample. Based on these results it is considered that the field and laboratory methods are appropriate, and that the data obtained is usable and considered to reasonably represent the concentrations at the sampling points at the time of sampling.

1.4. Results

1.4.1. Soils

The laboratory analytical results are summarised in Table LR2, see attached. Comparison of soil concentrations to the SILs discussed in Section 1.1 and provided in Table LR2 is as follows:

The following points are noted from these results:

- Concentrations of metals and TRH were below the adopted investigation levels or the laboratory's limit of reporting (LOR) in the samples analysed.
- Concentrations of BTEX, PAH, OCP, and PCB were below the adopted investigation levels and the laboratory's LOR in the samples analysed.
- No asbestos was identified in the samples analysed.

1.4.2. Groundwater

The laboratory test results for groundwater sample collected from BH01 are summarised in Table LR3 and laboratory certificates of analysis are presented in Attachment A. Comparison of groundwater concentrations in BH01 to the adopted GILs discussed in section 1.1.3 and provided in Table LR3 is as follows:

- Concentration of copper exceeded the adopted GIL of 1.4 µg/L, reporting a concentration of 6 µg/L.
- Concentration of zinc exceeded the adopted GIL of 8 µg/L, reporting concentration of 35 µg/L.
- Concentrations of TRH >C_{10}-C_{16} (F2), TRH >C_{10}-C_{40}, TRH >C_{16}-C_{34}, & Toluene were reported above the laboratory LOR. Note. Table 1C of the ASC NEPM does not include GILs for TRH or Toluene.

1.4.3. Interim Waste Classification Assessment

The laboratory test results for soil samples are summarised in Table LR2 and laboratory certificates of analysis are present in Attachment A. Comparison of soil concentrations to the acceptance criteria discussed in section 1.1.4 and provided in Table LR2 is as follows:

To assess the preliminary waste classification of the *in-situ* soils within the site the laboratory test results were compared with the contaminant threshold values (CT1 & CT2) provided in Table 1 of the NSW EPA (2014) Waste Classification Guidelines.

The following points are noted from these results:

- Concentrations of metals were below the CT1 – General Solid Waste or the laboratory's LOR.
- Concentrations of TRH and BTEX were below the CT1 – General Solid Waste or the laboratory's LOR in the samples analysed.

Based on the laboratory results for the soil samples analysed the surplus soil materials are assessed to have an interim waste classification as general solid waste.

1.5. Preliminary SCA Conclusions

D&N Geotechnical Pty Ltd were engaged to undertake a geotechnical investigation of the industrial property located at Lot A DP 382070, 31 George Street, Concord, the site. As part of this investigation a preliminary soil contamination assessment (SCA) was undertaken concurrently with the geotechnical investigation.

The objective of the preliminary SCA is to provide a preliminary assessment of soil and groundwater contamination and, if required, provide a basis for a more Detailed Site Investigation.

A site walkover showed that there were no visible signs of surface soil contamination observed, including foreign materials and hydrocarbon surface soil staining, on the site.

The geotechnical investigation included the drilling of 5 boreholes across the site to depths ranging from 1.1 to 10mbgs. In summary the subsurface conditions within the site consisted of fill, overlying residual soils, overlain weathered shale, overlaying shale bedrock to the depth of the investigation.

Given the stratigraphy encountered the contamination sampling was targeted in the upper soil profile with near surface soil samples (0.2-0.4mbgs) and soil samples (0.5-0.6mbgs) collected from the boreholes, BH01, BH02, BH03 & BH04. A total of 7 soil samples were submitted to a NATA accredited chemical laboratory for analysis for CoPC.

The laboratory results when compared with the ASC NEPM SILs for commercial / industrial landuse are below the adopted SILs and/or the laboratory's limit of reporting.

Based on site observations made during the field investigation, the soil and groundwater sampling, laboratory analysis, and data interpretation, we conclude that:

- The site is located within an electrical substation and is currently used for commercial/industrial purposes.
- Measured groundwater standing water levels from monitoring well installed in BH01 on this site was 7.5mbgs.
- Laboratory results for analysis of selected soil samples were below the adopted SILs sourced from ASC NEPM Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater, (NEPC 2013).
- Laboratory results for the groundwater sample from BH01 reported presence of some petroleum hydrocarbons (TRH fractions; $>C_{10}$-C_{16} (F2), TRH $>C_{10}$-C_{40}, & TRH $>C_{16}$-C_{34},) and Toluene above the laboratory limit of reporting (LOR). This result for Toluene is not of concern as the other BTEX fractions were all below the laboratory LOR which suggests they are not present in groundwater at BH01 currently. It is also noted that there is no guideline value for TRH or Toluene provided in Table 1C Groundwater Investigation Levels (GIL) of the ASC NEPM.
- The groundwater sample also reported concentrations of copper and zinc which were above the adopted GILs for freshwater. These marginally elevated results for copper and zinc are not of concern.
- A preliminary *in-situ* waste classification prepared for the surplus soils was classified as general solid waste.

On the basis of the findings of this preliminary SCA, it is assessed that there is a low potential risk from soil or groundwater contamination to human health or environment on this site. No evidence of soil or groundwater contamination was identified which would warrant further detailed site investigation or remediation in accordance with the requirements of *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55).

The site is assessed to be suitable for its proposed ongoing industrial use, subject to the implementation of the following recommendations:

Waste Classification Assessment – During construction works surplus soil requiring offsite disposal must be assessed and classified prior to being transported to an appropriately licenced landfill in accordance with the NSW EPA *Waste Classification Guidelines 2014.*

It is noted that the preliminary testing undertaken does not constitute a detailed waste classification for materials to be excavated from this site. Given the presence of imported fill material of unknown origin we recommend that further sampling and testing is undertaken to satisfy waste classification and/or respective NSW EPA approved resource recovery orders and exemptions.

Unexpected Finds Protocol – An unexpected fines protocol should be included as part of the Construction Environment Management Plan or as a stand-alone document in the event that potentially contaminated fill material or buried unexpected finds, such as asbestos waste, are encountered during construction earthworks.

1.6. References

Australian Standard (2005) *Guide to the Sampling and Investigation of Sites with Potentially Contaminated Soil. Part 1: Non volatile and Semi volatile Compounds.* AS4482.1-2005.

DUAP EPA (1998). *Managing Land Contamination Planning Guidelines, SEPP 55 – Remediation of Land.* Department of Urban Affairs and Planning & Environmental Protection Authority NSW, Sydney

NEPC (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (amended 2013)* (ASC NEPM). National Environmental Protection Council, Canberra

NSW EPA (2017). *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition).* Environment Protection Authority NSW, Sydney

NSW EPA. (2015). *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.* Environment Protection Authority NSW, Sydney

NSW EPA (2014). *Waste Classification Guidelines - Part 1: Classifying Waste.* Environment Protection Authority NSW, Sydney

NSW EPA (2011). *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. Environmental Protection Authority NSW, Sydney

NSW EPA. (1995). *Contaminated Sites: Sampling Design Guidelines.* Environment Protection Authority NSW, Sydney

Victoria EPA. (2010). *Industrial Waste Resource Guidelines (7), Sampling and Analysis: Soil Sampling.* Victoria Environmental Protection Authority, Melbourne.

1.7. Limitations

The findings contained in this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. If material is observed during construction that does not conform to that described in this report, or is suspicious in nature, then an environmental consultant should be contacted, and further assessments undertaken.

In preparing this report, current guidelines for assessment and management of contaminated land were followed. This work has been conducted in good faith in accordance with our understanding of the client's brief and general accepted practice for environmental consulting.

The objective of the preliminary SCA is to provide a preliminary assessment of soil and groundwater contamination and, if required, provide a basis for a more Detailed Site Investigation.

The work was conducted, and the preliminary SCA has been prepared, in response to specific instructions from the client to whom this preliminary SCA is addressed, within the time and budgetary requirements of the client, and in reliance on certain data and information made available to D&N Geotechnical and Ballpark Environmental. The analyses, evaluations, opinions and conclusions presented in this preliminary SCA are based on those instructions, requirements, data or information, and they could change if such instructions etc. are in fact inaccurate or incomplete.

No warranty, expressed or implied, is made as to the information and professional advice included in this preliminary SCA. Anyone relying on this document with reference to a particular development concept does so at their own risk and should satisfy themselves concerning its applicability and, where necessary, should seek expert advice in relation to the particular situation.

Tables

Table LR1: Results of Quality Control Soil Sample

Table LR2: Summary of Laboratory Results for Soil Samples

Table LR3: Summary of Laboratory Results for Groundwater Sample

Attachments

Attachment A – Laboratory Certificates

Ballpark Environmental Pty Ltd
PO Box 36
Nana Glen
NSW 2450

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **-ALL SRAs & Results - Andrew Ballard & Joel Parkin**

Report **690835-S**
Project name C-0339.00
Project ID C-0339.00
Received Date Nov 29, 2019

Client Sample ID			**BH01 0.2-0.4**	**BH01 0.5-0.6**	**BH02 0.4-0.6**	**BH03 0.5-0.6**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S19-No41396**	**S19-No41397**	**S19-No41398**	**S19-No41399**
Date Sampled			**Nov 28, 2019**	**Nov 28, 2019**	**Nov 28, 2019**	**Nov 28, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	650	170	< 50	< 50
TRH C29-C36	50	mg/kg	83	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	733	170	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	78	82	75	73
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	690	200	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	690	200	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5

Client Sample ID			BH01 0.2-0.4	BH01 0.5-0.6	BH02 0.4-0.6	BH03 0.5-0.6
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			S19-No41396	S19-No41397	S19-No41398	S19-No41399
Date Sampled			Nov 28, 2019	Nov 28, 2019	Nov 28, 2019	Nov 28, 2019
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	107	125	109	110
p-Terphenyl-d14 (surr.)	1	%	141	149	134	149
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
a-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Aldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
b-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
d-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
Toxaphene	1	mg/kg	< 1	< 1	< 1	< 1
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
Dibutylchlorendate (surr.)	1	%	106	107	127	104
Tetrachloro-m-xylene (surr.)	1	%	101	103	116	98
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1242	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1248	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1254	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1260	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PCB*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibutylchlorendate (surr.)	1	%	106	107	127	104
Tetrachloro-m-xylene (surr.)	1	%	101	103	116	98

Client Sample ID			BH01 0.2-0.4	BH01 0.5-0.6	BH02 0.4-0.6	BH03 0.5-0.6
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			S19-No41396	S19-No41397	S19-No41398	S19-No41399
Date Sampled			Nov 28, 2019	Nov 28, 2019	Nov 28, 2019	Nov 28, 2019
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	7.4	6.5	8.9	< 2
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	25	29	27	< 5
Copper	5	mg/kg	28	21	23	< 5
Lead	5	mg/kg	39	30	44	6.1
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	12	9.5	8.3	< 5
Zinc	5	mg/kg	30	18	98	11
% Moisture	1	%	19	20	21	3.1

Client Sample ID			BH04 0.2-0.3	BH04 0.4-0.6	QA01
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S19-No41400	S19-No41401	S19-No41402
Date Sampled			Nov 28, 2019	Nov 28, 2019	Nov 28, 2019
Test/Reference	LOR	Unit			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions					
TRH C6-C9	20	mg/kg	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	87	< 50	< 50
TRH C29-C36	50	mg/kg	95	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	182	< 50	< 50
BTEX					
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	77	70	71
Total Recoverable Hydrocarbons - 2013 NEPM Fractions					
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	150	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	150	< 100	< 100
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5

Client Sample ID			BH04 0.2-0.3	BH04 0.4-0.6	QA01
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S19-No41400	S19-No41401	S19-No41402
Date Sampled			Nov 28, 2019	Nov 28, 2019	Nov 28, 2019
Test/Reference	LOR	Unit			
Polycyclic Aromatic Hydrocarbons					
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	112	114	122
p-Terphenyl-d14 (surr.)	1	%	150	INT	INT
Organochlorine Pesticides					
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05	< 0.05
a-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Aldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05
b-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05
d-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2	< 0.2
Toxaphene	1	mg/kg	< 1	< 1	< 1
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.2	< 0.2	< 0.2
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.2	< 0.2	< 0.2
Dibutylchlorendate (surr.)	1	%	92	113	121
Tetrachloro-m-xylene (surr.)	1	%	101	113	116
Polychlorinated Biphenyls					
Aroclor-1016	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Aroclor-1242	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Aroclor-1248	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Aroclor-1254	0.5	mg/kg	< 0.5	< 0.5	< 0.5

Client Sample ID			BH04 0.2-0.3	BH04 0.4-0.6	QA01
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S19-No41400	S19-No41401	S19-No41402
Date Sampled			Nov 28, 2019	Nov 28, 2019	Nov 28, 2019
Test/Reference	LOR	Unit			
Polychlorinated Biphenyls					
Aroclor-1260	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Total PCB*	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Dibutylchlorendate (surr.)	1	%	92	113	121
Tetrachloro-m-xylene (surr.)	1	%	101	113	116
Heavy Metals					
Arsenic	2	mg/kg	17	8.0	10
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	20	31	33
Copper	5	mg/kg	39	27	22
Lead	5	mg/kg	65	33	46
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	8.7	5.8	9.2
Zinc	5	mg/kg	120	14	78
% Moisture	1	%	15	23	21

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

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
Eurofins | mgt Suite B6 (filtered metals)			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Dec 03, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Sydney	Dec 03, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Dec 03, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Dec 03, 2019	
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Sydney	Dec 03, 2019	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Metals M8	Sydney	Dec 03, 2019	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Organochlorine Pesticides	Sydney	Dec 03, 2019	14 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Polychlorinated Biphenyls	Sydney	Dec 03, 2019	28 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
% Moisture	Sydney	Nov 29, 2019	14 Days
- Method: LTM-GEN-7080 Moisture			

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NATA # 1261 Site # 20794

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Site # 23736

Company Name: Ballpark Environmental Pty Ltd
Address: PO Box 36
Nana Glen
NSW 2450

Project Name: C-0339.00
Project ID: C-0339.00

Order No.:
Report #: 690835
Phone: 0400 566 088
Fax:

Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH01 0.2-0.4	Nov 28, 2019		Soil	S19-No41396	X		X	X	X	
2	BH01 0.5-0.6	Nov 28, 2019		Soil	S19-No41397	X		X	X	X	
3	BH02 0.4-0.6	Nov 28, 2019		Soil	S19-No41398	X		X	X	X	
4	BH03 0.5-0.6	Nov 28, 2019		Soil	S19-No41399	X		X	X	X	
5	BH04 0.2-0.3	Nov 28, 2019		Soil	S19-No41400	X		X	X	X	
6	BH04 0.4-0.6	Nov 28, 2019		Soil	S19-No41401	X		X	X	X	
7	QA01	Nov 28, 2019		Soil	S19-No41402	X		X	X	X	
8	BH01	Nov 28, 2019		Water	S19-No41403						X
9	BH01 2.9-3.0	Nov 28, 2019		Soil	S19-No41404		X				

eurofins | Environment Testing

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Site # 23736

Company Name: Ballpark Environmental Pty Ltd
Address: PO Box 36
Nana Glen
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Order No.:
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Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
10	BH03 0.2-0.3	Nov 28, 2019		Soil	S19-No41405		X				
11	BH03 2.0-2.1	Nov 28, 2019		Soil	S19-No41406		X				
12	BH05 0.2-0.5	Nov 28, 2019		Soil	S19-No41407		X				
13	QA02	Nov 28, 2019		Soil	S19-No41408		X				
14	BH03 1.0-1.1	Nov 28, 2019		Soil	S19-No41418		X				
Test Counts						7	6	7	7	7	1

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - 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.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

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%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. 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.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. 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							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	105			70-130	Pass	
TRH C10-C14	%	77			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	105			70-130	Pass	
Toluene	%	110			70-130	Pass	
Ethylbenzene	%	113			70-130	Pass	
m&p-Xylenes	%	115			70-130	Pass	
o-Xylene	%	113			70-130	Pass	
Xylenes - Total	%	114			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	122			70-130	Pass	
TRH C6-C10	%	100			70-130	Pass	
TRH >C10-C16	%	76			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	104			70-130	Pass	
Acenaphthylene	%	114			70-130	Pass	
Anthracene	%	97			70-130	Pass	
Benz(a)anthracene	%	100			70-130	Pass	
Benzo(a)pyrene	%	112			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	%	113			70-130	Pass	
Benzo(g.h.i)perylene	%	100			70-130	Pass	
Benzo(k)fluoranthene	%	128			70-130	Pass	
Chrysene	%	123			70-130	Pass	
Dibenz(a.h)anthracene	%	92			70-130	Pass	
Fluoranthene	%	75			70-130	Pass	
Fluorene	%	103			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	96			70-130	Pass	
Naphthalene	%	119			70-130	Pass	
Phenanthrene	%	95			70-130	Pass	
Pyrene	%	72			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
Chlordanes - Total	%	122			70-130	Pass	
4.4'-DDD	%	125			70-130	Pass	
4.4'-DDE	%	116			70-130	Pass	
4.4'-DDT	%	110			70-130	Pass	
a-BHC	%	81			70-130	Pass	
Aldrin	%	127			70-130	Pass	
b-BHC	%	121			70-130	Pass	
d-BHC	%	124			70-130	Pass	
Dieldrin	%	127			70-130	Pass	
Endosulfan I	%	126			70-130	Pass	
Endosulfan II	%	116			70-130	Pass	
Endosulfan sulphate	%	123			70-130	Pass	
Endrin	%	122			70-130	Pass	
Endrin aldehyde	%	113			70-130	Pass	
Endrin ketone	%	124			70-130	Pass	
g-BHC (Lindane)	%	125			70-130	Pass	
Heptachlor	%	112			70-130	Pass	
Heptachlor epoxide	%	126			70-130	Pass	
Hexachlorobenzene	%	123			70-130	Pass	
Methoxychlor	%	117			70-130	Pass	
Toxaphene	%	105			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	93			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	101			70-130	Pass	
Cadmium	%	104			70-130	Pass	
Chromium	%	104			70-130	Pass	
Copper	%	102			70-130	Pass	
Lead	%	110			70-130	Pass	
Mercury	%	98			70-130	Pass	
Nickel	%	104			70-130	Pass	
Zinc	%	99			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S19-No35398	NCP	%	75			70-130	Pass	
Acenaphthylene	S19-No35398	NCP	%	83			70-130	Pass	
Benzo(b&j)fluoranthene	S19-No35398	NCP	%	81			70-130	Pass	
Benzo(k)fluoranthene	S19-No35398	NCP	%	79			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chrysene	S19-No35398	NCP	%	83			70-130	Pass	
Fluoranthene	S19-No35398	NCP	%	80			70-130	Pass	
Pyrene	S19-No35398	NCP	%	77			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
Toxaphene	S19-No41324	NCP	%	117			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S19-No41397	CP	%	92			70-130	Pass	
TRH C10-C14	S19-No41397	CP	%	86			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S19-No41397	CP	%	93			70-130	Pass	
Toluene	S19-No41397	CP	%	95			70-130	Pass	
Ethylbenzene	S19-No41397	CP	%	93			70-130	Pass	
m&p-Xylenes	S19-No41397	CP	%	95			70-130	Pass	
o-Xylene	S19-No41397	CP	%	93			70-130	Pass	
Xylenes - Total	S19-No41397	CP	%	95			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S19-No41397	CP	%	90			70-130	Pass	
TRH C6-C10	S19-No41397	CP	%	90			70-130	Pass	
TRH >C10-C16	S19-No41397	CP	%	84			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Anthracene	S19-No41397	CP	%	129			70-130	Pass	
Benz(a)anthracene	S19-No41397	CP	%	124			70-130	Pass	
Benzo(a)pyrene	S19-No41397	CP	%	127			70-130	Pass	
Benzo(g.h.i)perylene	S19-No41397	CP	%	110			70-130	Pass	
Dibenz(a.h)anthracene	S19-No41397	CP	%	102			70-130	Pass	
Fluorene	S19-No41397	CP	%	127			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S19-No41397	CP	%	104			70-130	Pass	
Naphthalene	S19-No41397	CP	%	130			70-130	Pass	
Phenanthrene	S19-No41397	CP	%	123			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
Chlordanes - Total	S19-No41397	CP	%	112			70-130	Pass	
4.4'-DDD	S19-No41397	CP	%	120			70-130	Pass	
4.4'-DDE	S19-No41397	CP	%	114			70-130	Pass	
4.4'-DDT	S19-No41397	CP	%	96			70-130	Pass	
a-BHC	S19-No41397	CP	%	110			70-130	Pass	
Aldrin	S19-No41397	CP	%	112			70-130	Pass	
b-BHC	S19-No41397	CP	%	100			70-130	Pass	
d-BHC	S19-No41397	CP	%	106			70-130	Pass	
Dieldrin	S19-No41397	CP	%	110			70-130	Pass	
Endosulfan I	S19-No41397	CP	%	110			70-130	Pass	
Endosulfan II	S19-No41397	CP	%	102			70-130	Pass	
Endosulfan sulphate	S19-No41397	CP	%	113			70-130	Pass	
Endrin	S19-No41397	CP	%	119			70-130	Pass	
Endrin aldehyde	S19-No41397	CP	%	97			70-130	Pass	
Endrin ketone	S19-No41397	CP	%	114			70-130	Pass	
g-BHC (Lindane)	S19-No41397	CP	%	107			70-130	Pass	
Heptachlor	S19-No41397	CP	%	110			70-130	Pass	
Heptachlor epoxide	S19-No41397	CP	%	108			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Hexachlorobenzene	S19-No41397	CP	%	115			70-130	Pass	
Methoxychlor	S19-No41397	CP	%	101			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S19-No41397	CP	%	87			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S19-No41397	CP	%	94			70-130	Pass	
Cadmium	S19-No41397	CP	%	95			70-130	Pass	
Chromium	S19-No41397	CP	%	88			70-130	Pass	
Copper	S19-No41397	CP	%	97			70-130	Pass	
Lead	S19-No41397	CP	%	111			70-130	Pass	
Mercury	S19-No41397	CP	%	115			70-130	Pass	
Nickel	S19-No41397	CP	%	94			70-130	Pass	
Zinc	S19-No41397	CP	%	91			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S19-No41396	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	S19-No41396	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	S19-No41396	CP	mg/kg	650	460	34	30%	Fail	Q15
TRH C29-C36	S19-No41396	CP	mg/kg	83	62	29	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S19-No41396	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S19-No41396	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S19-No41396	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	S19-No41396	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S19-No41396	CP	mg/kg	690	490	33	30%	Fail	Q15
TRH >C34-C40	S19-No41396	CP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S19-No41396	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S19-No41396	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S19-No41396	CP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S19-No41396	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S19-No41396	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S19-No41453	NCP	mg/kg	2.4	3.1	23	30%	Pass	
Cadmium	S19-No41453	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S19-No41453	NCP	mg/kg	8.4	12	34	30%	Fail	Q15
Copper	S19-No41453	NCP	mg/kg	31	39	24	30%	Pass	
Lead	S19-No41453	NCP	mg/kg	17	44	89	30%	Fail	Q15
Mercury	S19-No41453	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S19-No41453	NCP	mg/kg	16	20	20	30%	Pass	
Zinc	S19-No41453	NCP	mg/kg	62	180	97	30%	Fail	Q15
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S19-No41396	CP	%	19	20	1.0	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q08	The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Ursula Long	Analytical Services Manager
Andrew Sullivan	Senior Analyst-Organic (NSW)
Gabriele Cordero	Senior Analyst-Metal (NSW)
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

Glenn Jackson

General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

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

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

Certificate of Analysis

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NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Ballpark Environmental Pty Ltd
PO Box 36
Nana Glen
NSW 2450

Attention:	-ALL SRAs & Results - Andrew Ballard & Joel Parkin
Report	690835-AID
Project Name	C-0339.00
Project ID	C-0339.00
Received Date	Nov 29, 2019
Date Reported	Dec 06, 2019

Methodology:

Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS 4964 (2004) method for non-homogeneous samples is around 0.1 g/kg (equivalent to 0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis, this is considered to be at the nominal reporting limit of 0.01% (w/w). The NEPM screening level of 0.001% (w/w) is intended as an on-site determination, not a laboratory Limit of Reporting (LOR), per se. Examination of a large sample size (e.g. 500 mL) may improve the likelihood of detecting asbestos, particularly AF, to aid assessment against the NEPM criteria. Gravimetric determinations to this level of accuracy are outside of AS 4964 and hence NATA Accreditation does not cover the performance of this service (non-NATA results shown with an asterisk). *NOTE: NATA News March 2014, p.7, states in relation to AS 4964: "This is a qualitative method with a nominal reporting limit of 0.01 % " and that currently in Australia "there is no validated method available for the quantification of asbestos".This report is consistent with the analytical procedures and reporting recommendations in the NEPM and the WA DoH.*

Project Name C-0339.00
Project ID C-0339.00
Date Sampled Nov 28, 2019
Report 690835-AID

Client Sample ID	Eurofins Sample No.	Date Sampled	Sample Description	Result
BH01 0.2-0.4	19-No41396	Nov 28, 2019	Approximate Sample 63g Sample consisted of: Brown coarse-grained clayey soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
BH01 0.5-0.6	19-No41397	Nov 28, 2019	Approximate Sample 63g Sample consisted of: Brown coarse-grained clayey soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
BH02 0.4-0.6	19-No41398	Nov 28, 2019	Approximate Sample 63g Sample consisted of: Brown coarse-grained clayey soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
BH03 0.5-0.6	19-No41399	Nov 28, 2019	Approximate Sample 76g Sample consisted of: Brown fine-grained sandy soil	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
BH04 0.2-0.3	19-No41400	Nov 28, 2019	Approximate Sample 60g Sample consisted of: Brown coarse-grained soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
BH04 0.4-0.6	19-No41401	Nov 28, 2019	Approximate Sample 55g Sample consisted of: Brown coarse-grained clayey soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.
QA01	19-No41402	Nov 28, 2019	Approximate Sample 57g Sample consisted of: Brown coarse-grained clayey soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No trace asbestos detected.

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

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
Asbestos - LTM-ASB-8020	Sydney	Nov 29, 2019	Indefinite

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Phone : 0800 856 450
IANZ # 1290

Company Name: Ballpark Environmental Pty Ltd
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NSW 2450

Project Name: C-0339.00
Project ID: C-0339.00

Order No.:
Report #: 690835
Phone: 0400 566 088
Fax:

Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH01 0.2-0.4	Nov 28, 2019		Soil	S19-No41396	X		X	X	X	
2	BH01 0.5-0.6	Nov 28, 2019		Soil	S19-No41397	X		X	X	X	
3	BH02 0.4-0.6	Nov 28, 2019		Soil	S19-No41398	X		X	X	X	
4	BH03 0.5-0.6	Nov 28, 2019		Soil	S19-No41399	X		X	X	X	
5	BH04 0.2-0.3	Nov 28, 2019		Soil	S19-No41400	X		X	X	X	
6	BH04 0.4-0.6	Nov 28, 2019		Soil	S19-No41401	X		X	X	X	
7	QA01	Nov 28, 2019		Soil	S19-No41402	X		X	X	X	
8	BH01	Nov 28, 2019		Water	S19-No41403						X
9	BH01 2.9-3.0	Nov 28, 2019		Soil	S19-No41404		X				
10	BH03 0.2-0.3	Nov 28, 2019		Soil	S19-No41405		X				

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NATA # 1261 Site # 20794

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NSW 2450

Project Name: C-0339.00
Project ID: C-0339.00

Order No.:
Report #: 690835
Phone: 0400 566 088
Fax:

Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
11	BH03 2.0-2.1	Nov 28, 2019		Soil	S19-No41406		X				
12	BH05 0.2-0.5	Nov 28, 2019		Soil	S19-No41407		X				
13	QA02	Nov 28, 2019		Soil	S19-No41408		X				
14	BH03 1.0-1.1	Nov 28, 2019		Soil	S19-No41418		X				
Test Counts						7	6	7	7	7	1

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
5. This report replaces any interim results previously issued.

Holding Times

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

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

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

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

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Sample is dried by heating prior to analysis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Reference document for the NEPM. Government of Western Australia, Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (2009), including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil (2011)
NEPM	National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended)
ACM	Asbestos Containing Materials. Asbestos contained within a non-asbestos matrix, typically presented in bonded and/or sound condition. For the purposes of the NEPM, ACM is generally restricted to those materials that do not pass a 7mm x 7mm sieve.
AF	Asbestos Fines. Asbestos containing materials, including friable, weathered and bonded materials, able to pass a 7mm x 7mm sieve. Considered under the NEPM as equivalent to “non-bonded / friable”.
FA	Fibrous Asbestos. Asbestos containing materials in a friable and/or severely weathered condition. For the purposes of the NEPM, FA is generally restricted to those materials that do not pass a 7mm x 7mm sieve.
Friable	Asbestos-containing materials of any size that may be broken or crumbled by hand pressure. For the purposes of the NEPM, this includes both AF and FA. It is outside of the laboratory’s remit to assess degree of friability.
Trace Analysis	Analytical procedure used to detect the presence of respirable fibres in the matrix.

Comments

The samples received were not collected in an approved asbestos bag and was therefore sub-sampled from the 250mL glass jar. Valid sub-sampling procedures were applied so as to ensure that the sub-samples to be analysed accurately represented the samples received.

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Chamath JHM Annakkage	Senior Analyst-Asbestos (NSW)

Authorised by:

Laxman Dias	Senior Analyst-Asbestos (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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

Ballpark Environmental Pty Ltd
PO Box 36
Nana Glen
NSW 2450

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **-ALL SRAs & Results - Andrew Ballard & Joel Parkin**

Report **690835-W**
Project name C-0339.00
Project ID C-0339.00
Received Date Nov 29, 2019

Client Sample ID			**BH01**
Sample Matrix			**Water**
Eurofins Sample No.			**S19-No41403**
Date Sampled			**Nov 28, 2019**
Test/Reference	LOR	Unit	
Total Recoverable Hydrocarbons - 1999 NEPM Fractions			
TRH C6-C9	0.02	mg/L	< 0.02
TRH C10-C14	0.05	mg/L	0.14
TRH C15-C28	0.1	mg/L	0.4
TRH C29-C36	0.1	mg/L	0.2
TRH C10-C36 (Total)	0.1	mg/L	0.74
BTEX			
Benzene	0.001	mg/L	< 0.001
Toluene	0.001	mg/L	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002
o-Xylene	0.001	mg/L	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003
4-Bromofluorobenzene (surr.)	1	%	113
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
Naphthalene[N02]	0.01	mg/L	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02
TRH >C10-C16	0.05	mg/L	0.15
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	0.15
TRH >C16-C34	0.1	mg/L	0.5
TRH >C34-C40	0.1	mg/L	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	0.65
Heavy Metals			
Arsenic (filtered)	0.001	mg/L	0.004
Cadmium (filtered)	0.0002	mg/L	< 0.0002
Chromium (filtered)	0.001	mg/L	< 0.001
Copper (filtered)	0.001	mg/L	0.006
Lead (filtered)	0.001	mg/L	0.001
Mercury (filtered)	0.0001	mg/L	< 0.0001
Nickel (filtered)	0.001	mg/L	0.010
Zinc (filtered)	0.005	mg/L	0.035

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

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
Eurofins | mgt Suite B6 (filtered metals)			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Dec 03, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Sydney	Nov 29, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Nov 29, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Dec 03, 2019	
- Method: LTM-ORG-2010 TRH C6-C40			
Metals M8 filtered	Sydney	Nov 29, 2019	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

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NATA # 1261
Site # 23736

Company Name: Ballpark Environmental Pty Ltd
Address: PO Box 36
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NSW 2450

Project Name: C-0339.00
Project ID: C-0339.00

Order No.:
Report #: 690835
Phone: 0400 566 088
Fax:

Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH01 0.2-0.4	Nov 28, 2019		Soil	S19-No41396	X		X	X	X	
2	BH01 0.5-0.6	Nov 28, 2019		Soil	S19-No41397	X		X	X	X	
3	BH02 0.4-0.6	Nov 28, 2019		Soil	S19-No41398	X		X	X	X	
4	BH03 0.5-0.6	Nov 28, 2019		Soil	S19-No41399	X		X	X	X	
5	BH04 0.2-0.3	Nov 28, 2019		Soil	S19-No41400	X		X	X	X	
6	BH04 0.4-0.6	Nov 28, 2019		Soil	S19-No41401	X		X	X	X	
7	QA01	Nov 28, 2019		Soil	S19-No41402	X		X	X	X	
8	BH01	Nov 28, 2019		Water	S19-No41403						X
9	BH01 2.9-3.0	Nov 28, 2019		Soil	S19-No41404		X				

eurofins | Environment Testing

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Project Name: C-0339.00
Project ID: C-0339.00

Order No.:
Report #: 690835
Phone: 0400 566 088
Fax:

Received: Nov 29, 2019 10:36 AM
Due: Dec 6, 2019
Priority: 5 Day
Contact Name: -ALL SRAs & Results - Andrew

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Asbestos - AS4964	HOLD	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B6 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
10	BH03 0.2-0.3	Nov 28, 2019		Soil	S19-No41405		X				
11	BH03 2.0-2.1	Nov 28, 2019		Soil	S19-No41406		X				
12	BH05 0.2-0.5	Nov 28, 2019		Soil	S19-No41407		X				
13	QA02	Nov 28, 2019		Soil	S19-No41408		X				
14	BH03 1.0-1.1	Nov 28, 2019		Soil	S19-No41418		X				
Test Counts						7	6	7	7	7	1

eurofins | Environment Testing

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram | **mg/L:** milligrams per litre | **ug/L:** micrograms per litre

ppm: Parts per million | **ppb:** Parts per billion | **%:** Percentage

org/100mL: Organisms per 100 millilitres | **NTU:** Nephelometric Turbidity Units | **MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - 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.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

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%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. 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.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. 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							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Heavy Metals							
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	103			70-130	Pass	
TRH C10-C14	%	75			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	98			70-130	Pass	
Toluene	%	94			70-130	Pass	
Ethylbenzene	%	94			70-130	Pass	
m&p-Xylenes	%	90			70-130	Pass	
o-Xylene	%	93			70-130	Pass	
Xylenes - Total	%	91			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	95			70-130	Pass	
TRH C6-C10	%	105			70-130	Pass	
TRH >C10-C16	%	73			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic (filtered)	%	99			70-130	Pass	
Cadmium (filtered)	%	100			70-130	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium (filtered)			%	100			70-130	Pass	
Copper (filtered)			%	100			70-130	Pass	
Lead (filtered)			%	101			70-130	Pass	
Mercury (filtered)			%	104			70-130	Pass	
Nickel (filtered)			%	99			70-130	Pass	
Zinc (filtered)			%	95			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S19-No40166	NCP	%	105			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S19-No40166	NCP	%	95			70-130	Pass	
Toluene	S19-No40166	NCP	%	95			70-130	Pass	
Ethylbenzene	S19-No40166	NCP	%	92			70-130	Pass	
m&p-Xylenes	S19-No40166	NCP	%	92			70-130	Pass	
o-Xylene	S19-No40166	NCP	%	91			70-130	Pass	
Xylenes - Total	S19-No40166	NCP	%	92			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S19-No40166	NCP	%	95			70-130	Pass	
TRH C6-C10	S19-No40166	NCP	%	106			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	S19-No41403	CP	%	108			70-130	Pass	
Cadmium (filtered)	S19-No41403	CP	%	96			70-130	Pass	
Chromium (filtered)	S19-No41403	CP	%	90			70-130	Pass	
Copper (filtered)	S19-No41403	CP	%	83			70-130	Pass	
Lead (filtered)	S19-No41403	CP	%	89			70-130	Pass	
Mercury (filtered)	S19-No41403	CP	%	85			70-130	Pass	
Nickel (filtered)	S19-No41403	CP	%	84			70-130	Pass	
Zinc (filtered)	S19-No41403	CP	%	80			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S19-No40165	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S19-No40165	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	S19-No40165	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	S19-No40165	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	S19-No40165	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	S19-No40165	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total	S19-No40165	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S19-No40165	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
TRH C6-C10	S19-No40165	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	S19-No41849	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cadmium (filtered)	S19-No41849	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	S19-No41849	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S19-No41849	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	S19-No41849	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury (filtered)	S19-No41849	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	S19-No41849	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	S19-No41849	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.

Authorised By

Ursula Long	Analytical Services Manager
Andrew Sullivan	Senior Analyst-Organic (NSW)
Gabriele Cordero	Senior Analyst-Metal (NSW)

Glenn Jackson

General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

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

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

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NATA # 1261 Site # 23736

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Sample Receipt Advice

Company name:	**Ballpark Environmental Pty Ltd**
Contact name:	-ALL SRAs & Results - Andrew Ballard & Joel Parkin
Project name:	C-0339.00
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Nov 29, 2019 10:36 AM
Eurofins reference:	**690835**

Sample information

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

Notes

Jars subsampled for asbestos analysis. Jar labelled as BH03 1.0-1.1 placed on hold. Sample BH02 0.4-0.6 listed twice in the C.O.C, logged for analysis

Contact notes

If you have any questions with respect to these samples please contact:

Ursula Long on Phone : or by e.mail: UrsulaLong@eurofins.com

Results will be delivered electronically via e.mail to -ALL SRAs & Results - Andrew Ballard & Joel Parkin - info@ballparkenv.com.au.

BALLPARK ENVIRONMENTAL

Suite 2, 192 Pacific Highway
Coffs Harbour
NSW 2450 Australia
M: 0400 566 088
E. ballparkenviro@outlook.com

Chain of Custody | Laboratory Quotation/ Order No: | **Project No.:** C-0339.00 | Sheet 1 of 1

Dispatch to:	Sample Receipt - Eurofins Unit F3, Bldg F 16 Mars Road LANE COVE NSW 2066	Sampled By:	LC
Attention:	Sample receipt	Project Manager: (report results to)	info@ballparkenv.com.au

Consigning Officer	JP						
Date Dispatched	28-Nov-19						
Courier Service:							
Consignment Note No.:							

Relinquished By:	Andrew Ballard	Date:	Time:	Received By:	Luca D.	Date:	Time:
	Coffs Harbour				Eurofins	29/11/19	10:36 AM

Comments:	Sample Matrix	Container Type & Preservative	Sample No.	Sample Depth (m)	Date Sampled:	Analyses Required: Suite B7	Asbestos ID in soils	Suite B13	Suite B6							Send to Eurofins Melbourne	HOLD	Sample Condition on Receipt
	Soil	250ml Glass Jars	BH01	0.2-0.4		x	x	x										
	Soil	250ml Glass Jars	BH01	0.5-0.6		x	x	x										
	Soil	250ml Glass Jars	BH01	2.9-3													x	
	Soil	250ml Glass Jars	BH02	0.4-0.6		x	x	x										
	Soil	250ml Glass Jars	BH02	0.4-0.6													x	
	Soil	250ml Glass Jars	BH03	0.2-0.3													x	
	Soil	250ml Glass Jars	BH03	0.5-0.6		x	x	x										
	Soil	250ml Glass Jars	BH03	2-2.1													x	
	Soil	250ml Glass Jars	BH04	0.2-0.3		x	x	x										
	Soil	250ml Glass Jars	BH04	0.4-0.6		x	x	x										
	Soil	250ml Glass Jars	BH05	0.2-0.5													x	
	Water	Plastic/ Ambers/ Vials	BH01						x									
	Soil	250ml Glass Jars	QA01			x	x	x										
	Soil	250ml Glass Jars	QA02														x	

Special Laboratory Instructions:

Detection Limits: Normal

Turnaround Required: Standard TAT Requested

11.2°C

#690835