Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Salinity Investigation

Proposed Urban Development
Bradfield City Centre
215 Badgerys Creek Road, Bradfield

Prepared for
Western Parkland City Authority

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Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

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1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by Western Parkland City Authority (WPCA) to undertake a Salinity Investigation and Salinity Management Plan (SMP) for the future Bradfield City Centre site at 215 Badgerys Creek Road, Bradfield (the site, as shown on Drawings 1 and 2). The works were carried out in accordance with DP's proposal P222630.00 dated 19 June 2023.

Saline soils affect much of the Western Sydney region. Buildings and infrastructure located on shales of the Wianamatta Group are particularly at risk. Salinity can affect urban development in a number of ways, including corrosion of concrete, break down of bricks and mortar, corrosion of steel (including reinforcement), break up of roads, attack on buried infrastructure, reduced ability to grow vegetation and increased erosion potential.

It is understood that significant bulk earthworks are proposed for the site and assessment of the site salinity is required to manage salinity hazards on site for future earthworks and urban development.

The investigation comprised the completion of an electromagnetic survey (EM survey) of the site, followed by excavation of test pits and boreholes, laboratory testing of selected samples, engineering analysis and reporting. Details of the work undertaken and the results obtained are given within this report, together with comments relating to design and construction practice for minimising the effects of salinity.

The investigation was carried out concurrently with investigations for the Advanced Manufacturing Research Facility Building 2 and for the Stage 2 Civil and Stormwater Infrastructure which have been reported separately.

2. Site Information

Site Address	215 Badgerys Creek Road, Bradfield NSW
Legal Description	Lot 3101 on Deposited Plan (D.P.) 1282964
Approximate area	114.6 ha
Local Council Area	Liverpool City Council
Current Land Use	Mixed Use, Enterprise and ENZ Environment and Recreation

Surrounding Uses	North – Rural, grazing East – Riparian and Mixed use residential South – Riparian and Mixed use residential West – Mixed Use residential

The site location and layout are shown on Drawings 1 and 2 (Appendix B) and Figure 1 below. At the time of undertaking this assessment, the site was mostly grass-covered with some areas of thick shrubs. Construction was in progress for an underground Sydney Metro station box and for the Advanced Manufacturing Research Facility 1 (AMRF1) building area.

The site was previously a Royal Australian Air Force radio station. It is understood that there were a number of radio towers and staff base buildings which have been decommissioned and removed from site however some of the tower anchors, grounding and wiring have been left in ground.

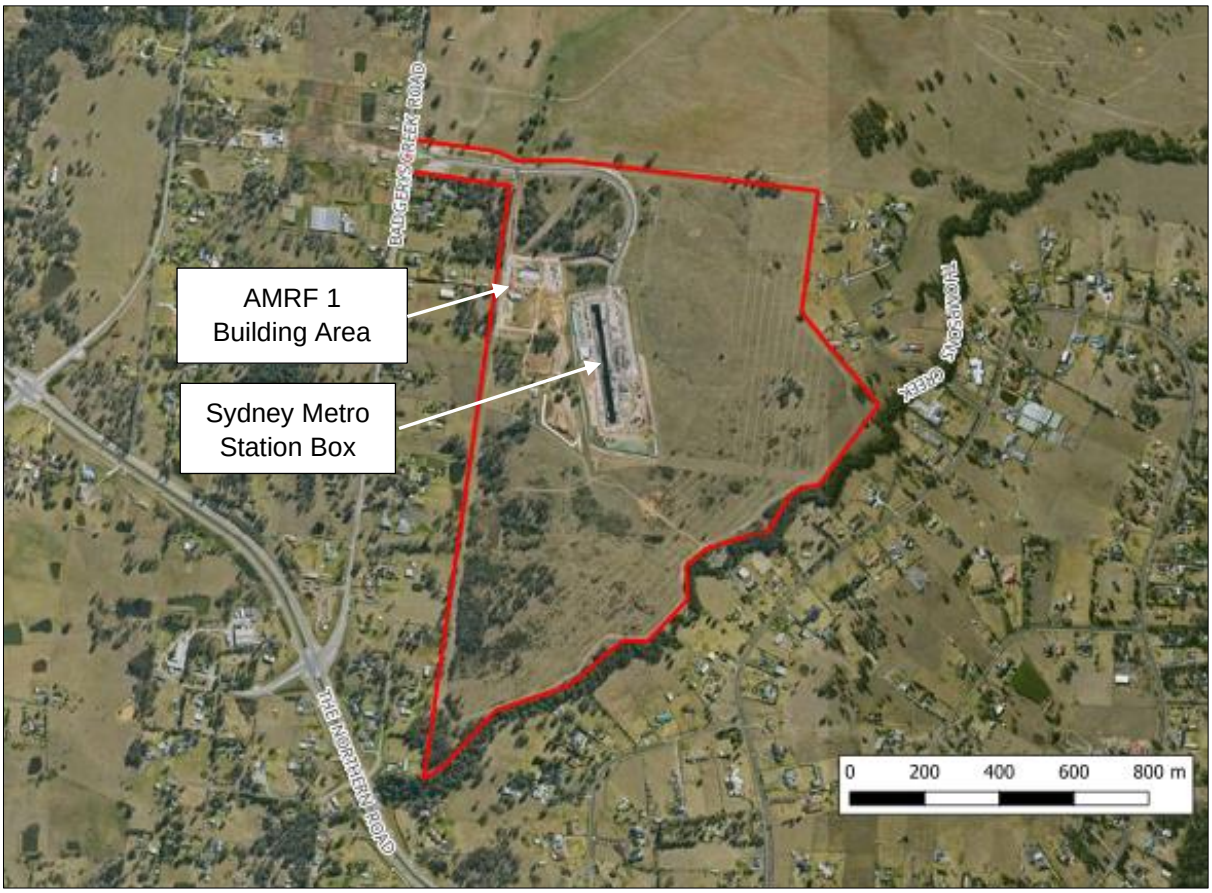

Figure 1: Site Location

3. Environmental Setting

3.1 Topography

The site typically traverses gently undulating terrain with an overall relief of approximately 20 m from the highest part of the site (approx. RL 80, relative to Australian height datum – AHD) in the north west corner of the site to the lowest part of the site (approx. RL 60), eastern corner of the site along Thompsons Creek. Ground surface slopes within the site are typically less than five degrees.

Topography is characterised by a mostly flat floodplain along Thompsons Creek which forms the south eastern boundary of the site. An ephemeral creek, Moore Gully, runs east to west in the southern portion of the site and drains into Thompsons Creek. There is a broad central ridgeline running from the central portion of the southern boundary towards the north east. Drainage is typically poor in the southern part of the site due to the relative flatness of the terrain.

3.2 Geology and Soils

Reference to the New South Wales Department of Minerals and Energy, *Geology of the Penrith 1:100,000 Sheet 9030, New South Wales Geological Survey, Sydney,* dated 1991, (DME, 1991) indicates that the northern and western portions of the site are underlain by the Bringelly Shale Formation (refer Figure 2, below). This unit typically comprises shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, with rare coal and tuff layers. Along Thompsons Creek and a small portion of Moore Gully, the Bringelly Shale is overlain by alluvial deposits comprising fine-grained sand, silt and clay.

The Luddenham Dyke is mapped to the north west of the site. The Luddenham Dyke is a Jurassic igneous intrusion comprising olivine basalt, analcite, augite, feldspar and magnetite which is typically up to 6 m wide (DME, 1991). Whilst mapping indicates that the dyke does not extend into the site, our investigation encountered material consistent with the dyke material near the central western part of the site.

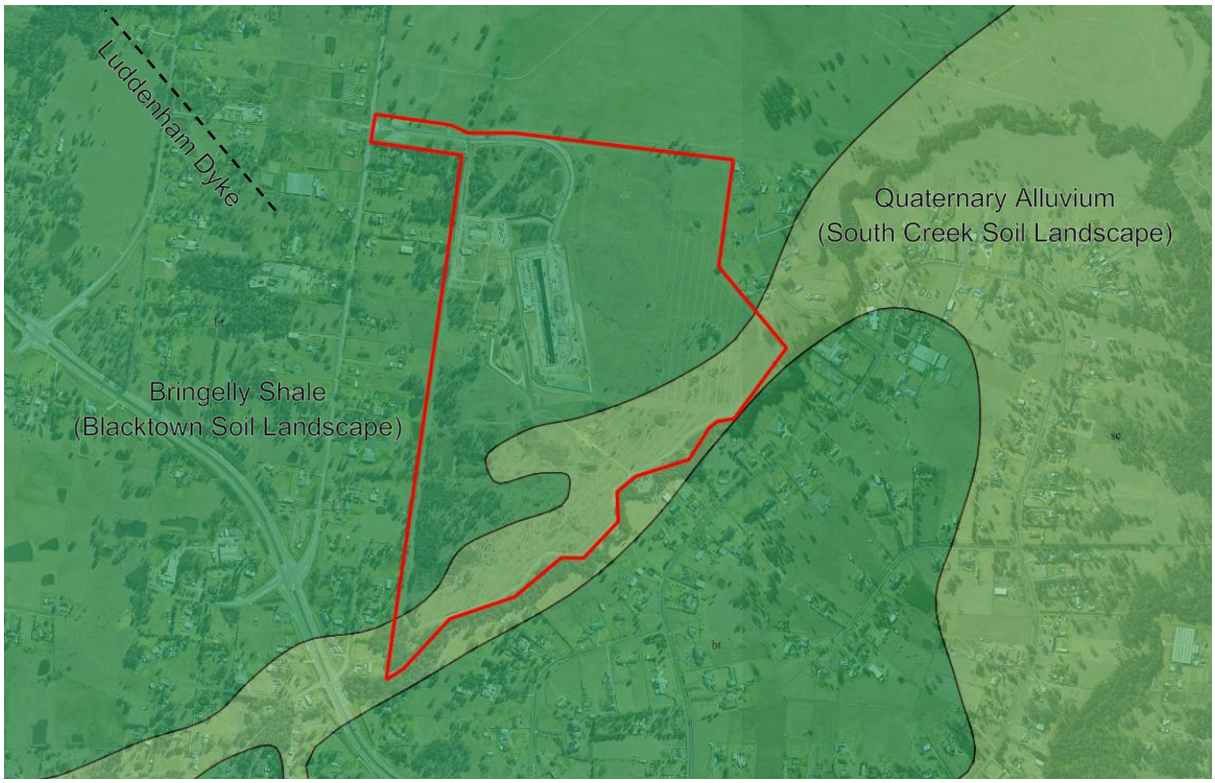

Figure 2: Geology and Soils Landscape Mapping

Reference to the Bannerman, S.M. and Hazelton, P.A., *Soil Landscapes of the Penrith 1:100 000 Sheet, Soil Conservation Service of NSW,* dated 1990, indicates that the site includes two soil landscape groups, including the Blacktown Soils (dark green) and South Creek (light green) soil landscapes. The approximate soil landscape boundaries match the corresponding underlying geology boundaries, as shown on Figure 2.

The northern and western portions of the site comprise soils of the Blacktown soil landscape, which is characterised by gently undulating rises, slopes usually less than 5%. This is a residual soil landscape, which the mapping indicates comprises multiple soil horizons that range from shallow red-brown podzolic soils comprising mostly clayey soils on crests and upper slopes, to deep brown to yellow clay soils on mid to lower slopes and in areas of poor drainage. These soils are typically of low fertility, are moderately reactive, highly plastic and generally have a low wet strength.

The floodplain of Thompsons Creek and the eastern part of Moore Gully is mapped as the South Creek soil landscape, which is characterised by floodplains, valley flats and drainage depressions of the channels, usually flat with incised channels that are mainly cleared. This is an alluvial soil landscape, which mapping indicates comprises multiple soil horizons, including red and yellow podzolic soils, most common on terraces, and yellow solodic soils. These soils are often very deep layered sediments over bedrock or relict soils, present an erosional hazard and experience frequent flooding.

Australian Soil Resource Information System managed by CSIRO Land and Water maps the site as extremely low probability of Acid Sulfate Soil occurrence.

According to NSW Department of Infrastructure, Planning and Natural Resources, *Map of Salinity Potential in Western Sydney*, 2002, the site has known salinity along Thompsons Creek and Moore Gully with moderate salinity potential in the remainder of the site. Refer to Figure 3 below.

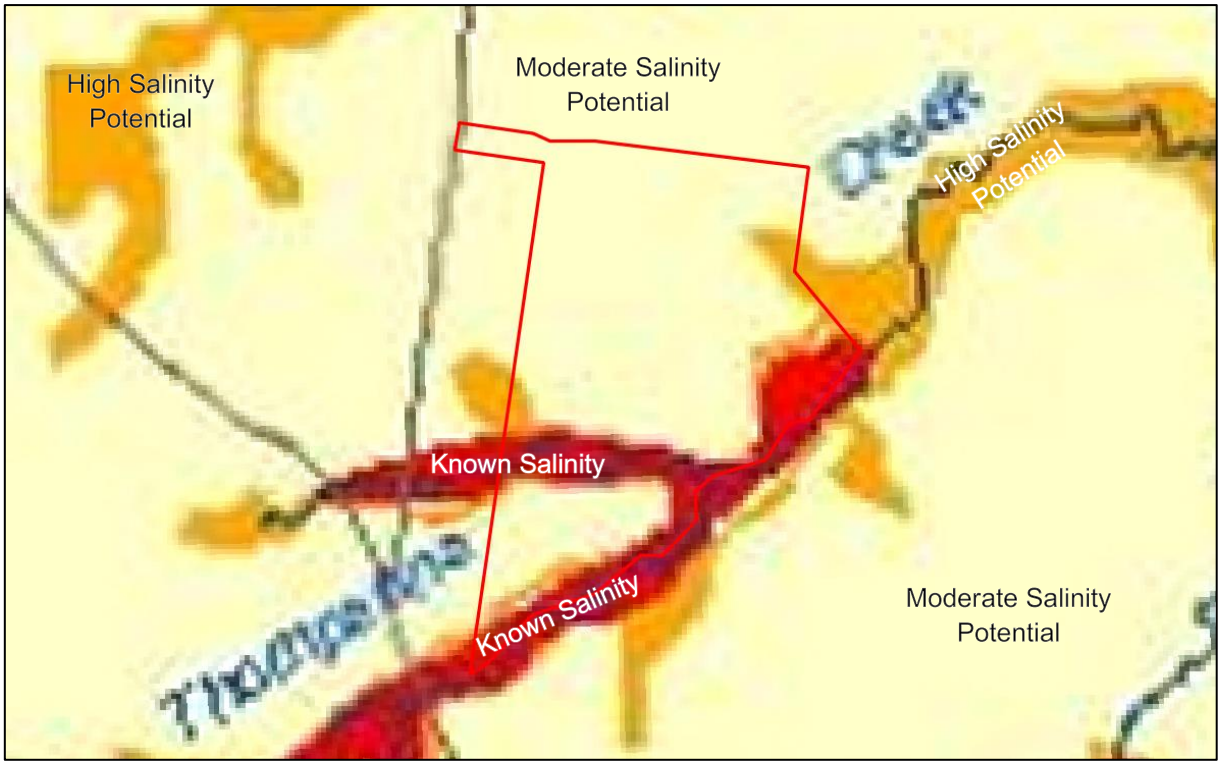

Figure 3: Regional Salinity Mapping

3.3 Surface Water and Groundwater

Surface water is found on the site in Thompsons Creek and Moore Gully which flow to the east and north to eventually join South Creek. Moore Gully has two small dams along the alignment and there is another small farm dam in the north eastern part of the site. Based on review of surface drainage it is anticipated that groundwater would primarily also flow towards the north east.

Unweathered Bringelly Shale has very low hydraulic conductivity and bores drilled into the unweathered shales in the Sydney area are generally dry or yielding small flows of saline groundwater, typically with total dissolved salts (TDS) contents of 10 000 mg / L to 30 000 mg / L (Old, 1942; McNally, 2004). Groundwater flow is likely to be dominated by fracture flow with resultant low yields (typically <1 L / s) in bores.

A search of the NSW Department of Planning, Industry and Environment groundwater bore database indicated that there are five exploration bores on the site drilled to depths of 6 – 12.2 m however no groundwater levels were available.

4. Field Work Methods

4.1 Intrusive Investigation

The intrusive field work for the salinity investigation comprised the following:

- Excavation of 10 test pits (Pits 301 – 310) to depths of up to 3 m or prior refusal using a JCB 4CX Eco backhoe fitted with a 450 mm bucket.
- Excavation of 8 boreholes to depths of 1 m using a 100 mm diameter hand auger;
- Collection of additional samples from test pits and boreholes excavated within the site for the separate AMRF Building 2 and Stage 2 Civil and Stormwater Investigations. The samples were collected as follows:
    - Collection of samples from three of the twelve boreholes (Bores 3, 6 and 11) drilled within the AMRF building footprint. The boreholes were drilled to depths of 2.9 – 3.5 m using 110 mm continuous solid flight augers fitted with a tungsten-carbide (TC) bit. The bores were extended to depths of 10 m, using 'NMLC' rotary coring techniques to obtain 50 mm diameter continuous rock core samples.
    - Collection of samples from the 23 test pits (Pits 101, 103 – 110, 113, 116 – 118, 121 – 128, 202 and 205) excavated to depths of 1.5 – 3.5 m using a JCB 4CX Eco backhoe fitted with a 450 mm bucket on the Stage 2 Civil and Stormwater Infrastructure site.
    - Collection of samples from five of the boreholes (Bores 201, 203, 204, 206, 207) drilled to depths of 5.5 – m using 110 mm continuous solid flight augers fitted with a tungsten-carbide (TC) bit on the Stage 2 Civil and Stormwater Infrastructure site
    - Standpipe piezometers were constructed in Bores 201, 203, 204, 206 and 207 which allowed additional collection of groundwater samples.

The test pits and boreholes were logged on site by a geotechnical engineer. The test locations were nominated by DP and located on site prior to the investigation using a differential GPS unit with a nominal accuracy of ±0.1 m. The test locations are shown in Drawing 3 (Appendix B) and test pit and borehole logs are provided in Appendix C.

All field measurements and mapping for this project have been carried out using the Geodetic Datum of Australia 2020 (GDA2020) and the Map Grid of Australia 2020 (MGA2020), Zone 56. All reduced levels are given in relation to Australian Height Datum (AHD).

4.2 Electromagnetic (EM) Profiling

EM-induction profiling was undertaken as part of the examination of soil salinity potential, enabling rapid continuous measurement of apparent electrical conductivity to target areas for soil sampling and to reduce the requirements for laboratory testing of soils for salinity assessment purposes.

Apparent electrical conductivity is variously referred to as ground or terrain conductivity, bulk conductivity or bulk electrical conductivity and is generally designated as σa or ECa and refers to the quadrature (out-of-phase) component of the response. Although measurement of apparent conductivities can include contributions from a variety of sources including groundwater, conductive soil and rock minerals (metals having an in-phase response), it has been estimated that in 75 - 90 % of

cases in Australia, apparent conductivity anomalies can be explained by the presence of soluble salts (Spies and Woodage, 2004). Apparent conductivity can therefore be considered, in the majority of cases, a good indicator of soil salinity.

Most portable instruments measure apparent conductivity in milliSiemens per metre (mS/m) and typical measurement ranges have been suggested as indicative of salinity classes (Chhabra 1966) as shown in Table 1.

Table 1: Salinity Classes in Relation to Apparent Conductivity

Class	ECa (mS/m)
Non-Saline	< 50
Slightly Saline	50 - 100
Moderately Saline	100 - 150
Very Saline	150 - 200
Extremely Saline	> 200

The survey instrument employed was the Dualem 42s, mounted on extensions behind a 4wd vehicle. The instrument (Figure 4) recorded data using 2.0 m and 4.0 m transmitter - receiver coil separations (horizontal co-planar coils configuration), and 2.1 m and 4.1 m transmitter - receiver coil separations (non-co-planar coils configuration, having vertical receiver coils). The instrument has a fixed transmitter frequency of 9k Hz and produces four quadrature (out-of-phase) and four in-phase data-streams for theoretical or nominal depths of investigation (response to ground conductors) of up to approximately 6 m below the coils, however this is dependent on actual soil conductivities (and sensor height above the ground) and most of the conductivity response was expected to be in the depth range of approximately 0 m - 4.0 m below the ground surface at this site.

Figure 4: Dualem 42s extended behind 4WD vehicle.

ECa data were acquired at 1 second intervals during slow continuous driving along on a grid of survey lines spaced approximately 25 m apart. Slashing of survey lines where necessary/possible was provided by the client. It is noted that not all areas of the site were accessible. Inaccessible areas included the thick vegetated area to the southwest of the site and the active construction areas. It is noted that the equipment is highly sensitive to interference from metallic objects such as construction fences and vehicles/plant etc. The approximate area covered by the survey was 71.5 Ha.

Positions were acquired using an internal GPS and are presented in GDA2020.

The data coverage achieved using the Dualem 42s (EM Induction) instrument is shown on Drawing 5, Appendix B.

5. Results

5.1 Field Work Observations – Northern Area of Site

The subsurface conditions encountered during the field investigation are shown on the test pit and borehole logs in Appendix B, together with notes defining classification methods and the descriptive terms used.

The typical succession of strata encountered within the test pits is summarised as follows:

TOPSOIL	Silty clay topsoil encountered to depths in the range 0.1 – 0.2 m in all test pits;
CLAY: (Residual)	Silty clay, typically stiff to very stiff, encountered to depths in the range 0.5 – 2.4 m in all test pits;
SHALE BEDROCK: (Bringelly Shale)	Shale bedrock, typically very low and low strength on first contact and increasing to low to medium strength with depth, encountered from depths in the range 0.5 – 2.4 m and continuing to the limit of investigation depth of 3.3 m in Pit 108 and to refusal depths of 1.3 – 2.8 m in all other Pits with the exception of Pit 123;
BASALT (Luddenham Dyke)	Basalt, high strength, encountered from a depth of 0.8 m in Pit 123. The basalt was highly fractured on first contact and caused refusal of the excavator bucket at a depth of 0.9 m

No free groundwater was observed in any of the test pits during excavation. It is noted that the test pits were immediately backfilled following excavation which precluded longer term monitoring of groundwater levels. It should be noted that groundwater levels are affected by factors such as preceding climatic conditions and soil permeability and can therefore fluctuate with time.

5.2 Field Work Observations – Moore Gully

The typical succession of strata encountered within the stormwater corridor test locations is summarised as follows:

TOPSOIL	Silty clay topsoil encountered to depths in the range 0.1 – 0.3 m in all test pits and boreholes;
CLAY: (Residual)	Silty clay, stiff to hard, encountered to depths in the range 1.4 – 2.6 m in Bores 201 and 207 and Pit 202;
CLAY: (Alluvial)	Silty clay, typically stiff to very stiff, encountered to depths of 4.5 and 4.8 m in Bores 203 and 206 respectively and to the limit of investigation depths of 3.5 – 5 m in Bore 204 and Pit 205;
SHALE BEDROCK: (Bringelly Shale)	Shale bedrock, typically very low and low strength on first contact and increasing to low to medium strength with depth, encountered from depths in the range 1.4 – 4.8 m and continuing to the limit of investigation depths of 3.5 – 10 m in Bores 201, 203, 206 and 207. Pit 202 was terminated on refusal in medium strength shale at a depth of 1.7 m;

Free groundwater was observed at depths of 3.5 m and 4.1 m in Pit 205 and Bore 206 respectively. Free groundwater was not observed whilst drilling or excavating in any of the other locations. Groundwater wells were installed in Bores 201, 203, 204, 206 and 207 for long term monitoring of groundwater levels. Well construction details are included on the borehole logs.

A summary of groundwater observations and measurements within the wells is presented Table 2. It is noted that groundwater levels will fluctuate over time in response to climatic variations or anthropogenic influences.

Table 2: Results of Groundwater Well Monitoring

Bore No.	Date	Groundwater Depth (m bgl)	Groundwater RL (m AHD)
4 Surface RL: 79.5 Well Depth 9.5 m	14 September 2023	5.7	73.8
	14 September 2023	7.8 (after bailing)	71.7
	18 September 2023	7.6	71.9
	25 September 2023	7.1	72.4
	26 September 2023	7.1	72.4
201 Surface RL: 68.1 Well Depth: 5.0 m	24 August 2023	2.05	66
	14 September 2023	2.17	65.9
	26 September 2023	2.22	65.9
203 Surface RL: 64.2 Well Depth 5.0 m	24 August 2023	3.0	61.2
	14 September 2023	2.7	61.5
	26 September 2023	2.7	61.5
204 Surface RL: 62.3 Well Depth: 5.0 m	24 August 2023	2.8	59.6
	14 September 2023	2.9	59.5
	26 September 2023	2.9	59.4

Bore No.	Date	Groundwater Depth (m bgl)	Groundwater RL (m AHD)
206 Surface RL: 59.3 Well Depth: 5.0 m	24 August 2023	1.7	57.7
	14 September 2023	1.8	57.5
	26 September 2023	1.8	57.5
207 Surface RL: 69.5 Well Depth: 10.0 m	24 August 2023	4	65.4
	14 September 2023	5.2	64.2
	26 September 2023	5.3	64.2

Boreholes 201, 203, 204 and 206 were drilled to the north of the water logged areas surrounding the Moore Gully water course. The groundwater levels generally match the levels of the low points of Moore Gully in the west and Thompsons Creek in the east.

Salt scaring or efflorescence were not observed during the investigation however rainfall in the period prior to the investigation may have reduced the visibility of such features.

5.3 EM Profiling Data Processing and Presentation

The apparent conductivity data were despiked, and filtered to remove responses from fences, buried earthing grids, reinforced foundations, coiled wire and other known large metallic objects. The line data were subsequently processed to generate 2D gridded data for map making and correlation with test-pit sampled laboratory analyses.

Based on the mapped distribution of apparent conductivities, the locations of Pits 301 – 310 were selected to enable soil sampling, primarily of the high conductivity areas but also of some low conductivity and moderate conductivity areas as controls and to populate the data set for correlation of field and laboratory results.

The in-phase measurements are generally insensitive to soil conductivity but respond to subsurface metallic conductors and were mapped to assess the degree of interference with the apparent conductivity data and to help enable despiking/removal of anomalies attributable to metallic objects.

5.4 Laboratory Results

A Summary Table (Appendix C) presents the results of laboratory tests, assessments of aggressivity to concrete and steel, sodicity class, textural classification, calculated salinity ECe and salinity class inferred from ECe values using the method of Richards (1954). The detailed laboratory test reports and chain of custody information are included in Appendix E. The total test sample numbers and the range of test results obtained are summarised in Tables 3 and 4.

Table 3: Summary of Parameters Tested in Soil Samples

Parameter		Units	Samples	Minimum	Maximum
pH		pH units	106	4.4	9.3
Chlorides		(mg/kg)	32	<10(1)	850
Sulphates		(mg/kg)	32	<10(1)	270
Aggressivity	to Concrete	[AS2159]	106	Non-aggressive	Moderately Aggressive
	to Steel	[AS2159]	106	Non-aggressive	Moderately Aggressive
Exchangeable Sodium (Na)		(meq/100g)	10	0.1	2.9
CEC (cation exchange capacity)		(meq/100g)	10	3.6	10.0
Sodicity [Na/CEC]		(ESP%)	10	2.8	33.0
Sodicity Class		[after DLWC]	10	Non-sodic	Highly sodic
EC1:5 [Lab.]		(mS/cm)	106	39.1	1600.00
Resistivity		Ω.cm	106	625	25575.4
ECe [M x EC1:5] [2]		(dS/m)	106	0.3	14.4
Salinity Class		[after Richards 1954]	106	Non-saline	Very Saline

1 concentrations were below the detection limit of 10 mg/kg

2 M is soil textural factor

Table 4: Summary of Testing in Groundwater

Borehole	pH	EC (mS/cm)	Salinity (Hazleton and Murphy 2007)
201	7.2	19,000	Very Saline
203	7.2	19,000	Very Saline
206	7.1	19,000	Very Saline
207	7.3	16,000	Very Saline

Figure 5 (following page) presents variations of aggressivity with depth, based on pH profiles at all sampling locations, together with class ranges indicated in the Australian Standard AS2159 (2009). The permeability of the sampled clay-rich soils at all sampling locations and the absence of free groundwater in most locations indicate that soils are in Condition “B” as defined by AS2159.

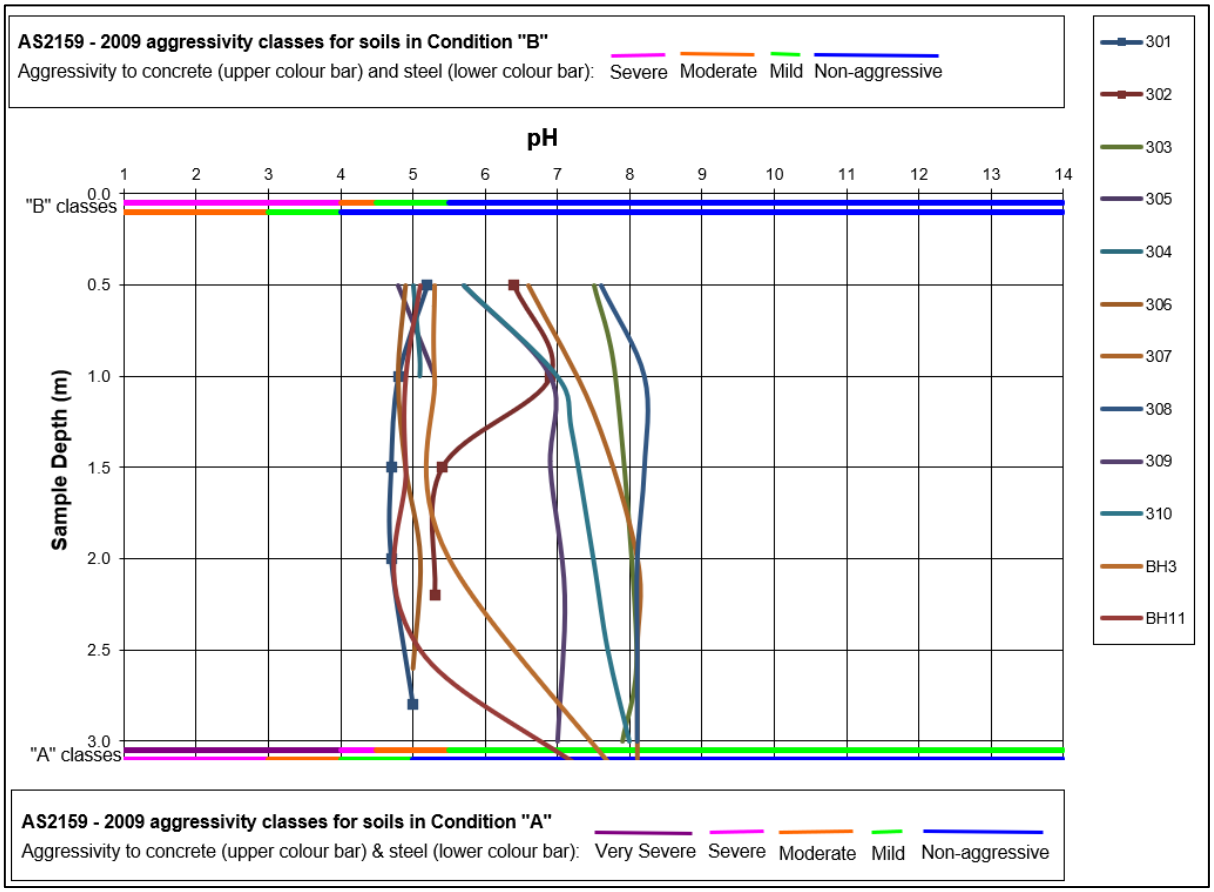

Figure 5: Vertical pH Profiles and Aggressivity Classes

Figure 6 (following page) presents the variations of salinity with depth, based on salinity (ECe) profiles at all sampling locations, together with the salinity classifications of Richards (1954).

Drawings 6 – 8 (Appendix B) show the “worst case” results of salinity and aggressivity from each sampling location This includes testing from 0 – 3 m for Pits 301 – 310 and Bore 4. Additional shallow samples were collected from the other test locations however the shallow sampling depth meant that they results may not represent the worst case and have not been presented as “worst case” results.

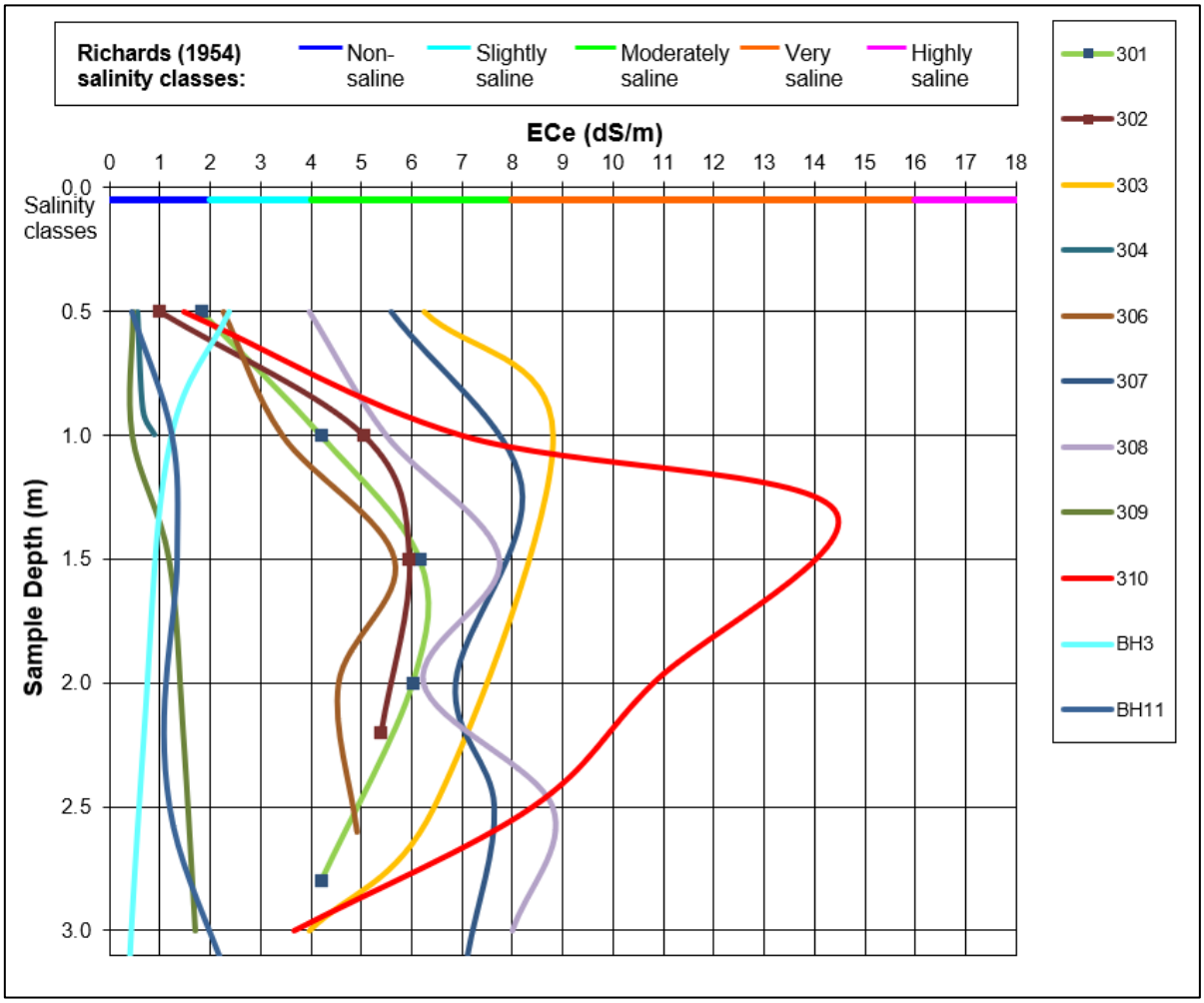

Figure 6: Vertical Salinity Profiles and Salinity Classes

5.4.1 Aggressivity to Steel

The results of the testing indicate that 51% of the samples tested were non-aggressive, 44% were mildly aggressive and 5% were moderately aggressive to steel based on resistivity values (AS 2159). In addition to resistivity, pH and chloride are causes of aggressivity to steel however all of the pH and chloride concentrations tested were non-aggressive to steel.

The worst case results for aggressivity to concrete for each test location are shown on Drawing 7 (Appendix B).

5.4.2 Aggressivity to Concrete

The results of the testing indicate that 44% of the samples tested were non-aggressive, 53% were mildly aggressive and 3% were moderately aggressive to concrete based on pH values (AS 2159). In addition to pH, sulfate is also a cause of aggressivity to concrete however all of the sulfate concentrations tested were non-aggressive to concrete.

The worst case results for aggressivity to concrete for each test location are shown on Drawing 8 (Appendix B).

5.4.3 Soil Salinity

The results of the testing indicate that 35% of the samples tested were non-saline, 27% were slightly saline, 32% were moderately saline and 6% were very saline. aggressive to concrete based on pH values (AS 2159). Figure 6 indicates that maximum salinity typically occurred between 1 – 2 m depths.

5.4.4 Sodicity and Dispersibility

Ten sodicity tests were undertaken and the results show mostly highly sodic soils (6 of the 10 samples), some sodic samples (3 of the 10 samples) and one non sodic samples. Highly sodic soils indicate a high potential for erodibility when left exposed.

Dispersion potentials, tested at depths of 0.5 – 1.5 m by the Emerson Crumb Test (refer Summary Table, Appendix D), were determined to be Class 2 (partial dispersion) and would have a high potential for erosion.

5.4.5 Groundwater Salinity

The results indicate that the groundwater within the site, compared to Hazelton and Murphy (Interpreting Soil Test Results, Table 5.35 *Classification of Saline Waters*, 2007) is very saline.

6. Salinity Assessment Incorporating EM Results

The DLWC salinity investigation guideline allows for a reduction in the density of test locations and the number of laboratory tests, when an EM investigation is carried out and the ECa results are correlated with the laboratory ECe results, enabling interpolation of data throughout the EM survey area at the high spatial density of that data.

The Dualem 42s measures the apparent bulk conductivity (ECa) of the subsurface, which is a cumulative response from approximately 0 – 4 m depth. The Dualem 42s sensitivity varies significantly with depth; with a maximum sensitivity at a depth of about 1 m which decreases to approximately 50% sensitivity at a depth of about 3 m. Given that many of the maximum salinity values in the test pits occurred at depths around 1.0 m – 1.5 m, where the Dualem 42s sensitivity is relatively higher than at greater depths, correlation with the maximum test pit salinities (ECe) was considered the appropriate.

To carry out the required correlations, the apparent conductivity (ECa) values from the 4 m coil separation, horizontal co-planar coil geometry collected using the Dualem 42s (expected to be sensitive to conductivity variations in the subsurface at depths ranging from 0 – 4 m depth, approximately), were extracted from the gridded line data at the test pit locations and the ECa values were plotted in a scattergram (Figure 7, below) against maximum salinity (ECe) values from test pits 302 - 310. A Reasonable linear trend between these parameters (correlation coefficient of 0.82) indicates that the

EM system is responding to soil salinity and that the EM data obtained provides a reasonable measure of the site salinity.

The line of best fit defines the ECe/ECa trend and provides an equation by which to convert apparent conductivities (ECa in mS/m), to estimate apparent maximum salinities (ECe in dS/m) throughout the data set.

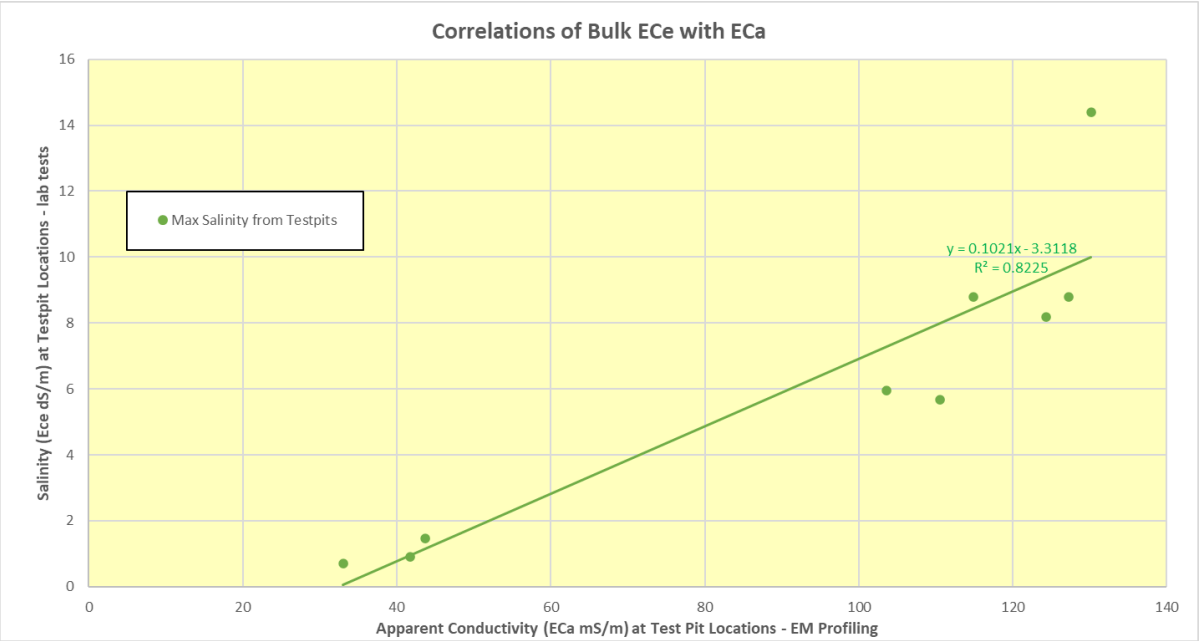

Figure 7: Correlation of apparent conductivity (ECa from EM profiling) with maximum salinity ECe from Testpits 302 – 310.

The correlation equation (of linear form: ECe = gradient x ECa - C) shown in Figure 7 above was applied to apparent conductivity gridded data for presentation as ECe salinity maps (Drawing 4, Appendix B) with continuous colour spectral scales in dS/m and at key depth ranges. The 2D-images were also contoured at 2 dS/m and 4 dS/m, and 8 dS/m, corresponding to boundaries of the salinity classes of Richards 1954, providing a direct subdivision of the study area into non-saline (< 2 dS/m), slightly saline (2 - 4 dS/m), moderately saline (4 - 8 dS/m) and very saline shown in yellow-red-white (8 - 16 dS/m) classes.

The resulting Salinity Map (Drawing 4, Appendix B) is considered likely to be most useful when attempting to categorise areas based on the likely maximum salinities to be encountered at depths from approximately 0 m – 3 m. However, it is noted that the instrument is significantly less sensitive at the deeper end of this range and is also more sensitive to thicker salinity affected soil layers. The instrument is also sensitive to other variables such as clay and moisture content of soils. Therefore, it is considered likely that maximum salinities which are significantly higher (or lower) than those indicated by the Salinity Map may occur in some areas.

As shown in Drawing 4, Appendix B, ECe salinities indicate very-saline conditions broadly occur along existing low lying areas and adjacent to water courses. This appears broadly consistent with the analytical results collected from the same test pits. Slightly to moderately saline conditions occur

throughout most of the investigated areas. Non-saline conditions are typically seen along the low ridgelines however this is not consistent along all ridges.

7. Impacts on the Proposed Development

7.1 Soils

The proposed urban development of the city centre will include bulk earthworks, construction of roads, buildings, water quality basins and services. Preliminary bulk earthworks plans indicate that cut and fill of up to approximately 3 m is proposed. Typically cut depths are less than 1.5 m with a minor area in the central western portion of the site reaching up to 3 m depths. The plans indicate that cut volumes of about 138,000 m^3 and fill volumes of about 507,000 m^3 are proposed resulting in an import volume of about 369,000 m^3 being required.

The mild and moderate aggressivity to concrete and steel, the presence of moderately saline and very saline and highly sodic soils are naturally occurring features of the local landscape and are not considered significant constraints to the proposed development, provided appropriate management techniques are employed.

Salinity and aggressivity affects the durability of concrete and steel by causing premature breakdown of concrete and corrosion of steel. This has impacts on the durability of structures (ie concrete and steel) in contact with these materials. Salinity also affects the ability of various vegetation to grow, particularly in riparian areas. As a result, management strategies will be required as detailed in Section 8.

Sodic soils have low permeability due to infilling of interstices with fine clay particles during the weathering process, restricting infiltration of surface water and potentially creating perched water tables, seepage in cut faces or ponding of water in flat open areas. In addition, sodic soils tend to erode when exposed. Management of sodic soils is therefore required to prevent these adverse effects. Management of sodic soils will be focused on maintaining surface cover as detailed in Section 8.

7.2 Groundwater

It is understood that a series of water quality basins are proposed along the Moore Gully creek line where shallow, very saline groundwater is present. The very saline groundwater encountered could be of concern to the proposed development in relation to infrastructure, local erosion and plant growth.

Very saline groundwater was encountered at depths as shallow as 1.7 m bgl within the boreholes, though it is noted that the groundwater levels closely matched the water levels noted at the surface in Moore Gully indicating that the groundwater and surface water are in connection. As a result there are likely other areas with shallow groundwater present.

Shallow saline groundwater can affect stormwater detention and management systems in two ways depending on the design levels relative to the groundwater level:

1. Where the groundwater table is above the design level, there will be seepage from the groundwater into the basins. This may reduce result in an increase in salinity in the basins during low flow periods (conversely, inflowing saline groundwater will be diluted in periods of rainfall).

2. Where a saline water table is near the surface but below the design level of a detention basin, then infiltration of water from the basin into the groundwater table may locally elevate the groundwater table bringing the saline water closer to the surface. As a result there may be impact on vegetation and/or infrastructure.

Both of these scenarios can be managed by good engineering practice and appropriate landscape design (i.e. using salt tolerant species and the use of an impermeable liner which would minimise the changes to the groundwater levels). Further assessment of the impact of the saline groundwater system should be undertaken at the detailed design phase of the project.

8. Preliminary Salinity Management Plan

8.1 General

The management plans given in the following sections are based on the results of testing carried out on the site. It is noted that the mapping and testing has been carried out on a broad scale and specific investigations are recommended for individual development sites within the Bradfield City Centre to provide more specific recommendations.

8.2 Bulk Earthworks

The following management strategies are designed to minimise potential to impact on the bulk earthworks aspects of the development.

A. When possible placement of excavated soils in fill areas with similar salinity characteristics (ie: to place material on to in-situ soils with a similar or higher aggressivity or salinity classification). Where this is not possible or not tracked, all fill areas should be treated as moderately aggressive to concrete and steel and moderately saline. Particular care should be take if cutting from areas mapped as very saline. In general the very saline areas are existing low-lying areas and near waterways which are proposed to be filled as shown in the provided bulk earthworks plans. The provided plans do not include the whole site and DP should review the plans are they are developed to confirm that any cut material from very saline areas is placed in existing very saline areas.

B. As the site will end up being primarily filled using imported material, testing should be undertaken prior to importation, to determine the salinity characteristics of the material. It is recommended that non-aggressive and non-saline to slightly saline soils be selected where possible but in any case, imported material should not be more aggressive or more saline than the material on which it is to be placed.

C. Management of sodicity should focus on capping of the upper surface of the sodic soils, both exposed by excavation and placed as filling, with a more permeable material (such as vegetated topsoil) to prevent ponding, to reduce capillary rise, to act as a drainage layer and to reduce the potential for erosion.

D. Sodic soils can also be managed by maintaining vegetation where possible and planting new salt tolerant species. The addition of organic matter, gypsum and lime can also be considered where appropriate. After gypsum addition, reduction of sodicity levels may require some time for sufficient infiltration and leaching of sodium into the subsoils, however capping of exposed sodic material

should remain the primary management method. Topsoil added at the completion of bulk earthworks is, in effect, also adding organic matter which may help infiltration and leaching of sodium.

E. Avoiding water collecting in low lying areas, in depressions, or behind fill. This can lead to water logging of the soils, evaporative concentration of salts, and eventual breakdown in soil structure resulting in accelerated erosion.

F. Surface drains should generally be provided along the top of batter slopes to reduce the potential for concentrated flows of water down slopes possibly causing scour.

G. Salt tolerant grasses and trees should be considered for landscaping, to reduce soil erosion as in Strategy A above and to maintain the existing evapo – transpiration and groundwater levels. Reference should be made to an experienced landscape planner or agronomist.

H. Management of groundwater should include capping of the upper surface with an impermeable layer for proposed waterways and basins to minimise interactions with the very saline groundwater.

8.3 Civil Construction and Service Installation

The following additional strategies are recommended for completion of service installation including but not limited to; roads, drainage and services. These strategies should be complementary to standard good building practices, including cover to reinforcement within concrete. As previously these requirements will be refined in a future salinity management plan undertaken prior to development application.

I. Any pavements should be designed to be well drained of surface water. There should not be excessive concentrations of runoff or ponding that would lead to waterlogging of the pavement or additional recharge to the groundwater through any more permeable zones in the underlying filling material.

J. Aggressivity results indicate soils that are mildly to moderately aggressive to concrete (refer Drawing 8, Appendix B) and non-saline to very saline (refer Drawings 4 and 6, Appendix B). For these areas of the site, the durability requirements provided in Tables 5 and 6 should be taken into account by the designer.

Table 5 – Recommended Durability Requirements for Concrete Structures

Site Salinity Classification	Site Soil Aggressivity to Concrete Classification	Recommended Durability Requirement (as per AS3600)		
		Minimum Concrete Strength (MPa)	Minimum Cover to Reinforcement (mm)	Minimum Cure Time (days)
Non-saline to Slightly Saline	Non-aggressive Soils	20	45	3
	Mildly Aggressive Soils	25		
	Moderately Aggressive Soils	32		7
Moderately Saline	Non-aggressive Soils	25	45	3
	Mildly Aggressive Soils			
	Moderately Aggressive Soils	32		7
Very Saline	Non-aggressive Soils	32	50	7
	Mildly Aggressive Soils			
	Moderately Aggressive Soils			

Table 6: Recommended Durability Requirements for Concrete Piles

Concrete Aggressivity (Refer Drawing 8)	Recommended Durability Requirement (as per AS2159)	
	Minimum Concrete Strength (MPa)	Minimum Cover to Reinforcement (mm)
Non Aggressive	32	45
Mildly Aggressive	32	60
Moderately Aggressive	40	65

K. Wet cast concrete pipes and currently manufactured spun concrete pipes are understood to have estimated compressive strengths of 50 MPa and 60 to 70 MPa, respectively, in excess of the requirements for mass concrete in J above. Reference to the maximum and minimum test results of Table 3 (Section 5 of this report) and to Tables E1 and 3.1 of AS 4058 – 2007 “Precast concrete pipes” indicates that the site falls within the AS 4058 Clay/Stagnant (low sulphate) soil type (chlorides ≤20 000 ppm, pH≥4.5 and sulphates ≤1000 ppm) and (in the absence of tidal water flow) falls within the AS 4058 Normal durability environment. Under these conditions, AS 4058 – compliant reinforced concrete pipes of general purpose Portland cement, with a minimum cover to reinforcement of 10 mm, are expected to have a design life in excess of

100 years. Any concrete pipes installed within the site should employ AS 4058 – compliant steel reinforced pipes of general purpose Portland cement, with minimum cover to reinforcement of 10 mm, or should be fibre reinforced.

L. Any future installation of concrete pipes up to a maximum diameter of 750 mm, within the Site, should employ fibre reinforced cement. Alternatively, concrete pipes in these areas should be encased in outer PVC conduits or should have a minimum equivalent strength as defined in J and K above.

M. Concrete pipes with a larger diameter than 750 mm should utilise sulphate resistant cement.

N. Resistivity results indicate soils that are aggressive to steel (Drawing 7, Appendix B). This drawing identifies mild aggressivity to steel (1000 – 2000 Ohm-cm) and moderate aggressivity steel (<1000 Ohm-cm) over the Site. For these areas of soil identified as mildly and moderately aggressive to steel, the following corrosion allowances (as per AS 2159 – 2009) should be taken into account by the designer:

- Mild: uniform corrosion allowance 0.01 – 0.02 mm/year;
- Moderate: uniform corrosion allowance 0.02 – 0.04 mm/year.

In instances where a coating is applied to the pile, if the design life of the pile is greater than the design life for the coating, consideration must be given to corrosion of the pile in accordance with the above list.

9. Conclusion

The salinity and aggressivity levels encountered in this investigation are typical of the region. Whilst the soil will require management it is considered that the strategies described herein when incorporated into the design and construction works are appropriate to mitigate the levels of salinity, aggressivity and sodicity identified at the site. Notwithstanding, additional assessments will be required as detailed design progresses including the following:

- Specific assessment of surface water to monitor changes in salinity with rainfall
- Assessment of the interaction of the proposed stormwater infrastructure and the saline groundwater system when design levels, locations and types (ie dry basins, wet basins, infiltration basins etc) have been determined.
- Additional detailed salinity assessments following the completion of bulk earthworks to provide more detailed spatial mapping and specific advice for individual developments.

10. References

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8. Standards Australia 1995, AS2159 – 2009 *Piling Design and Installation.*

9. Hazelton, P. A. and Murphy B. W. 2007, *Interpreting Soil Test Results* Department of Natural Resources

10. Standards Australia 2009, AS3600 - 2009 *Concrete Structures*

11. Standards Australia 2007, AS 4058 - 2007 *Precast Concrete Pipes*

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Badgerys Creek Road, Bradfield in accordance with DP's proposal dated 19 June 2023 and acceptance received from WPCA on 13 July 2023. The work was carried out under NSW Government General Conditions of Agreement. This report is provided for the exclusive use of Western Parkland City Authority for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

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Appendix A

About This Report

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

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

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

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections > 100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

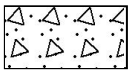
Symbols & Abbreviations

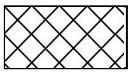
Graphic Symbols for Soil and Rock

General

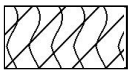

Asphalt

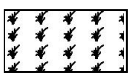

Road base

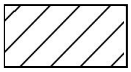

Concrete

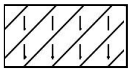

Filling

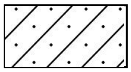
Soils


Topsoil

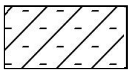

Peat

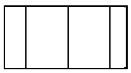

Clay

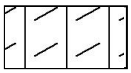

Silty clay

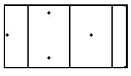

Sandy clay

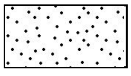

Gravelly clay

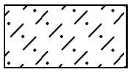

Shaly clay

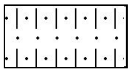

Silt


Clayey silt


Sandy silt

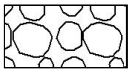

Sand

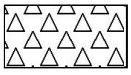

Clayey sand


Silty sand


Gravel

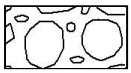

Sandy gravel


Cobbles, boulders

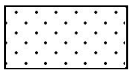

Talus

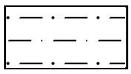
Sedimentary Rocks

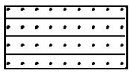

Boulder conglomerate

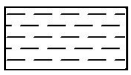

Conglomerate


Conglomeratic sandstone

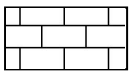

Sandstone


Siltstone

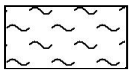

Laminite

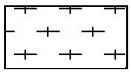

Mudstone, claystone, shale

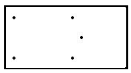

Coal


Limestone

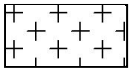
Metamorphic Rocks

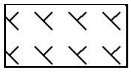

Slate, phyllite, schist

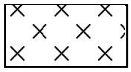

Gneiss

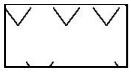

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawings 1 – 8

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Locality**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

N
MGA

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 1
REVISION: 0
SCALE: As Shown

BADGERYS CREEK ROAD

MOORE GULLY

THOMPSONS CREEK

Legend

- Site boundary
- Native Vegetation Zones
- Metro Station Site
- AMRF Building 1 Construction Site

0 100 200 300 400 m

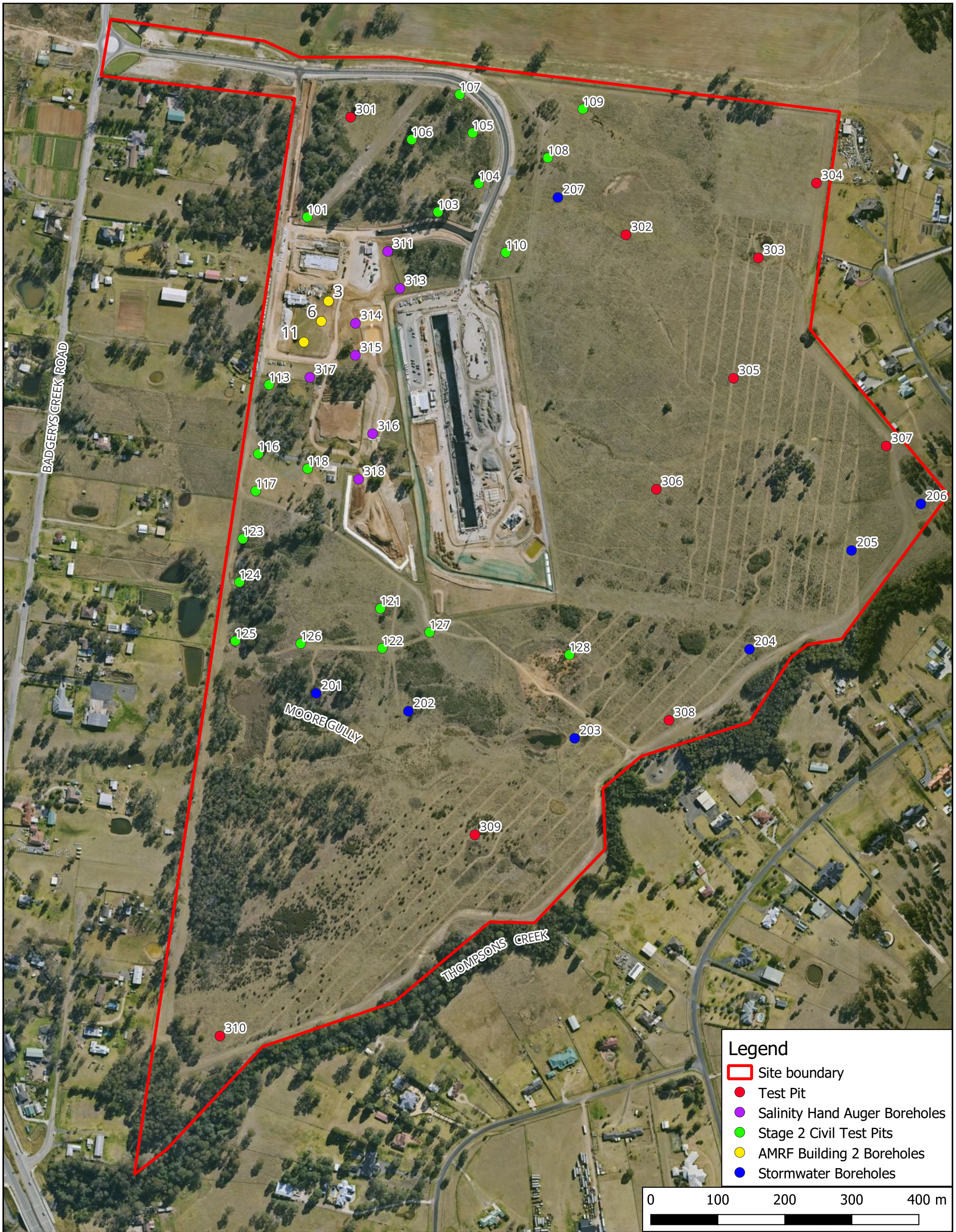
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Site Overview**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

N
MGA

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 2
REVISION: 0
SCALE: As Shown

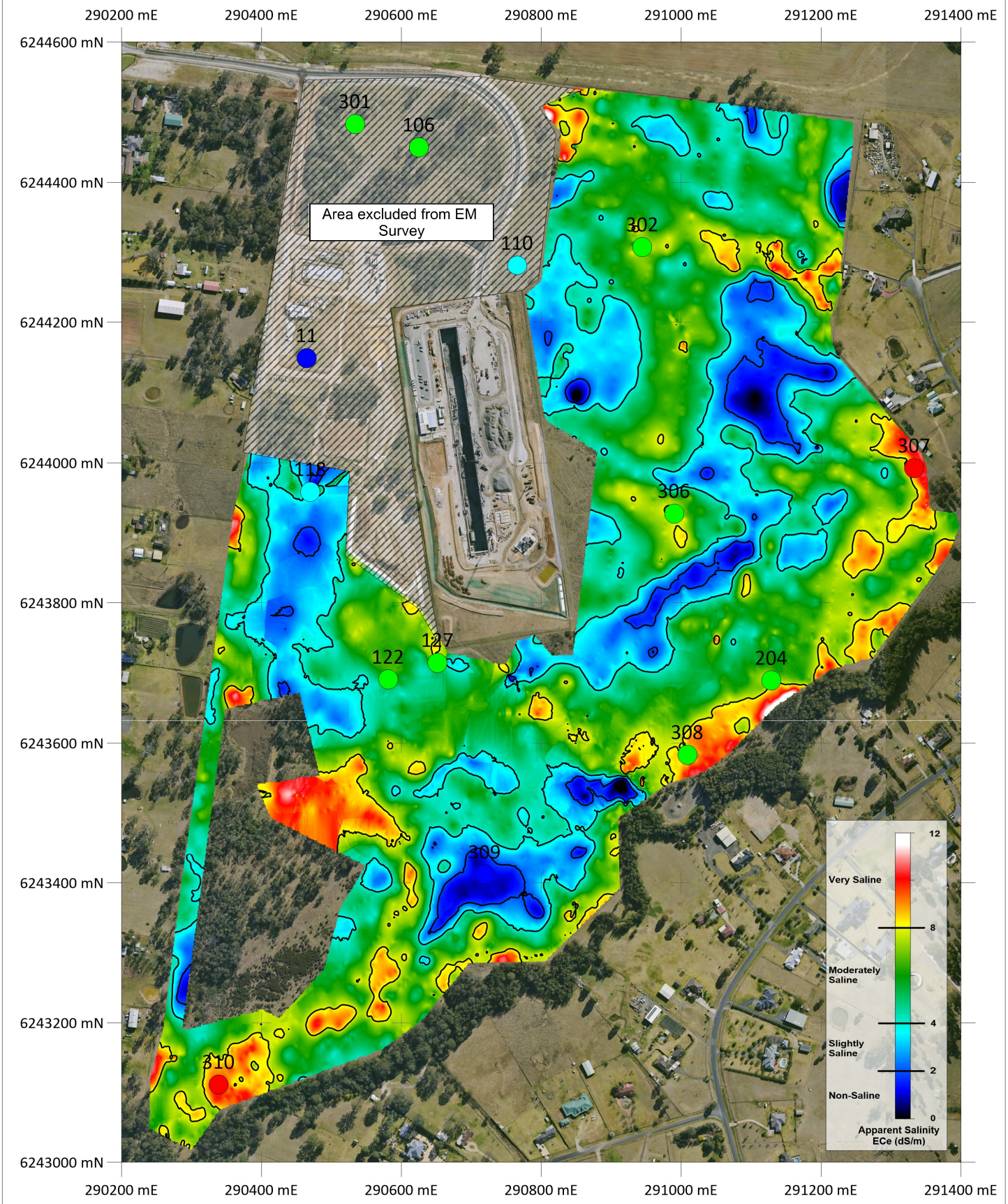


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Location Plan**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 3
REVISION: 0
SCALE: As Shown



Legend

- Testpit/Borehole where Maximum salinity was <2 dS/m (non saline)
- Testpit where Maximum salinity was 2 - 4 dS/m (slightly saline)
- Testpit where Maximum salinity was 4 - 8 dS/m (moderately saline)
- Testpit where Maximum salinity was 8 - 16 dS/m (very saline)

Scale

0 m 200 m 400 m 600 m 800 m

Datum: GDA2020 Projection: MGA2020 Zone 56

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Apparent Maximum Salinity From 0 m - 3 m Depth (approx.) From Dualem 42s (EM Induction) and Soil Sample Data Bradfield City Centre Bringelly, NSW**

N

OFFICE: Macarthur
DRAWN BY: JHH
DATE: 27 October 2023

CLIENT: Western Parkland City Authority | PROJECT No: 222630.00 | DRAWING No: 4 | REVISION: 0 | SCALE: As Shown

Legend

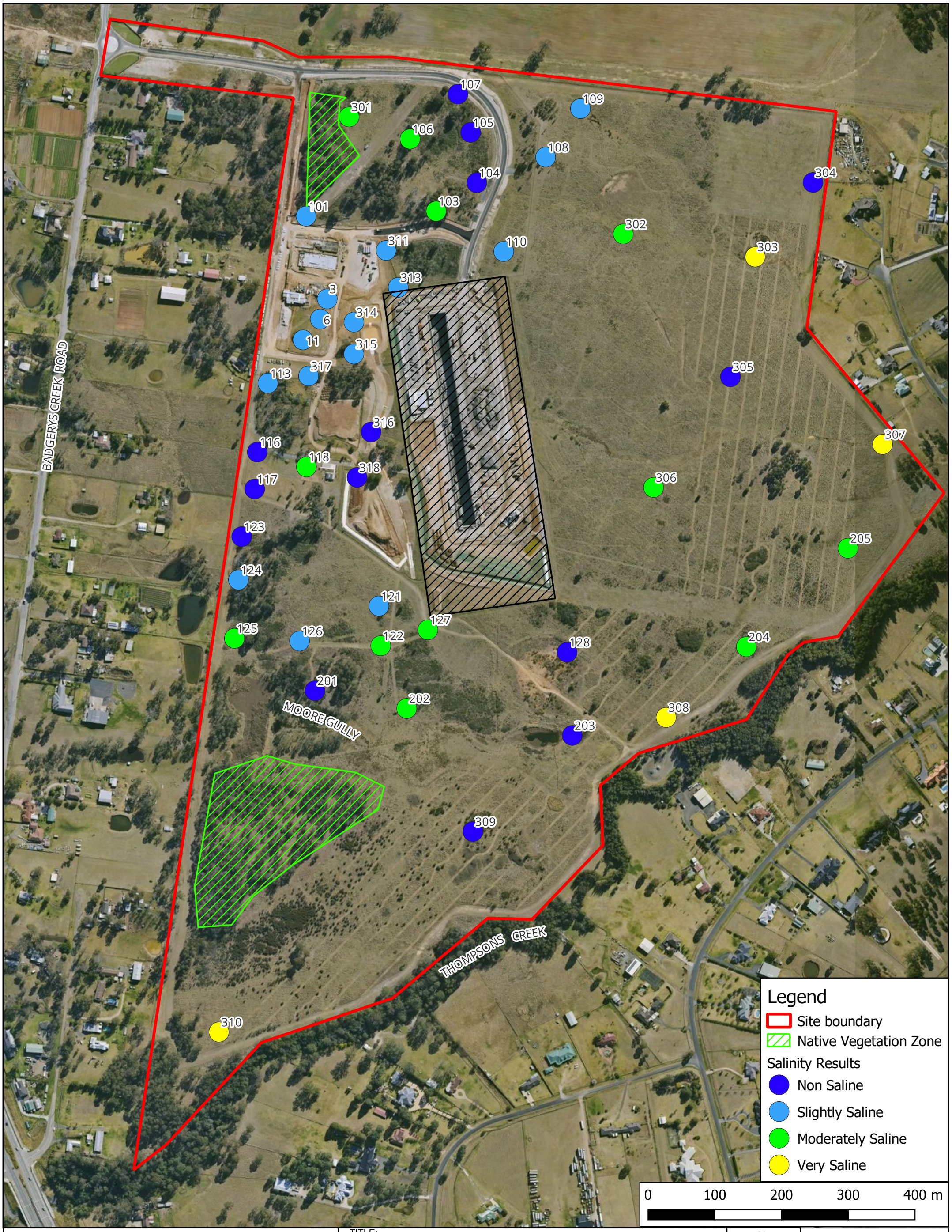
EM-induction conductivity instrument Data Coverage (post filtering)

Scale

0 m 200 m 400 m 600 m 800 m

Datum: GDA2020 Projection: MGA2020 Zone 56

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: **Data Coverage with Dualem 42s (EM Induction) Bradfield City Centre Bringelly, NSW**			OFFICE: Macarthur
				DRAWN BY: JHH
				DATE: 27 October 2023
CLIENT: Western Parkland City Authority	PROJECT No: 222630.00	DRAWING No: 5	REVISION: 0	SCALE: As Shown

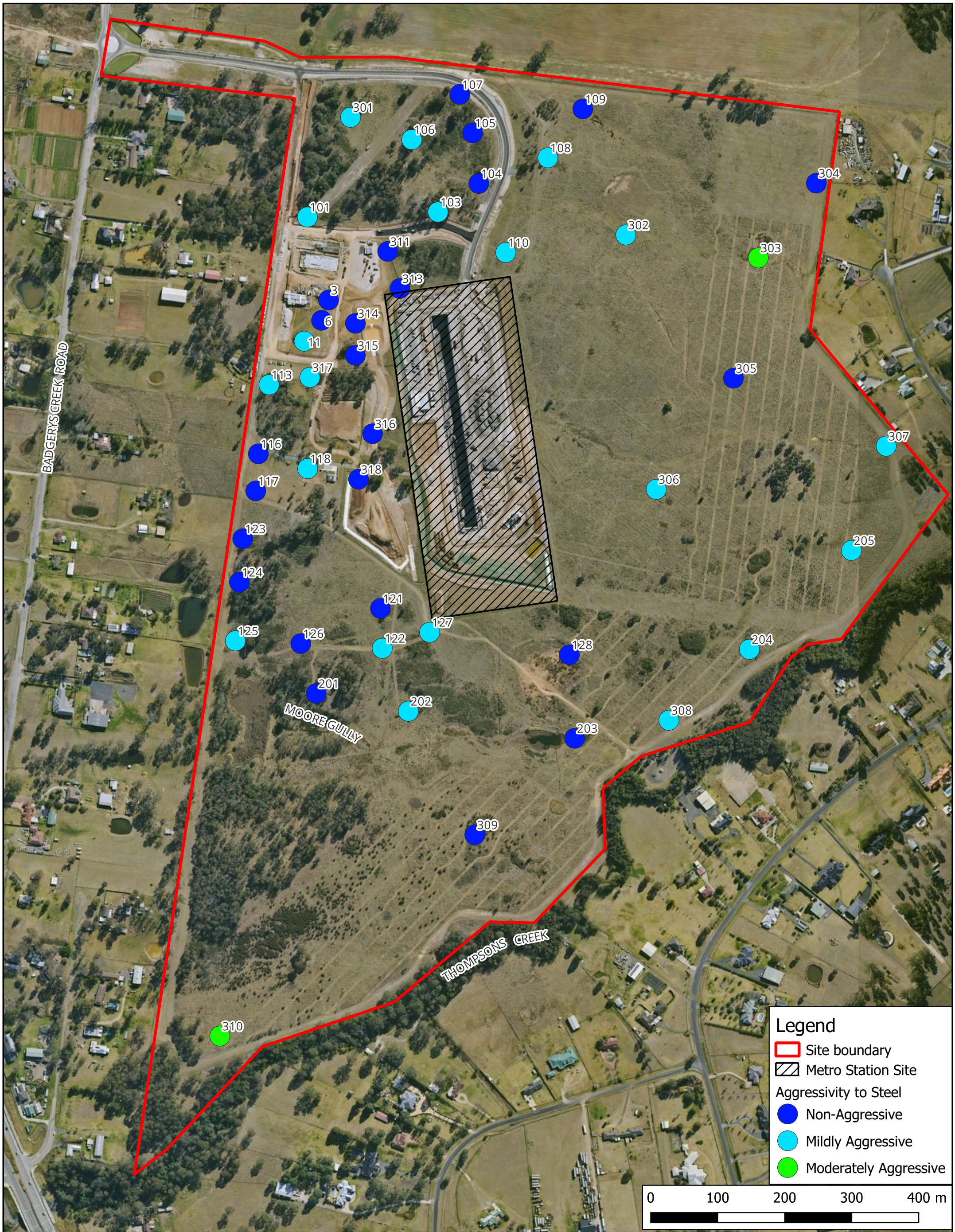


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Salinity at Test Locations**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. #: 222630.00
DRAWING No: 6
REVISION: 0
SCALE: As Shown

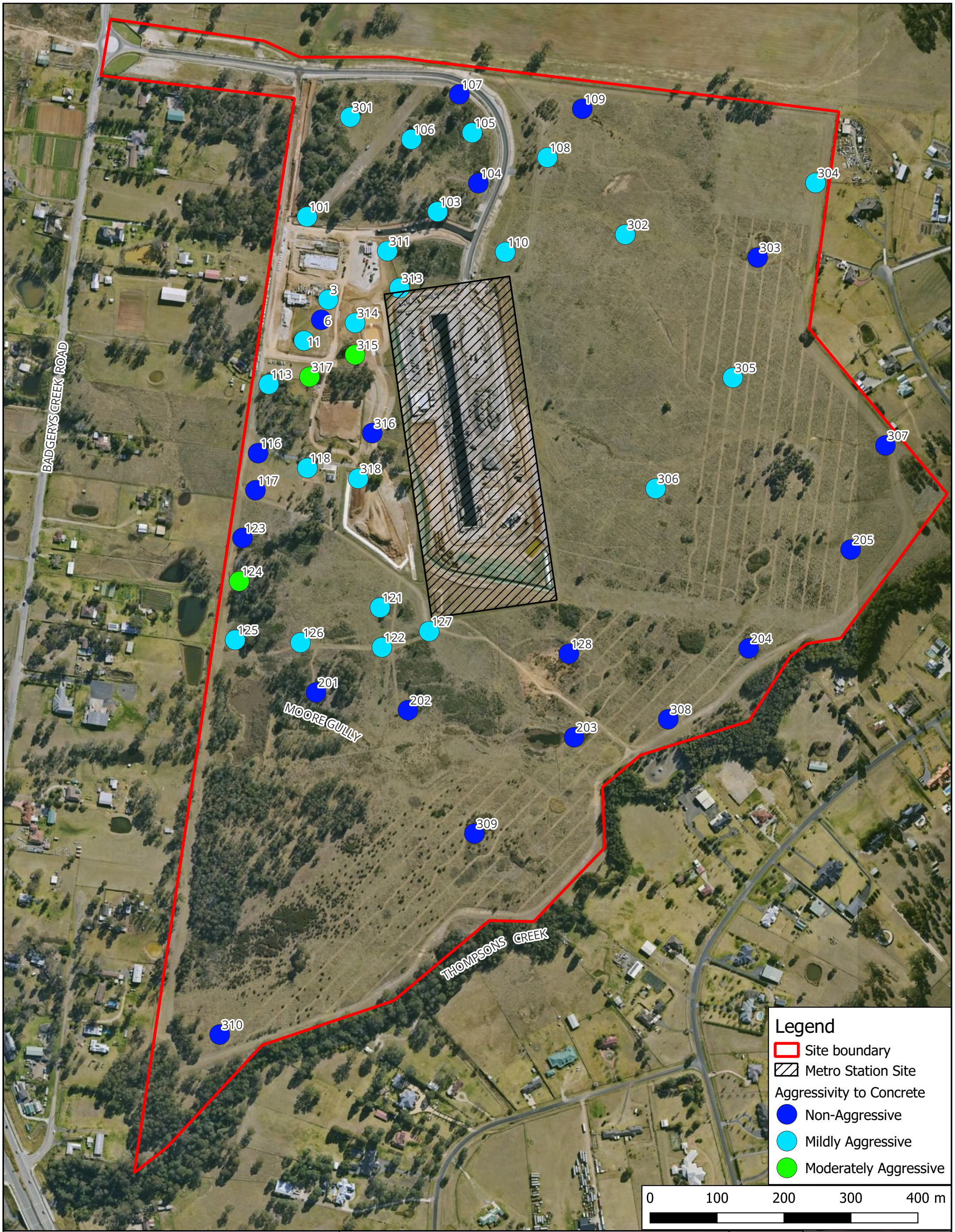


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Aggressivity to Steel**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. 222630.00
DRAWING No: 7
REVISION: 0
SCALE: As Shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Aggressivity to Concrete**
Bradfield City Centre Salinity Investigation
Badgerys Creek Road, Bringelly

OFFICE: Macarthur
DRAWN BY: ECR
DATE: 2.10.2023

CLIENT: Western Parkland City Authority
PROJ. 222630.00
DRAWING No: 8
REVISION: 0
SCALE: As Shown

Appendix C

Test Pit and Borehole Logs

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 78.3 mAHD
EASTING: 290501
NORTHING: 6244210
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
78	0.0	FILL/Silty CLAY CI-CH: medium to high plasticity, red-brown, trace gravel, w<PL							D			
									D			
									B			
									U_{50}			
	0.9	Silty CLAY CI-CH: medium to high plasticity, brown mottled pale grey, trace gravel, w<PL, stiff, residual							D			
77	1								S			3,4,6 N = 10
		Below 1.6m: grading to brown, very stiff										
	2											
	2.15	SHALE: brown, very low strength, Bringelly Shale							S			11,22/150mm refusal
76	2.9	SHALE: brown, laminated, interbedded with thin sandstone bands, low strength, highly weathered, Bringelly Shale						2.96-3.21m: Bx3, 1-3°, pl, cln	C	100	69	PL(A) = 0.22
	3							3.38-4.41m: Bx2, 5-10°, pl, cln				PL(A) = 0.19
		Between 3.5-4.9m: with thin, orange brown iron-indurated bands of medium or high strength						3.40-3.50m: J, 80°, pl, cln				PL(A) = 1
75								3.47m: J, 5-10°, ir, cln				
								3.52m: J, 35°, pl, cln				
	4							3.61-3.73m: Bx3, 1-5°, pl, cln				
								3.84-3.96m: Csx4, clay 1-8mm each				PL(A) = 0.22
74								4.08-4.19m: Bx2, 2-3°, pl, cln				
								4.31m: Ds 10mm				
								4.48&4.70: Bx2, 1-2°, pl, cln				
	5	Below 5.0m: grading to dark grey, reduced proportion of sandstone bands, with very low strength bands adjacent to decomposed seams, moderately weathered						4.81-4.90m: J, 60°, pl, cln				PL(A) = 0.17
								4.96m: B, 2-3°, pl, clay 2mm				
73								5.06-5.41m: Bx3, 2-3°, pl, cln				
								5.47m: Ds 5mm				
								5.56m: Ds 5mm				
								5.77m: Ds 10mm				
	5.82	Interbedded SANDSTONE and SILTSTONE (80:20): dark grey and pale grey, thinly bedded to laminated, fine grained sandstone, occasional bands of disturbed bedding, medium strength, slightly weathered, Bringelly Shale						5.8m: Ds 20mm				
	6											PL(A) = 0.37
72								6.47&6.76m: Bx2, 5-10°, pl, cln	C	100	84	
								6.90-7.02m: J, 60°, pl, ca co and fe vn				
	7							7.07-7.42m: Bx3, 2-3°, pl, clay 0-1mm				PL(A) = 0.49
71	7.42	SHALE: pale grey and dark grey, laminated to massive, with widely spaced zones of black carbonaceous shale, low strength, slightly weathered, Bringelly Shale						7.82m: J, 60°, pl, cln				

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 2.9m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 2.9m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 78.3 mAHD
EASTING: 290501
NORTHING: 6244210
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
70		SHALE: pale grey and dark grey, laminated to massive, with widely spaced zones of black carbonaceous shale, low strength, slightly weathered, Bringelly Shale *(continued)*							C	100	84	
								8.28-8.42m: Bx3, 2-3°, pl, clay 1-3mm 8.38m: Ds 20mm				PL(A) = 0.27
69	9							8.86-8.95m: Bx2, 1°, pl, cln 9.03-9.37m: Bx3, 1-3°, pl, clay 1mm				PL(A) = 0.27
								9.45m: J, 45°, pl, clay 5-10mm, fg	C	100	86	
68	10	Below 10.10m: medium strength						10.11-10.42m: Bx3, 1-5°, pl, cln				PL(A) = 0.44
								10.56m: B, 1°, pl, cln 10.7m: Ds 60mm 10.85m: B, 15°, pl, cln 11.02-11.39m: Bx3, cu, cln				
67	11											
	11.8	Interbedded SHALE and SANDSTONE (70:30): dark grey and pale grey, thinly laminated shale and fine grained sandstone, occasional zones of disturbed bedding and rounded shale clasts, medium strength, fresh, Bringelly Shale						11.57-11.78m: Bx4, 5-15°, pl, clay 0-3mm 11.62m: Ds 10mm 11.7m: Ds 10mm				PL(A) = 1.1 PL(A) = 0.46
66	12							12.14-12.57m: Bx5, 2-3°, pl, clay 0-1mm	C	100	89	PL(A) = 0.86
								12.72-12.90m: Bx3, 0-3°, pl, cln				
65	13							13.02-13.25m: Bx4, 0-5°, pl, cln 13.40&13.58m: B, 10°, pl, cln				PL(A) = 0.54
64	14							13.98m: Ds 20mm 14.00-14.66m: Bx5, 1-5°, pl, cln	C	100	95	PL(A) = 0.74
63	15	15.0 Bore discontinued at 15.0m - limit of investigation										

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 2.9m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 2.9m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 3 PROJECT: BRADFIELD AUGUST 2023

2.9m-7m

BORE: 3 PROJECT: BRADFIELD AUGUST 2023

7m-12m

BORE: 3 PROJECT: BRADFIELD AUGUST 2023

12m-15m

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 78.2 mAHD
EASTING: 290490
NORTHING: 6244180
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 222630.00
DATE: 4/8/2023
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
78		FILL/Silty CLAY CL-CI: low to medium plasticity, brown, trace gravel, w<PL							D			
									D			
	0.6	Silty CLAY CI-CH: medium to high plasticity, brown, trace gravel, w<PL, stiff, residual										
77	1								D			
	1.2	Silty CLAY CI-CH: medium to high plasticity, orange-brown and pale grey, trace ironstone gravel, w<PL, stiff, residual							S			4,6,6 N = 12
76	2											
	2.5											
	2.65	Silty CLAY CI: medium plasticity, orange-brown with red-brown mottling, with highly weathered and extremely weathered bands, w<PL, hard, residual							S			10,26/150mm refusal
75	3	Interbedded SANDSTONE and SHALE (50:50): grey-brown and dark orange-brown, thinly bedded to laminated, fine grained sandstone, occasional iron stained zones, low strength, moderately weathered, Bringelly Shale						3.40-3.79m: Bx6, 1-5°, pl, clay 0-2mm				PL(A) = 0.27
								4.02-4.45m: Bx7, 0-3°, pl, clay 0-4mm	C	100	36	PL(A) = 0.14
74	4							4.49-4.81m: Bx6, 2-3°, pl, clay 0-3mm 4.49-4.55m: J, 85°, un, fe vn 4.72m: Ds 30mm				
		Between 4.65-5.60m: with medium strength and very low strength bands, increased proportion of shale (~80%), highly weathered						5.04m: B, 5°, pl, cln 5.11-5.24m: J, 70°, pl, fe				
73	5							5.29-5.32m: Bx2, 5-10°, pl, cln 5.32m: Ds 20m	C	100	30	
	5.6	SANDSTONE: pale grey, fine grained, thinly bedded, with occasional siltstone laminations and bands, medium strength, slightly weathered, Bringelly Shale						5.35m: B, 0-10°, cu, cln 5.56m: B, 5°, pl, cln 5.85m: B, 3°, pl, cln				PL(A) = 0.29
72	6											PL(A) = 0.55
								6.62-6.84m: Bx3, 1-2°, pl, fe	C	100	95	
71	7	Below 7.02m: high strength						7.02-7.18m: Bx2, 2-3°, pl, cln				PL(A) = 1.2
	7.73							7.57m: B, 5°, pl, cln 7.78m: B, 2°, pl, clay 1mm				PL(A) = 0.15

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 3.4m

TYPE OF BORING: SFA to 2.5m, wash boring to 3.4m, NMLC coring to 10.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 78.2 mAHD
EASTING: 290490
NORTHING: 6244180
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 222630.00
DATE: 4/8/2023
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
70		SHALE: dark grey, laminated, low and medium strength with occasional lower strength zones, slightly weathered, Bringelly Shale *(continued)*							C	100	95	
								8.38-8.42m: Bx4, 5-10°, pl, cln				
								8.78m: B, 2°, pl, clay 1mm				
69	9							9.19-9.44m: Bx2, 2-5°, pl, cln	C	100	93	PL(A) = 0.16
								9.55m: B, 5°, pl, clay 1mm				
								9.6m: Ds 5mm				
								9.65m: Cs 70mm				
								9.88m: Cs 20mm				
68	10							10.09m: B, 0°, pl, clay				
	10.25	Bore discontinued at 10.25m - limit of investigation						10.25m: B, 0°, cln				
67	11											
66	12											
65	13											
64	14											
63	15											

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 3.4m

TYPE OF BORING: SFA to 2.5m, wash boring to 3.4m, NMLC coring to 10.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 6 PROJECT: BRADFIELD AUGUST 2023

3.4m-7m

BORE: 6 PROJECT: BRADFIELD AUGUST 2023

7m-10.4m

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 80.4 mAHD
EASTING: 290465
NORTHING: 6244149
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 222630.00
DATE: 17/8/2023
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
80	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							D			
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace gravel, w<PL, stiff, residual							D			
79	1	Below 1.3m: grading to pale grey							D S			2,4,7 N = 11
									D U_{50}			
78	2.3	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled pale brown, with extremely weathered shale bands, w<PL, very stiff, residual							S			6,12,17 N = 29
77	3.2	SHALE: brown, laminated, very low strength, Bringelly Shale										
	3.5	SHALE: grey-brown with bands of orange and grey, laminated, very low strength with bands of low strength, highly weathered, Bringelly Shale						3.5m: Cs 50mm 3.61-3.72m: Bx3, 0-5°, pl, clay vn 3.8m: Ds 50mm 3.85m: J, 90°, ir, cln 4.21m: J, 30°, ir, clay vn, fg 4.42m: Ds 40mm	C	100	73	PL(A) = 0.16 PL(A) = 0.07
76	4.6	Interbedded SANDSTONE and SHALE (50:50): grey-brown, grey and orange-brown, laminated to thinly bedded, fine grained sand, with carbonaceous laminations in upper 0.4m, occasional iron indurated, stained or cemented zones, low then medium strength, highly to moderately weathered, Bringelly Shale						4.81-4.89m: Bx2, 10-15°, pl, cln 4.97m: J, 70°, pl, cln 5.09-5.18m: Bx2, 0-10°, pl, fe vn 5.31m: J, 30°, pl, clay vn 5.43-5.75m: Bx4, 0-10°, pl, fe stn 5.95-6.32m: Bx4, 10°, pl, fe stn 6.18m: J, 60°, pl, fe, ti				PL(A) = 0.43 PL(A) = 0.3
75		Between 6.40-7.40m: increased proportion of shale (~90%), grading to slightly weathered						6.71m: Ds 10mm 6.96-7.20m: Bx2, 5-10°, pl, cln 7.28&7.64m: Bx2, 10°, pl, cln 7.3m: J, 30°, pl, cln	C	100	97	PL(A) = 0.3 PL(A) = 0.32 PL(A) = 0.63
74	7											
73												

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 3.5m

TYPE OF BORING: SFA to 3.5m, NMLC coring to 10.00m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56. Drilled adjacent to a stockpile within a site works compound

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 80.4 mAHD
EASTING: 290465
NORTHING: 6244149
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 222630.00
DATE: 17/8/2023
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
72		Interbedded SANDSTONE and SHALE (50:50): as previous							C	100	97	
								8.65m: J, 15°, pl,cln 8.75-9.31m: Bx6, 10°, pl, cln				PL(A) = 0.49
71	9 9.02	SHALE: dark grey, laminated, low strength, fresh, Bringelly Shale						9.18m: J, 20°, un, cln	C	100	100	PL(A) = 0.26
70	10 10.0	Bore discontinued at 10.0m - target depth reached										
69	11											
68	12											
67	13											
66	14											
65	15											

RIG: Explora 140 **DRILLER:** Ground Test (Steve) **LOGGED:** EJ/HDS **CASING:** HW to 2.5m, HQ to 3.5m

TYPE OF BORING: SFA to 3.5m, NMLC coring to 10.00m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA2020 Zone 56. Drilled adjacent to a stockpile within a site works compound

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 11 PROJECT: BRADFIELD AUGUST 2023

3.5m-8m

BORE: 11 PROJECT: BRADFIELD AUGUST 2023

8m-10m

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 81.3 mAHD
EASTING: 290469
NORTHING: 6244334

PIT No: 101
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
81	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D	0.5				
80	1	Below 0.9m: grading into extremely weathered shale, very stiff, with highly weathered low strength bands		D	1.0				
	1.5	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale		D	1.5				
79	2			D	2.0				
	2.5	Pit discontinued at 2.5m - refusal on low to medium strength shale							
78	3								
77	4								
76	5								
75	6								
74	7								
73	8								
72	9								
71	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.2 mAHD
EASTING: 290664
NORTHING: 6244342

PIT No: 103
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.3				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, w<PL, very stiff, residual		D/B	0.6				
	0.7	Below 0.4m: grading to pale grey, very stiff							
75	1	Below 0.6m: grading into extremely weathered shale, very stiff, with low strength, highly weathered bands							
	1.3	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale			1.3				
		Pit discontinued at 1.3m - refusal on low to medium strength shale							
74	2								
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.0 mAHD
EASTING: 290725
NORTHING: 6244384

PIT No: 104
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
73	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<<PL		D/B	0.5				
72	1	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual Below 0.8m: trace ironstone, very stiff		D	1.0				
		Below 1.4m: grading to pale grey, with extremely weathered shale bands		D	1.5				
71	2	Below 1.9m: with low strength, highly weathered shale bands							
	2.2	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 2.2m - refusal on low to medium strength shale							
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.1 mAHD
EASTING: 290716
NORTHING: 6244460

PIT No: 105
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium strength, dark brown mottled red, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CL-CI: low to medium plasticity, red-brown mottled grey, trace rootlets, w<PL, residual		D	0.5				
75	1	Below 0.8m: grading to pale grey mottled red, with extremely weathered shale bands		D	1.0				
	1.5	Below 1.3m: grading to pale grey, with low strength, highly weathered shale bands		D	1.5				
74	2	SHALE: pale brown, very low to low strength, Bringelly Shale		D	2.0				
	2.8	Pit discontinued at 2.8m - refusal on low to medium strength shale		D	2.8				
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 79.7 mAHD
EASTING: 290625
NORTHING: 6244450

PIT No: 106
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
79	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D	0.5				
	1	Below 0.9m: grading into extremely weathered, hard, with		B	1.0				
	1.1	low strength, highly weathered bands		D					
78		SHALE: pale red-brown, low to medium strength, Bringelly Shale		D	1.5				
	1.9			D	1.9				
	2	Pit discontinued at 1.9m - refusal on low to medium strength shale							
77	3								
76	4								
75	5								
74	6								
73	7								
72	8								
71	9								
70	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.2 mAHD
EASTING: 290697
NORTHING: 6244517

PIT No: 107
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown mottled red, with fine gravel and rootlets, w<<PL		D	0.1				
	0.5	Silty CLAY CI-CH: medium to high plasticity, red and pale brown, trace rootlets, with extremely weathered shale, very stiff and low strength, highly weathered bands, residual		D	0.5				
75	1.1	SHALE: pale brown, medium strength, Bringelly Shale		D/B	1.1				
		Pit discontinued at 1.1m - refusal on medium strength shale							
74	2								
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 71.6 mAHD
EASTING: 290828
NORTHING: 6244423

PIT No: 108
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
71	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled grey, trace fine to coarse gravel and rootlets, w<PL, very stiff to hard, residual		D	0.5				
	1	Below 0.9m: extremely weathered shale bands, very stiff to hard		D/B	1.0				
70									
	2	Below 1.8m: grading to pale grey, with low strength, highly weathered shale band		D	2.0		pp = 440-450		
	2.1	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
69	3								
	3.3	Pit discontinued at 3.3m - target depth reached		D	3.3				
68	4								
67	5								
66	6								
65	7								
64	8								
63	9								
62	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.1 mAHD
EASTING: 290880
NORTHING: 6244496

PIT No: 109
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale brown, trace rootlets, w<PL, firm to stiff, residual		D	0.5				
68	1	Below 0.8m: grading to red-brown, trace fine to coarse ironstone gravel, stiff		D	1.0				
		Below 1.3m: grading to pale grey mottled red		D	1.5		pp = 190-200		
67	2	Below 1.9m: grading to pale grey, extremely weathered shale, with very low strength, highly weathered bands		D	2.0		pp = 230-260		
	2.3			D	2.3				
	2.5	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 2.5m - target depth reached							
66	3								
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.0 mAHD
EASTING: 290765
NORTHING: 6244281

PIT No: 110
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
73	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity dark and pale brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.5				
72	1	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual Below 0.8m: grading to pale grey, with extremely weathered shale, very stiff, with low strength, highly weathered shale bands		D/B	1.0				
	1.5			D	1.5		pp = 390		
71	2	SHALE: red and pale brown, low to medium strength, highly weathered, Bringelly Shale		D	2.0		pp = 290		
	2.3	Pit discontinued at 2.3m - refusal on low to medium strength shale		D	2.3				
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 82.1 mAHD
EASTING: 290412
NORTHING: 6244084

PIT No: 113
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
82	0.15	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
81	1	Below 0.7m: grading to pale grey mottled red, with extremely weathered shale bands, stiff, with low strength, highly weathered shale bands		D	1.0				
	1.8								
80	1.81 2	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale Pit discontinued at 1.81m - refusal on low to medium strength shale							
79	3								
78	4								
77	5								
76	6								
75	7								
74	8								
73	9								
72	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, test pit moved east (offset 3m)

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 77.3 mAHD
EASTING: 290396
NORTHING: 6243981

PIT No: 116
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0.3	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual		D/B	0.5				
	0.9			D	0.9				
76	1.0	Below 0.7m: extremely weathered shale bands, stiff to very stiff							
		SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
		Pit discontinued at 1.0m - refusal on medium strength shale							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, test pit near Telstra service (offset 10m)

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 75.5 mAHD
EASTING: 290392
NORTHING: 6243926

PIT No: 117
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
75	0.2	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, firm to stiff, residual		D/B	0.5				
	1	Below 0.9m: grading to pale brown mottled grey, extremely weathered shale, hard		D	1.0				
74		Below 1.3m: grading to pale grey, with low strength, highly weathered shale bands		D	1.5				
	2	SHALE: pale grey, low to medium strength, highly weathered, Bringelly Shale							
	2.2	Pit discontinued at 2.2m - refusal on medium strength shale		D	2.2				
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Heavy grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 77.5 mAHD
EASTING: 290470
NORTHING: 6243959

PIT No: 118
PROJECT No: 222630.00
DATE: 8/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL		D	0.1				
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
	1	Below 0.8m: grading to pale grey mottled red, stiff		D	1.0				
76		Below 1.3m: with extremely weathered shale bands, very stiff		D	1.5		pp = 290-310		
	1.7	SHALE: red-brown, low to medium strength, highly weathered, Bringelly Shale							
	1.9	Pit discontinued at 1.9m - refusal on low to medium strength shale							
75	2								
	3								
74									
	4								
73									
	5								
72									
	6								
71									
	7								
70									
	8								
69									
	9								
68									
	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 71.3 mAHD
EASTING: 290578
NORTHING: 6243750

PIT No: 121
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
71	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, with fine to coarse ironstone gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual		D/B	0.5				
	1			D/B	1.0				
70		Below 1.4m: with extremely weathered shale, with low strength, highly weathered shale		D	1.5				
	1.9								
	2	SHALE: pale brown, very low to low strength, highly weathered, Bringelly Shale		D	2.0				
69	2.3			D	2.3				
		Pit discontinued at 2.3m - refusal on medium strength shale							
	3								
68									
	4								
67									
	5								
66									
	6								
65									
	7								
64									
	8								
63									
	9								
62									
	10								
61									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.1 mAHD
EASTING: 290581
NORTHING: 6243691

PIT No: 122
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled grey, trace fine to coarse gravel and rootlets, w<PL, stiff to very stiff, residual		D/B	0.5				
68	1	Below 0.7m: grading to pale grey mottled red, firm to stiff		D	1.0				
		Below 1.4m: grading to grey, with extremely weathered shale bands, stiff to very stiff		D	1.5				
67	2			D	2.0		pp = 250-300		
					2.5		pp = 200-210		
	2.8			D	2.8				
66	2.9 3	SHALE: pale brown, low to medium strength, highly weathered, with very stiff clay bands, Bringelly Shale							
		Pit discontinued at 2.9m - refusal on low strength shale							
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly moist on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 74.4 mAHD
EASTING: 290373
NORTHING: 6243854

PIT No: 123
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
74	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, brown, trace ironstone gravel and rootlets, w<PL, very stiff, residual		D	0.5				
	0.8			B					
73	0.91	BASALT: dark brown and black, high strength, fractured		D	0.9				
		Pit discontinued at 0.91m - refusal on high strength igneous rock							
72	2								
71	3								
70	4								
69	5								
68	6								
67	7								
66	8								
65	9								
64	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly moist on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.1 mAHD
EASTING: 290368
NORTHING: 6243789

PIT No: 124
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
73	0.1	TOPSOIL/Silty CLAY CI: medium plasticity, pale and dark brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, very stiff, residual		D	0.5				
				B					
72	1	Below 0.8m: grading to pale grey, hard		D	1.0				
		Below 1.3m: extremely weathered shale bands, with low strength, highly weathered shale bands		D	1.3				
				D	1.5				
	1.6	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale							
71	1.9	Pit discontinued at 1.9m - refusal on medium strength shale							
70	3								
69	4								
68	5								
67	6								
66	7								
65	8								
64	9								
63	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover, slightly wet on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 68.4 mAHD
EASTING: 290362
NORTHING: 6243702

PIT No: 125
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
68	0.4	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, pale and dark brown, with fine to coarse gravel and rootlets, w<<PL		D/B	0.5				
		Silty CLAY CI-CH: medium to high plasticity, pale brown mottled red, trace ironstone gravel and rootlets, w<PL, stiff, residual		D	1.0				
67				D/B	1.5				
		Below 1.8m: grading to grey mottled red							
66	3.0	Below 2.9m: trace ironstone cobbles							
		Pit discontinued at 3.0m - limit of investigation							
65									
64									
63									
62									
61									
60									
59									
58									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Heavy grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 72.8 mAHD
EASTING: 290459
NORTHING: 6243698

PIT No: 126
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
72	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace fine to coarse gravel and rootlets, with highly weathered shale band, w<pl, stiff to very stiff, residual		D/B	0.5				
	0.7								
	0.9	SHALE: pale brown, low to medium strength, highly weathered, Bringelly Shale		D	0.9				
		Pit discontinued at 0.9m - refusal on medium strength shale							

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.4 mAHD
EASTING: 290652
NORTHING: 6243715

PIT No: 127
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
69	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown mottled red-brown, with rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual		D	0.5				
68	1	Below 0.9m: grading to pale grey, firm to stiff		D/B	1.0				
				D	1.5		pp = 190-200		
	2	Below 1.9m: with low strength, highly weathered shale bands		D	2.0		pp = 250		
67	2.4	SHALE: pale grey, low to medium strength, extremely weathered, Bringelly Shale		D	2.5				
	2.8	Pit discontinued at 2.8m - refusal on low to medium strength shale		D	2.8				
66	3								
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Trace grass on surface, surrounded by metal pipes sticking out of the ground

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.0 mAHD
EASTING: 290860
NORTHING: 6243681

PIT No: 128
PROJECT No: 222630.00
DATE: 9/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, red-brown, trace fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace ironstone gravel and rootlets, w<PL, stiff, residual		D	0.5				
64	1			B	1.0				
		Below 1.4m: grading to pale grey mottled pale brown		D	1.5				
63	2			D	1.9				
		Below 2.1m: with extremely weathered shale bands							
	2.4	Pit discontinued at 2.4m - refusal on very low to low strength shale		D	2.4				
62	3								
61	4								
60	5								
59	6								
58	7								
57	8								
56	9								
55	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Trace grass on surface, surrounded by metal pipes sticking out of the ground

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 68.1 mAHD
EASTING: 290482
NORTHING: 6243623
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details: stick-up
68	0.1	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL		D	0.1				backfill
		Silty CLAY CI: medium plasticity, brown, trace gravel, w<PL, hard, residual		D	0.5				casing
				B					
67	1			D	1.0		10,17,18 N = 35		bentonite
				S					
				D	1.45 1.5				
		Below 1.6m: grading to pale grey							
66	2								
	2.0	SHALE: pale grey, very low to low strength							
65	3	Below 3.0m: grading to low to medium strength							sand
64	4								screen
63	5								
	5.0	Bore discontinued at 5.0m - limit of investigation							
62	6								
61	7								
60	8								
59	9								
58	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.5 mAHD
EASTING: 290620
NORTHING: 6243597

PIT No: 202
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown and red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual		D/B	0.5				
	1	Below 0.7m: grading to pale brown, very stiff		D	1.0				
		Below 1.1m: with extremely weathered shale bands, hard, with low strength, highly weathered band							
64	1.4	SHALE: pale brown, low to medium strength, extremely weathered, Bringelly Shale							
	1.7	Pit discontinued at 1.7m - refusal on medium strength shale		D	1.7				
63	2								
	3								
62									
	4								
61									
	5								
60									
	6								
59									
	7								
58									
	8								
57									
	9								
56									
	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface, next to a swamp (offset ~20-30m)

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 64.2 mAHD
EASTING: 290868
NORTHING: 6243556
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details: stick-up
64	0.2	TOPSOIL/Silty CLAY CL: low plasticity, orange-brown, trace gravel and rootlets, w<PL		D	0.1 0.2				backfill
		Silty CLAY CI-CH: medium to high plasticity, brown mottled pale grey, trace gravel, w<PL, stiff, alluvial		D B	0.5				casing
63	1			D S	1.0		4,6,9 N = 15		bentonite
		Below 1.5m: grading to red-brown			1.45				
62	2				2.5				
		Below 2.5m: grading to orange mottled pale grey, very stiff		S			5,8,13 N = 21		
61	3				2.95				sand
60	4			S	4.0		4,10,23 N = 33		screen
	4.5	SHALE: brown, very low strength			4.45				
59	5	5.0 Bore discontinued at 5.0m - limit of investigation							
58	6								
57	7								
56	8								
55	9								
54	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 62.3 mAHD
EASTING: 291129
NORTHING: 6243689
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 222630.00
DATE: 11/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
62	0.3	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL		D	0.1				stick-up
		Silty CLAY CL-CI: low to medium plasticity, pale brown mottled orange and red, trace gravel, w<PL, alluvial		D	0.5				backfill
61	1			D	1.0				casing
				S			3,4,8 N = 12		bentonite
				D	1.45 1.5				
60	2								
		Below 2.5m: becoming dark orange mottled dark brown, very stiff			2.5				
				S			6,8,10 N = 18		
	3				2.95				
59		Below 3.2m: grading to dark brown							sand
	4				4.0				screen
58				S			8,9,25 N = 34		
					4.45				
57	5	5.0 Bore discontinued at 5.0m - limit of investigation							
56	6								
55	7								
54	8								
53	9								
52	10								

RIG: Explora 140 **DRILLER:** W C Excavations (Will) **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA20 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 60.1 mAHD
EASTING: 291281
NORTHING: 6243837

PIT No: 205
PROJECT No: 222630.00
DATE: 10/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
60	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, pale brown, with fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace gravel and rootlets, w<PL, stiff, alluvial		D/B	0.5				
59	1	Below 0.9m: grading to red-brown mottled pale brown, trace ironstone, firm to stiff		D	1.0				
		Below 1.3m: grading to pale grey mottled pale brown		D	1.5		pp = 410		
58	2			D	2.0		pp = 290-310		
					2.5		pp = 110-130		
57	3								
	3.5	Below 3.3m: with heavily iron indurated cobbles		D	3.5			▽	
		Pit discontinued at 3.5m - limit of investigation							
56	4								
55	5								
54	6								
53	7								
52	8								
51	9								
50	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA20 Zone 56

WATER OBSERVATIONS: Seepage observed at 3.5-3.8m

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 59.3 mAHD
EASTING: 291385
NORTHING: 6243906
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 222630.00
DATE: 23/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
59	0.2	TOPSOIL/Silty CLAY CL: low plasticity, brown, trace gravel and rootlets, w<PL							stickup
		Silty CLAY CI-CH: medium to high plasticity, brown-grey, trace gravel, w~PL, stiff, alluvial		D/B	0.5				bentonite
58	1			D/B	1.0		pp = 200		1 casing
				S			4,6,8 N = 14		
				D/B	1.45 1.5		pp = 200-250		
57	2	Below 2.0m: grading to pale brown and pale grey, w~PL		D	2.0				2
				D	2.5				
				S			4,4,6 N = 10		
56	3			D	2.95 3.0				3 sand
					3.5				screen
55	4	Below 4.1m: w>PL			4.0			23-08-23	4
				S			5,5,5 N = 10 pp = 100		
					4.45 4.5				
	4.8	SHALE: brown, very low strength, extremely weathered							
54	5 5.0	Bore discontinued at 5.0m - limit of investigation							5
53	6								6
52	7								7
51	8								8
50	9								9
49	10								10

RIG: Explora 140 **DRILLER:** Steve **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 5.0m

WATER OBSERVATIONS: Free groundwater encountered whilst augering at 4.1m

REMARKS: Location coordinates are in MGA94 Zone 20. Well installed: 1m stickup, bentonite 0-1.0m, sand 1.0-5.0m; casing 0-2.0m, screen 2.0-5.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 69.5 mAHD
EASTING: 290843
NORTHING: 6244364
DIP/AZIMUTH: 90°/--

BORE No: 207
PROJECT No: 222630.00
DATE: 23/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
69	0.3	Silty CLAY CL: low plasticity, dark brown, trace gravel, w<PL							stickup
		Silty CLAY CI: brown, trace gravel, w<PL, stiff, residual		D	0.5				
	1			D	1.0				backfill
				S			3,5,8 N = 13		
68		Below 1.3m: grading to brown and pale grey		D	1.45 1.5		pp = 300-350		casing
	2			D	2.0				bentonite
67		Below 2.3m: grading to pale brown and pale grey			2.5				
	2.6	SHALE: grey, very low strength, extremely weathered		S	2.6		pp >600 8,18,17 N = 35		
	3			D	2.95 3.0				
66	3.5	SHALE: brown, very low to low strength, extremely weathered							
	4								
65									
	5								
64		Below 5.5m: grading to dark grey, very low to medium strength							
	6								sand
63									
	7								screen
62									
	8								
61									
	9								
60									
	10	10.0 Bore discontinued at 10.0m - limit of investigation							

RIG: Explora 140 **DRILLER:** Steve **LOGGED:** EJ **CASING:** N/A

TYPE OF BORING: 110mm SFA to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 20. Well installed: 1m stickup, backfill 0-1.8m, bentonite 1.8-2.6m, sand 2.6-10m; casing 0-4.0m, screen 4.0-10.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 80.1 mAHD
EASTING: 290534
NORTHING: 6244483

PIT No: 301
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
80	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown mottled ale grey, with fine to coarse gravel, trace rootlets, w<PL, residual		D	0.5				
79	1	Below 0.9m: grading to pale grey		D	1.0				
				D	1.5		pp = 410-420		
78	2			D	2.0		pp = 380-390		
		Below 2.7m: with extremely weathered shale band, trace low strength shale		D	2.8		pp >600		
77	3	3.0 Pit discontinued at 3.0m - limit of investigation							
76	4								
75	5								
74	6								
73	7								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 66.6 mAHD
EASTING: 290945
NORTHING: 6244308

PIT No: 302
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
66	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, residual		D	0.5				
	1			D	1.0				
65		Below 1.3m: grading to pale red-brown		D	1.5				
	2								
64		Below 2.1m: grading to pale grey, with extremely weathered shale band, with low strength, highly weathered shale		D	2.2		pp = 320-330		
	2.9	Pit discontinued at 2.9m - target depth reached							
63	3								
62	4								
61	5								
60	6								
59	7								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 62.6 mAHD
EASTING: 291142
NORTHING: 6244273

PIT No: 303
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
62.6	0.3	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brow, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets		D	0.5				
62	1			D	1.0				
61	2								
60		Below 2.4m: grading to pale grey, with extremely weathered shale, with low strength, highly weathered shale		D	2.5		pp = 290-300		
	2.9								
59.6	3.0	SHALE: pale grey, low to medium strength with clay bands, highly weathered, Bringelly Shale		D	3.0		pp >400		
		Pit discontinued at 3.0m - target depth reached							
59	4								
58	5								
57	6								
56	7								
55									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 66.1 mAHD
EASTING: 291229
NORTHING: 6244385

PIT No: 304
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
66	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets		D	0.5				
	0.9	Below 0.8m: grading to pale brown mottled pale grey, with extremely weathered shale, with low strength, highly weathered shale band		D	0.9				
65	1.1	SHALE: pale brown, medium to high strength, highly weathered, Bringelly Shale		D	1.0				
		Pit discontinued at 1.1m - refusal on high strength shale							
64	2								
63	3								
62	4								
61	5								
60	6								
59	7								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 64.4 mAHD
EASTING: 291105
NORTHING: 6244094

PIT No: 305
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
64	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, residual		D	0.5				
		Below 0.7m: grading to pale brown, with extremely weathered shale bands, with low to medium strength, highly weathered shale bands		D	1.0				
	1.1			D	1.1				
	1.2	SHALE: pale brown, trace clay bands, medium to high strength, highly weathered, Bringelly Shale							
63		Pit discontinued at 1.3m - refusal on medium to high strength shale							
62									
61									
60									
59									
58									
57									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; depth 1 to 7

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.8 mAHD
EASTING: 290990
NORTHING: 6243928

PIT No: 306
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel and rootlets, w<PL, residual		D	0.5				
		Below 0.6m: grading to pale grey mottled red-brown							
	1			D	1.0				
		Below 1.3m: grading to pale grey		D	1.5		pp = 300-310		
64	2			D	2.0		pp = 240-300		
		Below 2.5m: with ironstone gravel		D	2.6		pp = 360-390		
63	3	3.0 Pit discontinued at 3.0m - target depth reached							
62	4								
61	5								
60	6								
59	7								
58									

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 59.6 mAHD
EASTING: 291333
NORTHING: 6243992

PIT No: 307
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
59	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace fine to coarse gravel and rootlets, w<PL, residual/alluvium		D	0.5				
58	1	Below 1.1m: grading to red-brown, trace fine to coarse gravel and rootlets		D	1.2				
57	2	Below 1.9m: grading to pale brown, w~PL		D	2.0		pp = 230-250		
					2.5		pp = 110-120		
56	3								
	3.1	Pit discontinued at 3.1m - target depth reached			3.1		pp = 120-130		
55	4								
54	5								
53	6								
52	7								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 62.5 mAHD
EASTING: 291009
NORTHING: 6243583

PIT No: 308
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
62	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, brown, trace fine to coarse gravel and rootlets, w<PL		D	0.5				
61	1			D	1.0				
				D	1.5		pp = 250-280		
60	2			D	2.0		pp = 300-350		
		Below 2.1m: grading to pale brown mottled grey		D	2.5		pp = 450		
59	3	3.0 Pit discontinued at 3.0m - target depth reached		D	3.0		pp = 150-190		
58	4								
57	5								
56	6								
55	7								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 65.7 mAHD
EASTING: 290719
NORTHING: 6243412

PIT No: 309
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
65	0.2	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CL-CI: low to medium plasticity, red-brown, trace rootlets, w<PL, alluvium		D	0.5				
		Below 0.8m: trace fine to coarse gravel		D	1.0				
64	1.2	Silty CLAY CI-CH: medium to high plasticity, dark red-brown, trace fine to coarse ironstone gravel and rootlets, w<PL, residual		D	1.5		pp = 200-210		
		Below 2.1m: grading to pale grey mottled red-brown		D	2.2		pp = 430-460		
63	3.0	Pit discontinued at 3.0m - target depth reached		D	3.0		pp = 300-310		
62									
61									
60									
59									
58									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 67.6 mAHD
EASTING: 290339
NORTHING: 6243112

PIT No: 310
PROJECT No: 222630.00
DATE: 30/8/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
67	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace rootlets, w<PL, residual		D	0.5				
	1			D	1.0				
		Below 1.2m: grading to dark and pale brown, trace fine to coarse gravel		D	1.3		pp = 450-460		
66		Below 1.4m: grading to pale brown mottled pale grey							
	2			D	2.0		pp = 500-510		
65				D	2.5		pp = 550-600		
	2.9								
	3	SHALE: pale grey, low to medium strength, with pale grey clay bands, highly weathered, Bringelly Shale		D	3.0				
	3.0	Pit discontinued at 3.0m - target depth reached							
64	4								
63	5								
62	6								
61	7								
60									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: JCB 4CX backhoe (9 tonne) - 450mm bucket

LOGGED: OAP

SURVEY DATUM: MGA2020 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Grass cover on surface

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 75.3 mAHD
EASTING: 290589
NORTHING: 6244283
DIP/AZIMUTH: 90°/--

BORE No: 311
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
75	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace rootlets, w<PL, residual		D	0.5				
	0.9			D	0.9				
74	1	Bore discontinued at 0.9m - target depth reached							
73	2								
72	3								
71	4								
70	5								
69	6								
68	7								

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 74.0 mAHD
EASTING: 290607
NORTHING: 6244228
DIP/AZIMUTH: 90°/--

BORE No: 313
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
74	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace rootlets, w<PL, residual		D	0.5				
		Below 0.7m: grading to grey mottled red-brown							
73	1.0	Bore discontinued at 1.0m - target depth reached		D	1.0				
72	2								
71	3								
70	4								
69	5								
68	6								
67	7								

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 75.7 mAHD
EASTING: 290541
NORTHING: 6244176
DIP/AZIMUTH: 90°/--

BORE No: 314
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
75	0.1	TOPSOIL/Silty CLAY CI-CH: medium to high plasticity, dark red-brown, trace fine to coarse gravel and rootlets, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to coarse gravel, w<PL, residual		D	0.5				
		Below 0.6m: grading to pale grey mottled red-brown							
	0.9			D	0.9				
	1	Bore discontinued at 0.9m - target depth reached							
74	2								
73	3								
72	4								
71	5								
70	6								
69	7								
68									

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 76.6 mAHD
EASTING: 290541
NORTHING: 6244128
DIP/AZIMUTH: 90°/--

BORE No: 315
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
76	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, pale brown, trace fine to coarse gravel, w<PL, residual		D	0.5				
		Below 0.8m: grading to pale grey							
1	1.0	Bore discontinued at 1.0m - target depth reached		D	1.0				
75	2								
74	3								
73	4								
72	5								
71	6								
70	7								
69									

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56. Grass cover on surface

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 73.7 mAHD
EASTING: 290567
NORTHING: 6244011
DIP/AZIMUTH: 90°/--

BORE No: 316
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
73	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, trace fine to coarse gravel and rootlets, w<<PL							
		Silty CLAY CL-CI: low to medium plasticity, brown, with fine to coarse ironstone gravel, trace rootlets, w<<PL, residual		D	0.5				
72	1.0	Bore discontinued at 1.0m - target depth reached		D	1.0				
71									
70									
69									
68									
67									
66									

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 79.5 mAHD
EASTING: 290473
NORTHING: 6244095
DIP/AZIMUTH: 90°/--

BORE No: 317
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
79	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with rootlets, trace fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace rootlets, w<PL, residual		D	0.5				
		Below 0.7m: grading to pale grey mottled red-brown		D	1.0				
78	1.1	Bore discontinued at 1.1m - target depth reached							

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56. Grass cover on surface

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Western Parkland City Authority
PROJECT: Proposed Urban Development
LOCATION: Badgerys Creek Road, Bringelly

SURFACE LEVEL: 75.5 mAHD
EASTING: 290546
NORTHING: 6243943
DIP/AZIMUTH: 90°/--

BORE No: 318
PROJECT No: 222630.00
DATE: 5/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
75	0.1	TOPSOIL/Silty CLAY CL-CI: low to medium plasticity, dark brown, with fine to coarse gravel, w<PL							
		Silty CLAY CI-CH: medium to high plasticity, red-brown, trace rootlets, w<PL, residual		D	0.5				
	0.75	Below 0.7m: grading to pale brown mottled red-brown		D	0.7				
		Bore discontinued at 0.75m - refusal, possibly on rock							

RIG: Hand auger **DRILLER:** W C Excavations (Will) **LOGGED:** OAP **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA2020 Zone 56. Grass cover on surface

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Site Photos

Photo 1: Photo from near Test Pit 106 look south west in Stage 2

Photo 2: Photo from near Test Pit 109 looking south west at Stage 2

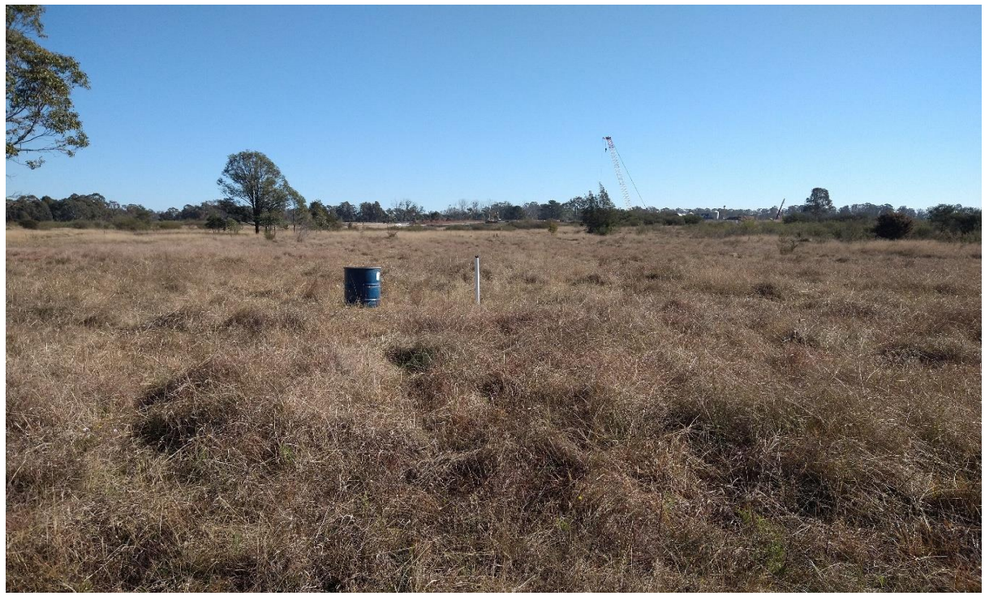

Photo 3: Photo from south east end of site looking north west towards Stage 2

Photo 4: Photo from near Borehole 203 looking west along Moore Gully

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Western Parkland City Authority		
OFFICE:	Macarthur	DRAWN BY:	ECR
SCALE:	NTS	DATE:	4 Oct 2023

Site Photographs 1 to 4
Proposed Urban Development
Bradfield City Centre, Badgerys Creek Road, Bringelly

PROJECT No:	222630.00
PLATE No:	1
REVISION:	0

Photo 5: Test Pit 107 profile (refusal at 1.1m)
Typical of northern part of Stage 2

Photo 6: Spoil from Test Pit 107

Photo 7: Test Pit 117 profile (Refusal at 2.2m)
Typical of central and southern parts of Stage 2

Photo 8: Medium to low strenght shale from base of Pit 117

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Western Parkland City Authority		**Site Photographs 5 to 8**	PROJECT No:	222630.00
	OFFICE: Macarthur	DRAWN BY: ECR	**Proposed Urban Development**	PLATE No:	2
	SCALE: NTS	DATE: 4 Oct 2023	**Bradfield City Centre, Badgerys Creek Road, Bringelly**	REVISION:	0

Photo 9: Test Pit 123 showing profile where the Luddenham Dyke was encountered (Refusal at 0.9m)

Photo 10: Basaltic material from base of Test Pit 123 - high strength

Photo 11: Test Pit 205 in stormwater corridor showing typical alluvial soil profile

Photo 12: Alluvial soil from Pit 205

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Western Parkland City Authority		**Site Photographs 9 to 12**	PROJECT No:	222630.00
	OFFICE: Macarthur	DRAWN BY: ECR	**Proposed Urban Development**	PLATE No:	3
	SCALE: NTS	DATE: 4 Oct 2023	**Bradfield City Centre, Badgerys Creek Road, Bringelly**	REVISION:	0

Appendix E

Results of Laboratory Testing

Test Bore or Pit	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					Exchangeable Sodium (Na) Concentration	Cation Exchange Capacity	Sodicity	Sodicity Class	Emerson Crumb Class Number	Dispersion?	Soil Texture Group	Textural Factor (M)	$EC_{1:5}$	EC_e	Sample Salinity Class
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity			[Na/CEC]			(from Emerson Class)	(for detailed soil logs see Report Appendix)		[Lab.]	[M x $EC_{1:5}$]	(Based on sample ECe)
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					(meq/100g)	(meq/100g)	(%)	[after DLWC]		[AS1289.3.8.1]	[after DLWC]	[after DLWC]	(microS/cm)	(deciS/m)	[Richards 1954]
301	0.5	5.2	190	91	3846	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	1.3	9	15	Sodic			Medium clay	7	260	1.8	Non-Saline
	1.0	4.8			1667	B	Mild		Non-Aggressive		Mild							Medium clay	7	600	4.2	Moderately Saline
	1.5	4.7			1136	B	Mild		Non-Aggressive		Mild							Medium clay	7	880	6.2	Moderately Saline
	2.0	4.7			1163	B	Mild		Non-Aggressive		Mild							Medium clay	7	860	6.0	Moderately Saline
.	2.8	5			1429	B	Mild		Non-Aggressive		Mild							Heavy clay	6	700	4.2	Moderately Saline
302	0.5	6.4	43	29	9091	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Clay loam	9	110	1.0	Non-Saline
	1.0	6.9			1786	B	Non-Aggressive		Non-Aggressive		Mild							Clay loam	9	560	5.0	Moderately Saline
	1.5	5.4			1176	B	Mild		Non-Aggressive		Mild							Medium clay	7	850	6.0	Moderately Saline
.	2.2	5.3			1299	B	Mild		Non-Aggressive		Mild							Medium clay	7	770	5.4	Moderately Saline
303	0.5	7.5	850	160	1282	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild	3	9	33	Highly Sodic			Light medium clay	8	780	6.2	Moderately Saline
	1.0	7.8			909	B	Non-Aggressive		Non-Aggressive		Moderate							Light medium clay	8	1100	8.8	Very Saline
	2.5	8.1			1087	B	Non-Aggressive		Non-Aggressive		Mild							Medium clay	7	920	6.4	Moderately Saline
.	3.0	7.9			1515	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	660	4.0	Slightly Saline
304	0.5	5	60	36	10989	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	91	0.5	Non-Saline
	0.9	5.1			9091	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	110	0.7	Non-Saline
.	1.0	5.1			6667	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	150	0.9	Non-Saline
305	0.5	4.8	10	25	10526	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	1	9	10	Sodic			Medium clay	7	95	0.7	Non-Saline
.	1.0	5.3	10	86	10101	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	99	0.7	Non-Saline
306	0.5	4.9	150	180	4000	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	1	6	18	Highly Sodic			Clay loam	9	250	2.3	Slightly Saline
	1.0	4.8			2041	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7	490	3.4	Slightly Saline
	1.5	4.9			1235	B	Mild		Non-Aggressive		Mild							Medium clay	7	810	5.7	Moderately Saline
	2.0	5.1			1538	B	Mild		Non-Aggressive		Mild							Medium clay	7	650	4.6	Moderately Saline
.	2.6	5			1220	B	Mild		Non-Aggressive	Non-Aggressive	Mild							Heavy clay	6	820	4.9	Moderately Saline
307	0.5	6.6	650	210	1250	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild	2	6	28	Highly Sodic			Medium clay	7	800	5.6	Moderately Saline
	1.2	7.5			1099	B	Non-Aggressive		Non-Aggressive		Mild							Clay loam	9	910	8.2	Very Saline
	2.0	8.1			1163	B	Non-Aggressive		Non-Aggressive		Mild							Light medium clay	8	860	6.9	Moderately Saline
	2.5	8.1			1111	B	Non-Aggressive	Non-Aggressive	Non-Aggressive		Mild							Light clay	9	900	7.7	Moderately Saline
.	3.1	8.1			1124	B	Non-Aggressive		Non-Aggressive		Mild							Light medium clay	8	890	7.1	Moderately Saline
308	0.5	7.6	210	50	2273	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	2	10	24	Highly Sodic			Clay loam	9	440	4.0	Slightly Saline
	1.0	8.2	360	62	1639	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Clay loam	9	610	5.5	Moderately Saline
	1.5	8.2			1163	B	Non-Aggressive		Non-Aggressive	Non-Aggressive	Mild							Clay loam	9	860	7.7	Moderately Saline
	2.0	8.1			1124	B	Non-Aggressive		Non-Aggressive	Non-Aggressive	Mild							Medium clay	7	890	6.2	Moderately Saline
	2.5	8.1			909	B	Non-Aggressive		Non-Aggressive		Moderate							Light medium clay	8	1100	8.8	Very Saline
.	3.0	8.1			1000	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Light medium clay	8	1000	8.0	Moderately Saline
309	0.5	5.7	10	10	18868	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	0	4	3	Non-Sodic			Clay loam	9	53	0.5	Non-Saline
	1.0	6.9			19608	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Clay loam	9	51	0.5	Non-Saline
	1.5	6.9			5882	B	Non-Aggressive		Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	170	1.2	Non-Saline
	2.2	7.1			4762	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7	210	1.5	Non-Saline
.	3.0	7			5263	B	Non-Aggressive	Non-Aggressive	Non-Aggressive		Non-Aggressive							Clay loam	9	190	1.7	Non-Saline
310	0.5	5.7	120	20	4762	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	2	9	16	Highly Sodic			Medium clay	7	210	1.5	Non-Saline
	1.0	7	810	66	1000	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Medium clay	7	1000	7.0	Moderately Saline
	1.3	7.2			625	B	Non-Aggressive		Non-Aggressive		Moderate							Clay loam	9	1600	14.4	Very Saline
	2.0	7.5			833	B	Non-Aggressive		Non-Aggressive		Moderate							Clay loam	9	1200	10.8	Very Saline
	2.5	7.7			714	B	Non-Aggressive		Non-Aggressive		Moderate							Heavy clay	6	1400	8.4	Very Saline
.	3.0	8			1639	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	610	3.7	Slightly Saline
311	0.5	5.1	170	150	2941	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	2	9	23	Highly Sodic			Medium clay	7	340	2.4	Slightly Saline
.	0.9	4.8			2326	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7	430	3.0	Slightly Saline
313	0.5	4.7	110	120	3846	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	260	1.8	Non-Saline
.	1.0	4.7			3333	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7	300	2.1	Slightly Saline
314	0.5	4.6	210	110	2857	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	350	2.1	Slightly Saline
.	0.9	4.6			2500	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7	400	2.8	Slightly Saline

Test Bore or Pit	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					Exchangeable Sodium (Na) Concentration	Cation Exchange Capacity	Sodicity	Sodicity Class	Emerson Crumb Class Number	Dispersion?	Soil Texture Group	Textural Factor (M)	$EC_{1:5}$	EC_e	Sample Salinity Class
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity			[Na/CEC]			(from Emerson Class)	(for detailed soil logs see Report Appendix)		[Lab.]	[M x $EC_{1:5}$]	(Based on sample ECe)
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					(meq/100g)	(meq/100g)	(%)	[after DLWC]		[AS1289.3.8.1]	[after DLWC]	[after DLWC]	(microS/cm)	(deciS/m)	[Richards 1954]
315	0.5	4.8	67	45	5882	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	170	1.0	Non-Saline
.	1.0	4.5			2778	B	Moderate		Non-Aggressive		Non-Aggressive							Medium clay	7	360	2.5	Slightly Saline
316	0.5	6.0	20	20	12195	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	1	7	14	Sodic			Heavy clay	6	82	0.5	Non-Saline
.	1.0	6.0			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Clay loam	9	120	1.1	Non-Saline
317	0.5	4.8	230	130	2632	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	380	2.7	Slightly Saline
.	1.0	4.5			1818	B	Moderate		Non-Aggressive		Mild							Heavy clay	6	550	3.3	Slightly Saline
318	0.5	5.3	100	68	4762	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	210	1.5	Non-Saline
.	0.7	5.5			5556	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	180	1.1	Non-Saline
BH3	0.5	5.3	220	150	3791	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Clay loam	9	264	2.4	Slightly Saline
	1.0	5.3	260	270	5666	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	177	1.2	Non-Saline
	2.0	5.5	480	250	9217	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	109	0.8	Non-Saline
	4.0	9.3	77	21	17422	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	57	0.3	Non-Saline
.	5.0	8.6	140	37	3747	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	267	1.6	Non-Saline
BH6	0.5	6.1	52	46	2873	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Clay loam	9	348	3.1	Slightly Saline
BH11	0.5	5.1	140	62	15385	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	65	0.5	Non-Saline
	1.0	4.9	420	180	5599	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	179	1.3	Non-Saline
	1.5	4.9	610	270	5179	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	193	1.4	Non-Saline
	2.5	5.1	640	250	5817	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Medium clay	7	172	1.2	Non-Saline
	4.0	9.2	210	100	1832	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Heavy clay	6	546	3.3	Slightly Saline
.	7.0	7.6	800	200	1877	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Heavy clay	6	533	3.2	Slightly Saline
101	0.5	5.1			1729	B	Mild		Non-Aggressive		Mild							Heavy clay	6.0	578	3.5	Slightly Saline
103	0.5	5.0			1575	B	Mild		Non-Aggressive		Mild							Medium clay	7.0	635	4.4	Moderately Saline
104	0.5	5.8			10091	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Light medium clay	8.0	99	0.8	Non-Saline
105	0.5	5.5			4929	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6.0	203	1.2	Non-Saline
106	0.5	4.9			1945	B	Mild		Non-Aggressive		Mild							Medium clay	7.0	514	3.6	Slightly Saline
	1.0	4.8			1328	B	Mild		Non-Aggressive		Mild							Light medium clay	8.0	753	6.0	Moderately Saline
.	1.5	4.9			1381	B	Mild		Non-Aggressive		Mild					2	Some	Medium clay	7.0	724	5.1	Moderately Saline
107	0.6	7.1			5157	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7.0	194	1.4	Non-Saline
108	0.5	5.3			1898	B	Mild		Non-Aggressive		Mild							Medium clay	7.0	527	3.7	Slightly Saline
109	0.5	5.8			2585	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7.0	387	2.7	Slightly Saline
110	0.5	5.4			4953	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7.0	202	1.4	Non-Saline
.	1.5	5.0			1724	B	Mild		Non-Aggressive		Mild							Heavy clay	6.0	580	3.5	Slightly Saline
113	0.5	4.6			1793	B	Mild		Non-Aggressive		Mild							Heavy clay	6.0	558	3.3	Slightly Saline
116	0.5	6.2			25575	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7.0	39	0.3	Non-Saline
117	0.5	5.8			7133	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7.0	140	1.0	Non-Saline
118	0.5	5.0			3024	B	Mild		Non-Aggressive		Non-Aggressive							Medium clay	7.0	331	2.3	Slightly Saline
	1.0	4.8			1556	B	Mild		Non-Aggressive		Mild							Medium clay	7.0	643	4.5	Moderately Saline
.	1.5	5.1			1998	B	Mild		Non-Aggressive		Mild							Medium clay	7.0	500	3.5	Slightly Saline
121	0.5	5.0			2400	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6.0	417	2.5	Slightly Saline
122	0.5	5.2			1727	B	Mild		Non-Aggressive		Mild							Heavy clay	6	579	3.5	Slightly Saline
	1.0	5.2			1359	B	Mild		Non-Aggressive		Mild							Medium clay	7	736	5.2	Moderately Saline
.	1.5	5.4			1265	B	Mild		Non-Aggressive		Mild							Medium clay	7	791	5.5	Moderately Saline
123	0.5	6.0			4970	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	201	1.2	Non-Saline
124	0.5	4.4			2680	B	Moderate		Non-Aggressive		Non-Aggressive							Light medium clay	8	373	3.0	Slightly Saline
125	0.5	5.0			1166	B	Mild		Non-Aggressive		Mild							Heavy clay	6	857	5.1	Moderately Saline
126	0.5	5.0			2174	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	460	2.8	Slightly Saline
127	0.5	4.6			1493	B	Mild		Non-Aggressive		Mild					2	Some	Heavy clay	6	670	4.0	Moderately Saline
	1.0	4.8			1448	B	Mild		Non-Aggressive		Mild							Medium clay	7	691	4.8	Moderately Saline
.	1.5	5.0			1920	B	Mild		Non-Aggressive		Mild							Light medium clay	8	521	4.2	Moderately Saline
128	0.5	6.1			6793	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					2	Some	Light clay	8.5	147	1.3	Non-Saline
201	0.5	6.1			7310	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7	137	1.0	Non-Saline
202	1.0	6.6			1217	B	Non-Aggressive		Non-Aggressive		Mild					2	Some	Medium clay	7	822	5.8	Moderately Saline
203	1.0	6.3			4953	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Medium clay	7	202	1.4	Non-Saline
204	1.5	7.5			1280	B	Non-Aggressive		Non-Aggressive		Mild					2	Some	Medium clay	7	781	5.5	Moderately Saline
205	1.0	7.2			1257	B	Non-Aggressive		Non-Aggressive		Mild							Medium clay	7	795	5.6	Moderately Saline

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CERTIFICATE OF ANALYSIS 332311

Client Details

Client	Douglas Partners Pty Ltd
Attention	Eric Riggle
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**222630.00 Bringelly, Bradfield City Centre**
Number of Samples	12 Soil
Date samples received	06/09/2023
Date completed instructions received	06/09/2023

Analysis Details

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

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

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

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

Report Details

Date results requested by	13/09/2023
Date of Issue	12/09/2023

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Results Approved By
Diego Bigolin, Inorganics Supervisor
Loren Bardwell, Development Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Acid Extractable metals in soil					
Our Reference		332311-1	332311-2	332311-7	332311-8
Your Reference	UNITS	BH3/0.5	BH3/1	BH11/0.5	BH11/1
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Manganese	mg/kg	320	570	120	46

Texture and Salinity*						
Our Reference		332311-1	332311-2	332311-3	332311-4	332311-5
Your Reference	UNITS	BH3/0.5	BH3/1	BH3/2	BH3/4	BH3/5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	310	370	560	230	190
Texture Value	-	9.0	7.0	7.0	6.0	6.0
Texture	-	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	2.8	2.6	3.9	<2	<2
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		332311-6	332311-7	332311-8	332311-9	332311-10
Your Reference	UNITS	BH6/0.5	BH11/0.5	BH11/1	BH11/1.5	BH11/2.5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	150	190	550	700	680
Texture Value	-	9.0	7.0	7.0	7.0	7.0
Texture	-	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY
ECe	dS/m	<2	<2	3.8	4.9	4.7
Class	-	NON SALINE	NON SALINE	SLIGHTLY SALINE	MODERATELY SALINE	MODERATELY SALINE

Texture and Salinity*			
Our Reference		332311-11	332311-12
Your Reference	UNITS	BH11/4	BH11/7
Date Sampled		08/04/2023	08/04/2023
Type of sample		Soil	Soil
Date prepared	-	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	280	780
Texture Value	-	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	<2	4.7
Class	-	NON SALINE	MODERATELY SALINE

Misc Inorg - Soil						
Our Reference		332311-1	332311-2	332311-3	332311-4	332311-5
Your Reference	UNITS	BH3/0.5	BH3/1	BH3/2	BH3/4	BH3/5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
pH 1:5 soil:water	pH Units	5.3	5.3	5.5	9.3	8.6
Chloride, Cl 1:5 soil:water	mg/kg	220	260	480	77	140
Sulphate, SO4 1:5 soil:water	mg/kg	150	270	250	21	37

Misc Inorg - Soil						
Our Reference		332311-6	332311-7	332311-8	332311-9	332311-10
Your Reference	UNITS	BH6/0.5	BH11/0.5	BH11/1	BH11/1.5	BH11/2.5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023	07/09/2023	07/09/2023	07/09/2023
pH 1:5 soil:water	pH Units	6.1	5.1	4.9	4.9	5.1
Chloride, Cl 1:5 soil:water	mg/kg	52	140	420	610	640
Sulphate, SO4 1:5 soil:water	mg/kg	46	62	180	270	250

Misc Inorg - Soil			
Our Reference		332311-11	332311-12
Your Reference	UNITS	BH11/4	BH11/7
Date Sampled		08/04/2023	08/04/2023
Type of sample		Soil	Soil
Date prepared	-	07/09/2023	07/09/2023
Date analysed	-	07/09/2023	07/09/2023
pH 1:5 soil:water	pH Units	9.2	7.6
Chloride, Cl 1:5 soil:water	mg/kg	210	800
Sulphate, SO4 1:5 soil:water	mg/kg	100	200

Moisture						
Our Reference		332311-1	332311-2	332311-3	332311-4	332311-5
Your Reference	UNITS	BH3/0.5	BH3/1	BH3/2	BH3/4	BH3/5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/09/2023	08/09/2023	08/09/2023	08/09/2023	08/09/2023
Date analysed	-	09/09/2023	09/09/2023	09/09/2023	09/09/2023	09/09/2023
Moisture	%	13	17	13	2.4	4.9

Moisture						
Our Reference		332311-6	332311-7	332311-8	332311-9	332311-10
Your Reference	UNITS	BH6/0.5	BH11/0.5	BH11/1	BH11/1.5	BH11/2.5
Date Sampled		08/04/2023	08/04/2023	08/04/2023	08/04/2023	08/04/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/09/2023	08/09/2023	08/09/2023	08/09/2023	08/09/2023
Date analysed	-	09/09/2023	09/09/2023	09/09/2023	09/09/2023	09/09/2023
Moisture	%	15	13	19	20	18

Moisture			
Our Reference		332311-11	332311-12
Your Reference	UNITS	BH11/4	BH11/7
Date Sampled		08/04/2023	08/04/2023
Type of sample		Soil	Soil
Date prepared	-	08/09/2023	08/09/2023
Date analysed	-	09/09/2023	09/09/2023
Moisture	%	3.6	2.7

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-123	Determined using a "Texture by Feel" method.
Metals-020	Determination of various metals by ICP-AES.

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			07/09/2023	[NT]	[NT]	[NT]	[NT]	07/09/2023	[NT]
Date analysed	-			07/09/2023	[NT]	[NT]	[NT]	[NT]	07/09/2023	[NT]
Manganese	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	112	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			07/09/2023	[NT]	[NT]	[NT]	[NT]	07/09/2023	[NT]
Date analysed	-			07/09/2023	[NT]	[NT]	[NT]	[NT]	07/09/2023	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	332311-2
Date prepared	-			07/09/2023	1	07/09/2023	07/09/2023		07/09/2023	07/09/2023
Date analysed	-			07/09/2023	1	07/09/2023	07/09/2023		07/09/2023	07/09/2023
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.3	5.5	4	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	220	220	0	105	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	150	150	0	102	#

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	07/09/2023	07/09/2023		[NT]	[NT]
Date analysed	-			[NT]	11	07/09/2023	07/09/2023		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	9.2	9.2	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	210	210	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	100	100	0	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

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

Samples were out of the recommended holding time for this analysis pH/EC.

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CERTIFICATE OF ANALYSIS 332592

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Eric Riggle
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**222630.00, Bringelly**
Number of Samples	59 Soil
Date samples received	08/09/2023
Date completed instructions received	08/09/2023

Analysis Details

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

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

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

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

Report Details

Date results requested by	15/09/2023
Date of Issue	15/09/2023

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

Results Approved By
Loren Bardwell, Development Chemist
Nick Sarlamis, Assistant Operation Manager

Authorised By
Nancy Zhang, Laboratory Manager

Texture and Salinity*						
Our Reference		332592-1	332592-2	332592-3	332592-4	332592-5
Your Reference	UNITS	301/0.5	301/1	301/1.5	301/2	301/2.8
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	260	600	880	860	700
Texture Value	-	7.0	7.0	7.0	7.0	6.0
Texture	-	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY
ECe	dS/m	<2	4.2	6.2	6.0	4.2
Class	-	NON SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE

Texture and Salinity*						
Our Reference		332592-6	332592-7	332592-8	332592-9	332592-10
Your Reference	UNITS	302/0.5	302/1	302/1.5	302/2.2	303/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	110	560	850	770	780
Texture Value	-	9.0	9.0	7.0	7.0	8.0
Texture	-	CLAY LOAM	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY	LIGHT MEDIUM CLAY
ECe	dS/m	<2	5.0	5.9	5.4	6.3
Class	-	NON SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE

Texture and Salinity*						
Our Reference		332592-11	332592-12	332592-13	332592-14	332592-15
Your Reference	UNITS	303/1	303/2.5	303/3	304/0.5	304/0.9
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	1,100	920	660	91	110
Texture Value	-	8.0	7.0	6.0	6.0	6.0
Texture	-	LIGHT MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	9.0	6.5	4.0	<2	<2
Class	-	VERY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		332592-16	332592-17	332592-18	332592-19	332592-20
Your Reference	UNITS	304/1	305/0.5	305/1	306/0.5	306/1
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	150	95	99	250	490
Texture Value	-	6.0	7.0	7.0	9.0	7.0
Texture	-	HEAVY CLAY	MEDIUM CLAY	MEDIUM CLAY	CLAY LOAM	MEDIUM CLAY
ECe	dS/m	<2	<2	<2	2.3	3.5
Class	-	NON SALINE	NON SALINE	NON SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		332592-21	332592-22	332592-23	332592-24	332592-25
Your Reference	UNITS	306/1.5	306/2	306/2.6	307/0.5	307/1.2
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	810	650	820	800	910
Texture Value	-	7.0	7.0	6.0	7.0	9.0
Texture	-	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY	MEDIUM CLAY	CLAY LOAM
ECe	dS/m	5.6	4.6	4.9	5.6	8.2
Class	-	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	VERY SALINE

Texture and Salinity*						
Our Reference		332592-26	332592-27	332592-28	332592-29	332592-30
Your Reference	UNITS	307/2	307/2.5	307/3.1	308/0.5	308/1
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	860	900	890	440	610
Texture Value	-	8.0	8.5	8.0	9.0	9.0
Texture	-	LIGHT MEDIUM CLAY	LIGHT CLAY	LIGHT MEDIUM CLAY	CLAY LOAM	CLAY LOAM
ECe	dS/m	6.9	7.7	7.1	4.0	5.5
Class	-	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	MODERATELY SALINE

Texture and Salinity*						
Our Reference		332592-31	332592-32	332592-33	332592-34	332592-35
Your Reference	UNITS	308/1.5	308/2	308/2.5	308/3	309/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	860	890	1,100	1,000	53
Texture Value	-	9.0	7.0	8.0	8.0	9.0
Texture	-	CLAY LOAM	MEDIUM CLAY	LIGHT MEDIUM CLAY	LIGHT MEDIUM CLAY	CLAY LOAM
ECe	dS/m	7.7	6.2	8.6	8.4	<2
Class	-	MODERATELY SALINE	MODERATELY SALINE	VERY SALINE	VERY SALINE	NON SALINE

Texture and Salinity*						
Our Reference		332592-36	332592-37	332592-38	332592-39	332592-40
Your Reference	UNITS	309/1	309/1.5	309/2.2	309/3	310/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	51	170	210	190	210
Texture Value	-	9.0	7.0	7.0	9.0	7.0
Texture	-	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY	CLAY LOAM	MEDIUM CLAY
ECe	dS/m	<2	<2	<2	<2	<2
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		332592-41	332592-42	332592-43	332592-44	332592-45
Your Reference	UNITS	310/1	310/1.3	310/2	310/2.5	310/3
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	1,000	1,600	1,200	1,400	610
Texture Value	-	7.0	9.0	9.0	6.0	6.0
Texture	-	MEDIUM CLAY	CLAY LOAM	CLAY LOAM	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	7.3	14	11	8.1	3.7
Class	-	MODERATELY SALINE	VERY SALINE	VERY SALINE	VERY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		332592-46	332592-47	332592-48	332592-49	332592-50
Your Reference	UNITS	311/0.5	311/0.9	313/0.5	313/1	314/0.5
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	340	430	260	300	350
Texture Value	-	7.0	7.0	7.0	7.0	6.0
Texture	-	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY
ECe	dS/m	2.3	3.0	<2	2.1	2.1
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	NON SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		332592-51	332592-52	332592-53	332592-54	332592-55
Your Reference	UNITS	314/0.9	315/0.5	315/1	316/0.5	316/1
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	400	170	360	82	120
Texture Value	-	7.0	6.0	7.0	6.0	9.0
Texture	-	MEDIUM CLAY	HEAVY CLAY	MEDIUM CLAY	HEAVY CLAY	CLAY LOAM
ECe	dS/m	2.8	<2	2.5	<2	<2
Class	-	SLIGHTLY SALINE	NON SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE

Texture and Salinity*					
Our Reference		332592-56	332592-57	332592-58	332592-59
Your Reference	UNITS	317/0.5	317/1	318/0.5	318/0.7
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Electrical Conductivity 1:5 soil:water	µS/cm	380	550	210	180
Texture Value	-	7.0	6.0	7.0	6.0
Texture	-	MEDIUM CLAY	HEAVY CLAY	MEDIUM CLAY	HEAVY CLAY
ECe	dS/m	2.6	3.3	<2	<2
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE

Misc Inorg - Soil						
Our Reference		332592-1	332592-2	332592-3	332592-4	332592-5
Your Reference	UNITS	301/0.5	301/1	301/1.5	301/2	301/2.8
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	5.2	4.8	4.7	4.7	5.0
Chloride, Cl 1:5 soil:water	mg/kg	190	[NA]	[NA]	[NA]	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	91	[NA]	[NA]	[NA]	[NA]

Misc Inorg - Soil						
Our Reference		332592-6	332592-7	332592-8	332592-9	332592-10
Your Reference	UNITS	302/0.5	302/1	302/1.5	302/2.2	303/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	6.4	6.9	5.4	5.3	7.5
Chloride, Cl 1:5 soil:water	mg/kg	43	[NA]	[NA]	[NA]	850
Sulphate, SO4 1:5 soil:water	mg/kg	29	[NA]	[NA]	[NA]	160

Misc Inorg - Soil						
Our Reference		332592-11	332592-12	332592-13	332592-14	332592-15
Your Reference	UNITS	303/1	303/2.5	303/3	304/0.5	304/0.9
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	7.8	8.1	7.9	5.0	5.1
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	60	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	36	[NA]

Misc Inorg - Soil						
Our Reference		332592-16	332592-17	332592-18	332592-19	332592-20
Your Reference	UNITS	304/1	305/0.5	305/1	306/0.5	306/1
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	5.1	4.8	5.3	4.9	4.8
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	10	10	150	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	25	86	180	[NA]

Misc Inorg - Soil						
Our Reference		332592-21	332592-22	332592-23	332592-24	332592-25
Your Reference	UNITS	306/1.5	306/2	306/2.6	307/0.5	307/1.2
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	4.9	5.1	5.0	6.6	7.5
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	650	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	210	[NA]

Misc Inorg - Soil						
Our Reference		332592-26	332592-27	332592-28	332592-29	332592-30
Your Reference	UNITS	307/2	307/2.5	307/3.1	308/0.5	308/1
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	8.1	8.1	8.1	7.6	8.2
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	210	360
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	50	62

Misc Inorg - Soil						
Our Reference		332592-31	332592-32	332592-33	332592-34	332592-35
Your Reference	UNITS	308/1.5	308/2	308/2.5	308/3	309/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	8.2	8.1	8.1	8.1	5.7
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	[NA]	<10
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	[NA]	<10

Misc Inorg - Soil						
Our Reference		332592-36	332592-37	332592-38	332592-39	332592-40
Your Reference	UNITS	309/1	309/1.5	309/2.2	309/3	310/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	6.9	6.9	7.1	7.0	5.7
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	[NA]	120
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	[NA]	[NA]	20

Misc Inorg - Soil						
Our Reference		332592-41	332592-42	332592-43	332592-44	332592-45
Your Reference	UNITS	310/1	310/1.3	310/2	310/2.5	310/3
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	7.0	7.2	7.5	7.7	8.0
Chloride, Cl 1:5 soil:water	mg/kg	810	[NA]	[NA]	[NA]	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	66	[NA]	[NA]	[NA]	[NA]

Misc Inorg - Soil						
Our Reference		332592-46	332592-47	332592-48	332592-49	332592-50
Your Reference	UNITS	311/0.5	311/0.9	313/0.5	313/1	314/0.5
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	5.1	4.8	4.7	4.7	4.6
Chloride, Cl 1:5 soil:water	mg/kg	170	[NA]	110	[NA]	210
Sulphate, SO4 1:5 soil:water	mg/kg	150	[NA]	120	[NA]	110

Misc Inorg - Soil						
Our Reference		332592-51	332592-52	332592-53	332592-54	332592-55
Your Reference	UNITS	314/0.9	315/0.5	315/1	316/0.5	316/1
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	4.6	4.8	4.5	6.0	6.0
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	67	[NA]	20	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	45	[NA]	20	[NA]

Misc Inorg - Soil					
Our Reference		332592-56	332592-57	332592-58	332592-59
Your Reference	UNITS	317/0.5	317/1	318/0.5	318/0.7
Date Sampled		05/09/2023	05/09/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023
Date analysed	-	11/09/2023	11/09/2023	11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units	4.8	4.5	5.3	5.5
Chloride, Cl 1:5 soil:water	mg/kg	230	[NA]	100	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	130	[NA]	68	[NA]

ESP/CEC						
Our Reference		332592-1	332592-10	332592-17	332592-19	332592-24
Your Reference	UNITS	301/0.5	303/0.5	305/0.5	306/0.5	307/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	30/08/2023	30/08/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023
Date analysed	-	13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023
Exchangeable Ca	meq/100g	0.8	0.8	2.7	0.3	0.2
Exchangeable K	meq/100g	0.2	0.1	0.1	<0.1	<0.1
Exchangeable Mg	meq/100g	6.6	4.9	5.1	4.6	4.4
Exchangeable Na	meq/100g	1.3	2.9	0.9	1.1	1.8
Cation Exchange Capacity	meq/100g	8.9	8.8	8.9	6.1	6.4
ESP	%	14	33	10	18	28

ESP/CEC						
Our Reference		332592-29	332592-35	332592-40	332592-46	332592-54
Your Reference	UNITS	308/0.5	309/0.5	310/0.5	311/0.5	316/0.5
Date Sampled		30/08/2023	30/08/2023	30/08/2023	05/09/2023	05/09/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023
Date analysed	-	13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023
Exchangeable Ca	meq/100g	1.7	0.9	1.2	0.4	0.1
Exchangeable K	meq/100g	0.1	<0.1	0.1	0.2	0.2
Exchangeable Mg	meq/100g	6.2	2.6	6.4	6.4	5.7
Exchangeable Na	meq/100g	2.4	<0.1	1.5	2.1	1
Cation Exchange Capacity	meq/100g	10	3.6	9.2	9.0	7.0
ESP	%	23	[NT]	16	23	14

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-123	Determined using a "Texture by Feel" method.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-OES analytical finish.

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			11/09/2023	1	11/09/2023	11/09/2023		11/09/2023	[NT]
Date analysed	-			11/09/2023	1	11/09/2023	11/09/2023		11/09/2023	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	260	240	8	102	[NT]
Texture Value	-		INORG-123	[NT]	1	7.0	7.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	10	11/09/2023	11/09/2023		11/09/2023	[NT]
Date analysed	-			[NT]	10	11/09/2023	11/09/2023		11/09/2023	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	10	780	830	6	103	[NT]
Texture Value	-		INORG-123	[NT]	10	8.0	8.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			[NT]	19	11/09/2023	11/09/2023		11/09/2023	[NT]
Date analysed	-			[NT]	19	11/09/2023	11/09/2023		11/09/2023	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	19	250	280	11	103	[NT]
Texture Value	-		INORG-123	[NT]	19	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	29	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	29	11/09/2023	11/09/2023		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	29	440	500	13	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	29	9.0	[NT]		[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	40	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	40	11/09/2023	11/09/2023		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	40	210	190	10	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	40	7.0	[NT]		[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	46	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	46	11/09/2023	11/09/2023		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	46	340	340	0	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	46	7.0	[NT]		[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	332592-6
Date prepared	-			11/09/2023	1	11/09/2023	11/09/2023		11/09/2023	11/09/2023
Date analysed	-			11/09/2023	1	11/09/2023	11/09/2023		11/09/2023	11/09/2023
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.2	5.1	2	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	190	200	5	108	96
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	91	98	7	105	88

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	10	11/09/2023	11/09/2023		11/09/2023	[NT]
Date analysed	-			[NT]	10	11/09/2023	11/09/2023		11/09/2023	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	10	7.5	7.6	1	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	10	850	[NT]		96	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	10	160	[NT]		88	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			[NT]	19	11/09/2023	11/09/2023		11/09/2023	[NT]
Date analysed	-			[NT]	19	11/09/2023	11/09/2023		11/09/2023	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	19	4.9	4.8	2	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	19	150	[NT]		[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	19	180	[NT]		[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	29	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	29	11/09/2023	11/09/2023		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	29	7.6	7.6	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	29	210	260	21	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	29	50	57	13	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	40	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	40	11/09/2023	11/09/2023		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	40	5.7	5.7	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	40	120	[NT]		[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	40	20	[NT]		[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	46	11/09/2023	11/09/2023		[NT]	[NT]
Date analysed	-			[NT]	46	11/09/2023	11/09/2023		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	46	5.1	5.1	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	46	170	170	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	46	150	150	0	[NT]	[NT]

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			13/09/2023	[NT]	[NT]	[NT]	[NT]	13/09/2023	[NT]
Date analysed	-			13/09/2023	[NT]	[NT]	[NT]	[NT]	13/09/2023	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	112	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	101	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

Tests/Analytes PH and EC for #1-45 have exceeded the recommended technical holding times, Envirolab Group form 347 "Recommended Preservation and Holding Times" can be provided on request (available on the Envirolab website)

ESP: Where the exchangeable Sodium is less than the PQL and CEC is less than 10meq/100g, the ESP cannot be calculated.

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CERTIFICATE OF ANALYSIS 335091

Client Details

Client	Douglas Partners Pty Ltd
Attention	Eric Riggle
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**222630.00 - Bringelly, Bradfield City Centre**
Number of Samples	4 Water
Date samples received	11/10/2023
Date completed instructions received	11/10/2023

Analysis Details

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

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

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

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

Report Details

Date results requested by	12/10/2023
Date of Issue	12/10/2023

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

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics					
Our Reference		335091-1	335091-2	335091-3	335091-4
Your Reference	UNITS	201	203	206	207
Date Sampled		26/09/2023	26/09/2023	26/09/2023	26/09/2023
Type of sample		Water	Water	Water	Water
Date prepared	-	11/10/2023	11/10/2023	11/10/2023	11/10/2023
Date analysed	-	11/10/2023	11/10/2023	11/10/2023	11/10/2023
pH	pH Units	7.2	7.2	7.1	7.3
Electrical Conductivity	µS/cm	19,000	19,000	19,000	16,000

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			11/10/2023	[NT]	[NT]	[NT]	[NT]	11/10/2023	[NT]
Date analysed	-			11/10/2023	[NT]	[NT]	[NT]	[NT]	11/10/2023	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

Samples were out of the recommended holding time for this analysis.

Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003K
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**106 (0.5 m)**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale grey, trace fine to coarse gravel and rootlets, w<PL, very stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

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Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003L
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**127 , Depth: 0.5 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, trace rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

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Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003M
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**128 , Depth: 0.5 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown, trace ironstone gravel and rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

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Senior Technician
Laboratory Accreditation Number: 828

Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003N
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**202 , Depth: 1.0 m**
Material:	Silty CLAY CI-CH: medium to high plasticity, pale brown and red-brown, trace fine to coarse gravel and rootlets, w<PL, stiff, residual

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

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Report Number:	**222630.00-4**
Issue Number:	1
Date Issued:	21/09/2023
Client:	Western Parkland City Authority
	Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact:	Ambreen Imitaz
Project Number:	222630.00
Project Name:	Proposed Urban Development
Project Location:	Badgerys Creek Road, Bringelly NSW
Work Request:	11003
Sample Number:	MA-11003O
Date Sampled:	10/08/2023
Dates Tested:	24/08/2023 - 20/09/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**204 , Depth: 1.5 m**
Material:	Silty CLAY CL-CI: low to medium plasticity, brown, trace gravel, w<PL

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		
Temperature of Water (^{o}C)	25		

Material Test Report

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Dates Tested: 24/08/2023 - 20/09/2023
Location: Badgerys Creek Road, Bringerlly

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Approved Signatory: Nilusha Arachchi
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Laboratory Accreditation Number: 828

Determination of pH of Soil (In-House) DP MAC1

Sample Number	Location	Depth (m)	Material	pH Value
MA-11003P	101	0.5	Soil	5.1
MA-11003Q	103	0.5	Soil	5.0
MA-11003R	104	0.5	Soil	5.8
MA-11003S	105	0.5	Soil	5.5
MA-11003T	106	0.5	Soil	4.9
MA-11003U	106	1.0	Soil	4.8
MA-11003V	106	1.5	Soil	4.9
MA-11003W	107	0.6	Soil	7.1
MA-11003X	108	0.5	Soil	5.3
MA-11003Y	109	0.5	Soil	5.8
MA-11003Z	110	0.5	Soil	5.4
MA-11003AA	110	1.5	Soil	5.0
MA-11003AB	113	0.5	Soil	4.6
MA-11003AC	116	0.5	Soil	6.2
MA-11003AD	117	0.5	Soil	5.8
MA-11003AE	118	0.5	Soil	5.0
MA-11003AF	118	1.0	Soil	4.8
MA-11003AG	118	1.5	Soil	5.1
MA-11003AH	121	0.5	Soil	5.0
MA-11003AI	122	0.5	Soil	5.2
MA-11003AJ	122	1.0	Soil	5.2
MA-11003AK	122	1.5	Soil	5.4
MA-11003AL	123	0.5	Soil	6.0
MA-11003AM	124	0.5	Soil	4.4
MA-11003AN	125	0.5	Soil	5.0
MA-11003AO	126	0.5	Soil	5.0
MA-11003AP	127	0.5	Soil	4.6
MA-11003AQ	127	1.0	Soil	4.8
MA-11003AR	127	1.5	Soil	5.0
MA-11003AS	128	0.5	Soil	6.1
MA-11003AT	201	0.5	Soil	6.1
MA-11003AU	202	1.0	Soil	6.6

Sample Number	Location	Depth (m)	Material	pH Value
MA-11003AV	203	1.0	Soil	6.3
MA-11003AW	204	1.5	Soil	7.5
MA-11003AX	205	1.0	Soil	7.2

Material Test Report

Report Number: **222630.00-4**
Issue Number: 1
Date Issued: 21/09/2023
Client: Western Parkland City Authority
Level 2,10 Valentine Avenue, Parramatta NSW 2150
Contact: Ambreen Imitaz
Project Number: 222630.00
Project Name: Proposed Urban Development
Project Location: Badgerys Creek Road, Bringelly NSW
Work Request: 11003
Dates Tested: 24/08/2023 - 20/09/2023
Location: Badgerys Creek Road, Bringerlly

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Determination of EC of Soil (In-House) DP MAC2

Sample Number	Location	Depth (m)	Material	EC Value (µS/cm)
MA-11003P	101	0.5	Soil	578.30
MA-11003Q	103	0.5	Soil	634.80
MA-11003R	104	0.5	Soil	99.10
MA-11003S	105	0.5	Soil	202.90
MA-11003T	106	0.5	Soil	514.10
MA-11003U	106	1.0	Soil	752.80
MA-11003V	106	1.5	Soil	724.30
MA-11003W	107	0.6	Soil	193.90
MA-11003X	108	0.5	Soil	526.80
MA-11003Y	109	0.5	Soil	386.80
MA-11003Z	110	0.5	Soil	201.90
MA-11003AA	110	1.5	Soil	580.20
MA-11003AB	113	0.5	Soil	557.80
MA-11003AC	116	0.5	Soil	39.10
MA-11003AD	117	0.5	Soil	140.20
MA-11003AE	118	0.5	Soil	330.70
MA-11003AF	118	1.0	Soil	642.80
MA-11003AG	118	1.5	Soil	500.40
MA-11003AH	121	0.5	Soil	416.60
MA-11003AI	122	0.5	Soil	579.00
MA-11003AJ	122	1.0	Soil	735.80
MA-11003AK	122	1.5	Soil	790.60
MA-11003AL	123	0.5	Soil	201.20
MA-11003AM	124	0.5	Soil	373.20
MA-11003AN	125	0.5	Soil	857.40
MA-11003AO	126	0.5	Soil	459.90
MA-11003AP	127	0.5	Soil	669.80
MA-11003AQ	127	1.0	Soil	690.50
MA-11003AR	127	1.5	Soil	520.80
MA-11003AS	128	0.5	Soil	147.20
MA-11003AT	201	0.5	Soil	136.80
MA-11003AU	202	1.0	Soil	821.70

Sample Number	Location	Depth (m)	Material	EC Value (µS/cm)
MA-11003AV	203	1.0	Soil	201.90
MA-11003AW	204	1.5	Soil	781.10
MA-11003AX	205	1.0	Soil	795.40