Douglas Partners
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Report on
Geotechnical Investigation

Oakdale East Industrial Estate
224-398 Burley Road, Horsley Park

Prepared for
Goodman Pty Ltd

Project 86545.01
December 2018

Douglas Partners
Geotechnics / Environment / Groundwater

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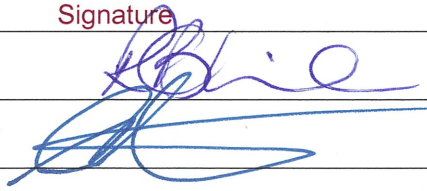
Author		13 December 2018
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Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for the Oakdale East Industrial Estate site, located on the eastern side of Old Wallgrove Road, Horsley Park. The investigation was commissioned by Guy Smith of Goodman Pty Ltd (Goodman) and was undertaken in accordance with DP's proposal SYD180799.P.001.Rev0 dated 4 September 2018.

It is understood that the south-western part of the greater Austral Bricks Plant 3 site is proposed for development as an industrial estate that will include a number of new warehouses and a masonry plant situated on either side of a new estate cul-de-sac. The current Masterplan indicates four warehouses and a masonry plant with extensive hardstands for product storage and vehicular use/parking.

The investigation was undertaken to inform the civil and structural aspects of the development, including the provision of advice on site preparation and earthworks, foundations, retaining walls, pavements, groundwater, drainage, slope stability and salinity. A copy of the Masterplan is presented in Appendix B (refer Drawing No. OAK EAST MP02 (D)).

The assessment included a visual inspection and walkover of the site, excavation of test pits, drilling of cored boreholes and laboratory testing. This report follows DP's previous desktop study report for the site (refer 86545.01.R.001.Rev1, dated 2 October 2018).

DP also carried out an environmental assessment for the site. The results of the assessment are presented separately in our report titled Report on Detailed Site Investigation with Limited Sampling (Ref: 86545.00.R.002.Rev0, dated December 2018).

2. Response to Project SEARs

DP has undertaken a review of the Secretary's Environmental Assessment Requirements (SEARs) for the project (SEAR No. 1225 dated 19 September 2018) and confirms that the relevant items have been addressed herein. Items considered to be relevant to the geotechnical aspects for the project include:

- Soil and Water – refer Sections 4, 5 and 8

3. Site Description

3.1 Site Identification

The greater Austral Bricks site is identified as Lot No. 1 Burley Road (DP 843901) within Horsley Park and has a street address of 224-398 Burley Road, Horsley Park. The proposed subdivision site (Oakdale East) forms the south-western part of Lot 1 and is located to the north of Burley Road and to the east of Old Wallgrove Road. The proposed estate boundaries are shown on the Masterplan included in Appendix B.

3.2 Site Description

The site is an irregular shaped area of about 10.8 hectares. It has an approximate 340 m long frontage to Burley Road and a 245 m frontage to Old Wallgrove Road.

The site is occupied by an extensive array of large stockpiles comprising materials of 'stock-in-trade' for the manufacture of bricks and pavers. The stockpiles cover more than half of the site and are separated by unsealed access tracks. There are also areas of land that are grass covered, which generally represent the natural landform. Internal natural drainage lines are recognisable and drain towards basins to the east of the site within the Austral Bricks land and then on to Reedy Creek further to the east. Scattered tree growth is present along the drainage lines and the southern site boundary.

To the north and east of the site further large soil stockpiles are present. The Austral Bricks Plant 3 manufacturing warehouse and associated kilns/structures are located north of the western part of Oakdale East, with the warehouses approximately 30 m north of the development boundary. These structures are generally steel-framed and clad in sheet metal, although other brick administration buildings and associated concrete hardstand areas are also present. A large and deep quarry exists primarily to the north east of the site and lies wholly outside of the proposed development footprint. The quarry is estimated as being up to 35 m deep (possibly more) and includes a number of settling ponds and further stock-in-trade stockpiles. The side walls of the quarry are battered at approximately 45 degrees in shale and 30 degrees in soil overburden.

The ground surface within the site is expected to have once exhibited gently undulating terrain that was probably covered with natural bushland. Since development into a brick manufacturing plant, substantial alterations, as outlined above, have been made to the natural terrain shape. Site levels across the Oakdale East precinct generally range between RL 60 m and RL 90 m, relative to Australian height datum.

The following figures are photographs taken from within the Oakdale East development site.

Figure 1: View to East Overlooking Land to the East of the Proposed Subdivision Area

Figure 2: View to North Overlooking the Eastern Part of the Proposed Subdivision Area

Figure 3: View to West along Southern Site Boundary

Figure 4: View of Typical Site Access Track near Test Pit TP12

Figure 5: View to South West Overlooking the South-Western Part of the Existing Quarry

4. Desktop Study

4.1 Geology

Reference to the Penrith 1:100,000 Geological Series Sheet indicates that the Oakdale East site is underlain by Bringelly Shale of the Wianamatta Group of Middle Triassic age, with some more recent fluvial sediments (Quaternary alluvium) present along Reedy Creek but east of the development site boundary.

An extract of the map is shown in Figure 6 along with an outline of the proposed subdivision boundary.

Bringelly Shale typically comprises shales, siltstones and claystones, which weather to form clays of high plasticity (shaded green in Figure 6).

The fluvial soils are likely to consist of a range of sands, silts and clays that have been deposited by natural overland and creek flows (shaded orange in Figure 6).

Several diatremes are mapped about 600 m to 800 m to the south west of the site. Diatremes are volcanic necks typically comprising volcanic breccia with varying amounts of sedimentary breccia and basalt.

Figure 6: Extract of Regional Geological Map

4.2 Hydrogeology

The hydrogeology of the Bringelly Shale is usually characterised by shallow seepage along the soil and shale interface and a deep fractured rock aquifer tens of metres below surface levels. Aquifer recharge is minimal due to the low permeability of the near surface clays, and horizontal flow velocities in the soil and rock are commonly less than 10 m per year.

A search of the NSW Department of Primary Industries Office of Water database was undertaken. No registered groundwater bores were identified within the site. The closest boreholes were recorded over 600 m from the site boundary.

Standing water levels in the quarry to the north-east of the site are noted to vary considerably, mostly due to rainfall and local catchment runoff. Historical aerial photographs and previous site observations dating back several years has generally indicated times of water storage in the quarry base and the associated settling ponds, however, there is little to no evidence of significant water seepage through the quarry walls or floor. Currently, the quarry is essentially dry, although it is noted that several pumps are present at various locations across the quarry.

Extensive investigations by DP have been undertaken on the Bringelly Shale Formation at Eastern Creek. The results of in situ testing indicate that:

- The transmissivity of the shale/siltstone is low to very low with estimated hydraulic conductivity of 10^{-6} to 10^{-8} m/sec; and
- The groundwater is highly saline and therefore unsuitable for stock watering or irrigation.

Historical data published by Old A.N (1942) reported chloride ion concentrations in the Blacktown area of 6 – 8 g/L with a peak value from the Bringelly shale of 31.75 g/L.

4.3 Soil Landscapes

Reference to the Penrith 1:100 000 Soil Landscape Sheet for the area suggests that the site is primarily underlain by the Blacktown soil landscape (shaded brown in Figure 7), with the alluvial South Creek soil landscape following the Reedy Creek alignment east of the site (shaded green in Figure 7). Mapping also indicates an extensive area of 'disturbed terrain' (shaded dark brown in Figure 7), which represents the extensive quarrying and stockpiling that has occurred across the site.

Blacktown is a residual soil landscape formed on low hills and rises underlain by the Wianamatta Group Shale with slope gradients typically 0-10%. These soils are typically shallow on crests and moderately deep on slopes and drainage lines. The soils are moderately erodible, have a high erosion hazard and are moderately reactive.

The South Creek soil landscape is an alluvial soil landscape formed in the floodplains and creek lines of the Cumberland Plain, is derived from Wianamatta Group Shale and has slope gradients typically of 0-3%. This landscape is highly modified due to rural/urban development. It is an active alluvial area with many areas of fluvial erosion (including streambank erosion) and deposition. The soils may have local severe salt scalding and localised sheet and gully erosion.

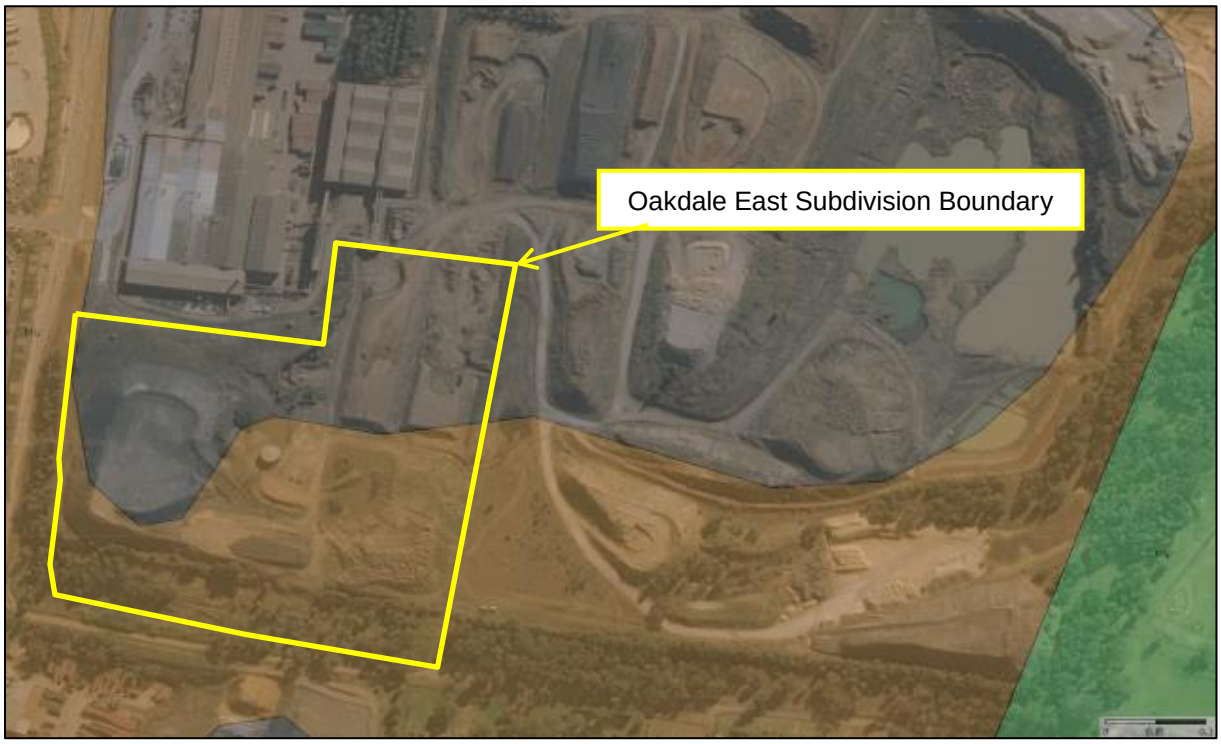


Figure 7: Extract of Regional Soil Landscapes Map

4.4 Salinity

Regional mapping of soil salinity hazard in Western Sydney has been undertaken by the Department of Infrastructure and Planning. Mapping indicates a moderate salinity potential for most of the site with a high salinity potential indicated along Reedy Creek to the east of the site. Where excavation has been undertaken for quarrying, the salinity potential would be lower due to the removal of the overburden soils. A preliminary assessment of potential salinity levels was undertaken as part of the geotechnical investigation. Further discussions are presented below in Section 8.9.

4.5 Acid Sulphate Soils

No acid sulphate soils have been mapped in the vicinity of the site. There were no signs of acid sulphate soils being present on the site during the field investigation.

5. Field Investigation

5.1 Field Work Methods

The field work for this investigation was conducted over three days from 22 to 24 October 2018 and included:

- Walkover inspection by a Senior Geotechnical Engineer.
- Drilling of three bores (BH1 to BH3) using a truck mounted drill rig fitted with solid flight augers and a tungsten carbide (TC) bit. Bores BH1 and BH2 were drilled in the areas of proposed deepest cuttings and were initially drilled up to 1 m into rock to depths of 1.45 m and 2.35 m respectively to identify the subsurface conditions. Both bores were then extended using NMLC diamond core methods to depths of 10.05 m and 10.25 m, respectively. Bore BH3 was drilled adjacent to an existing water tank on top of an existing soil stockpile to ascertain if the supporting foundation was filling or natural soil. Bore BH3 was drilled using augers to 10.45 m depth and did not intersect rock.
- Standard penetration tests (SPT) were carried out at regular depth intervals during auger drilling in all three bores to assess apparent in situ strength and subsoil consistency.
- Excavation of 18 test pits (TP1 to TP16, TP3A and TP5A) using a 3.5 tonne excavator fitted with a 450 mm wide toothed bucket. The test pits were excavated to depths of between 0.8 m and 4 m to identify the upper subsoil profiles and to allow more detailed inspection and sampling of the near-surface soils.
- Dynamic cone penetrometer (DCP) tests adjacent to selected locations to assess in situ soil strength.
- Sampling of soils to assist in logging and to provide specimens for laboratory testing of soil plasticity, aggressivity, salinity and California bearing ratio tests.

The locations of the tests and ground surface levels at the boreholes and test pits were measured relative to MGA94 and AHD using dGPS and are generally accurate to within 0.1 m. The borehole and test pit locations are shown on Drawing 1, in Appendix B.

It is noted that the investigation covered a larger area of the Austral Bricks Plant 3 site due to earlier revisions of the Masterplan indicating a possible larger subdivision footprint. It is considered that the location and number of tests undertaken during the field investigation is sufficient to adequately categorise the site, although it may be beneficial to undertake additional test pitting to further refine the development design (e.g. for earthworks, salinity, or similar) once the existing stockpiles of brick making materials have been removed.

5.2 Field Work Results

The subsurface conditions encountered in the boreholes and test pits are given in the borehole and test pit log descriptions in Appendix C, together with notes defining classification methods and descriptive terms.

A summary of the typical sequence of subsurface conditions encountered at site is presented below:

Filling:	Generally poorly to moderately compacted but also well compacted, grey and brown sandy clay, silty clay, gravelly clay, clay and ripped shale filling with some shale and sandstone gravels, cobbles and boulders from the ground surface to depths of between 0.5 m and 8 m at test pits TP1 to TP5A, TP8, TP9, TP13 to TP16 and bores BH1 to BH3. All filling is associated with the existing stockpiles on the site or shallow regrade works along the southern boundary. Test pits TP2 to TP5 also contained considerable quantities of refuse bricks and pavers, indicating possible refuse product stockpiles that have since become partially buried by further stockpiling of soil.
Topsoil:	Firm grey silty clay topsoil with fine gravels and grass rootlets from the ground surface at test pits TP6, TP7, TP11 and TP12 within the southern part of the site outside of the influence of the existing stockpiles. Generally moist and between 0.1 m and 0.2 m thick.
Natural (Residual) Clays:	Stiff, very stiff and hard red-brown, orange-brown, brown and grey silty clay, gravelly clay, clay and shaly clay with some ironstone gravels in test pits TP2 and TP6 to TP14 and bores BH1 to BH3 underlying the filling or topsoil. Natural clays were generally dry to moist and extended to depths of between 0.9 m and 2.9 m.
Rock:	Extremely low to very low strength and occasionally low strength shale and siltstone encountered at the base of test pits TP2, TP6 to TP11, TP13 and TP16 from depths of 1.3 m to 2.8 m. The deeper cored bores BH1 and BH2 encountered shale and laminite over sandstone and interbedded siltstone and sandstone from depths of 1.25 m and 1.4 m to the termination of drilling at approximately 10 m depth. Rock core strength testing indicating a gradation of rock strengths from very low to medium-high strength with the rock assessed as extremely to slightly weathered.

Most of the filling encountered in the test pits and boreholes is associated with the existing stockpiles of potential brick making material stored on the site. It is apparent from the test locations however, that the visual separation of the stockpiles at the ground surface is not always a true indication of the existence of filling below the ground surface, as it appears that some of the existing access roads on

the site have been partially formed on filling that is probably the result of prior stockpiling at greater depth (refer TP13 to TP16).

Groundwater was observed as a minor seepage flow across the top of the shale in test pit TP2 at a depth of 2.8 m. Groundwater was also observed as stored water within the filling in test pit TP4 at 1 m depth. Groundwater was not encountered in any of the other test pits or the bores. Long-term measurement of groundwater levels was beyond the scope of this investigation.

6. Laboratory Testing

Soil samples were collected from selected boreholes and test pits during the field investigation. Four representative samples of soil collected from the test pits were subjected to laboratory Atterberg limits tests in accordance with AS1289.3.1.2, AS1289.3.2.1 and AS1289.3.3.1 and California bearing ratio (CBR) tests in accordance with AS1289.6.1.1. The test results are presented in Appendix D and are summarised in Table 1.

Table 1: Summary of Laboratory Atterberg Limits and CBR Test Results

Test Pit	Depth (m)	Soil Description	LL (%)	PL (%)	PI (%)	CBR (%)	Swell (%)
TP5A	0.2 – 0.8	Silty Clay Filling	40	18	22	4.5	1.0
TP7	0.2 – 0.8	Clay	58	22	36	1.5	2.5
TP9	0.3 – 0.8	Clay	63	21	42	1.0	4.0
TP13	0.4 – 0.9	Clay	53	18	35	6	1.0

Where: *LL = Liquid Limit* *PL = Plastic Limit* *PI = Plasticity Index*

In addition, four representative samples collected from the test pits were subjected to a suite of chemical tests including texture classification, electrical conductivity, pH, chlorides (Cl), and sulphates (SO_4). The test results are presented in Appendix D and are summarised in Table 2.

Table 2: Summary of Laboratory Aggressivity and Salinity Test Results

Sample ID	Depth (m)	$EC_{1:5}$ (dS/m)	Texture Class	ECe (dS/m)	pHw (1:5)	Cl (mg/kg)	SO_4 (mg/kg)	Comments*	
								Salinity	Acidity
TP8	1.0	0.20	LC	1.70	5.6	210	39	Non Saline	Moderate
TP9	0.5	0.50	LMC	4.00	5.0	600	150	Slight	Very Strong
TP10	0.5	0.26	MC	1.82	5.3	240	68	Non Saline	Strong
TP11	1.0	0.39	LMC	3.12	5.2	400	140	Slight	Strong

Where
$EC_{1:5}$ = Electrical Conductivity
EC_e = Electrical Conductivity corrected for texture
pHw = pH in water
Cl = Chloride
SO4 = Sulphate
** = Refer text below*
LC = Light Clay
MC = Medium Clay
LMC = Light Medium Clay

7. Proposed Development

It is understood that the south-western part of the greater Austral Bricks Plant 3 site is proposed for development as an industrial estate that will include a number of new warehouses and a masonry plant situated on either side of a new estate cul-de-sac. The current Masterplan indicates four warehouses and a masonry plant with extensive hardstands for product storage and vehicular use/parking. A copy of the Masterplan is presented in Appendix B (refer Drawing No. OAK EAST MP07 (A)).

Project specifics include a considerable volume of cut to fill earthworks to create the various levelled building pads and road alignment. It is anticipated that the warehouses will be of steel portal frame construction supported on pad footings founding at relatively shallow depth. The buildings will include mezzanine offices and will be clad with sheet metal. The warehouse slabs and surrounding hardstands and car parks will likely be of reinforced concrete. The central industrial access road will be of flexible design and will include an asphalt seal over conventional roadbase.

Subject to final design levels, the construction of retaining walls may be required internally between lots or externally at the perimeter of the estate unless there is sufficient space available to construct batters.

8. Comments

8.1 Geotechnical Model

Based on the regional mapping, our walkover inspection, previous projects on the site and nearby, and the results of the investigation the subsurface conditions on the Oakdale East site generally consist of:

- Filling associated with the considerable stockpiling of large ‘stock-in-trade’ stockpiles that comprise various blends of clays, ripped shale and ripped sandstone as potential brick making materials;
- Remnant filling from on-site regrade earthworks associated with previous site developments, installation of services and fire sprinkler mains and regrading of the site for the formation of internal access roads and site drainage pathways; over
- Topsoil (clayey silt and silty clay) typically less than 0.3 m thick (where present); over
- Stiff to hard silty clays and clays to depths of 1 m to 3 m across most of the site, although some areas affected by previous quarrying activities have had their overburden soil profiles removed; over
- Highly to slightly weathered, very low to low (and higher) strength shale, siltstone and sandstone, with interbedded siltstone and sandstone at depth. Typically, the degree of weathering reduces with depth, which corresponds with an increase in rock strength.

Localised filling can be expected around existing structures, service lines and access roads. The investigation results indicate that such filling is generally up to 1.5 m thick (at the test locations, potentially deeper elsewhere) when intersected outside of the stockpile areas. Within the stockpiles

the investigation encountered filling to 8 m depth, although it is likely that such filling exceeds 10 m depth centrally within the larger stockpiles.

The natural soil thickness below the filling and topsoil is generally 1 m to 1.5 m thick but was encountered to 2.9 m thickness at test pit TP14, which may indicate a propensity for deeper soil profiles on lower slopes as compared to higher ridge crests. The clays are generally moderately to highly reactive to soil moisture variation (i.e. they are likely to shrink and/or swell).

Unmapped igneous dykes have previously been identified north of Oakdale East and it is therefore possible that further similar dykes may be encountered inside the site. These dykes are likely to be associated with the diatremes mapped to the south west of the site. Generally, these dykes have been localised and typically less than 3 m wide. The dyke rock and other rocks immediately adjacent to the dyke may be either much higher strength or, alternatively, much lower strength than the typical host rocks in the area. Intrusion of the dykes can sometimes cause fracturing of the surrounding rocks and can also cause damming of groundwater seepage.

There is likely to be some softer and wetter near-surface soils along the existing drainage lines and additionally near the rock surface due to minor subsurface seepage flow. Such seepage is likely to be intermittent and relatively minor.

8.2 Site Preparation and Earthworks

Prior to commencing bulk earthworks on the site it will be necessary to remove all 'stock-in-trade' stockpiles to avoid a loss of material assets with general site cutting. All stockpiles should be wholly relocated outside of the subdivision footprint and kept for future brick making purposes elsewhere within the Austral Bricks property.

Once the site is uninhibited by the stockpiles, the following site preparations should be undertaken:

- Remove all existing vegetation and root affected soils, topsoils and existing filling from the development footprint and stockpile for reuse in landscaped areas, or remove from site, giving due consideration to the requirements of the site contamination assessment.
- Proof roll the exposed surface within areas proposed for filling using a minimum 10 tonne smooth drum roller in non-vibration mode. The surface should be rolled a minimum of six times with the last two passes observed by an experienced geotechnical engineer to detect any 'soft spots'. Remove any additional unsuitable soil identified during proof rolling.
- For unsuitable areas after removal of 'soft spots', compact the exposed base of any rework area to a minimum dry density ratio of 98%, relative to Standard compaction, maintaining the moisture content of the filling within 2% of Standard OMC.
- Place suitable site materials, or suitable imported filling, within the rework depth in 300 mm maximum thickness layers and compact to a minimum dry density ratio of 98%, relative to Standard compaction, maintaining the moisture content of the filling within 2% of Standard OMC.
- Place sufficient additional layers of filling to return the ground surface to its initial stripped level.
- Place additional layers of filling in a similar manner until finished bulk surface level is attained.

Geotechnical inspection and testing of the filling should be carried out in accordance with a Level 1 standard, as defined in AS3798-2007 Guidelines for Earthworks for Commercial and Residential Developments.

The moderately to highly plastic nature of the residual clays are such that very poor trafficability conditions should be expected when this material is exposed to wet weather. The use of a minimum 150 mm thick layer of strong, durable crushed rock fill or recycled concrete as a protective 'running' surface may allow 'all-weather' access to the site following wet weather and thus should be considered for the site's surface on completion of the bulk earthworks.

The moderately to highly reactive nature of the residual clays results in a potential for adverse shrink and swell ground movements as the moisture content of the soil changes. The potential for and extent of movement will increase if these soils are compacted too dry or too wet. Accordingly the soils are likely to be suitable for reuse on the site provided that the moisture content of the soils is carefully controlled during compaction and the soils are protected against drying out after compaction is completed (i.e. by placement of subsequent filling layers or a protective layer of granular filling, as outlined in the preceding paragraph.

8.3 Excavation

Current indications are that up to 7 m to 8 m of cutting and/or filling may be required to achieve final design levels. Accordingly, excavation will mostly be within existing natural clay and weathered shale, although the deepest areas of cutting will encounter medium and possibly high strength rock. Subject to the anticipated balancing of the cutting and filling volumes across the site, excavation within weathered in situ shale, siltstone and sandstone is also likely at the base of benched cuttings and for detailed excavation of shallow footings (i.e. strip, pad, etc.), service trenches, or for the possible drilling of bored piles into rock within filling areas if piled footing systems are adopted.

Excavation of the upper soil layers (natural or filled) should be readily achieved using conventional earthmoving equipment, such as tracked excavators and scrapers. Subject to the depth of excavation proposed, ripping or hydraulic rock hammering will be required when excavations extend below 0.5 m into bedrock of at least low strength. For economical use of scrapers, pre-ripping of hard clay and weathered rock is suggested.

While excavation of the soils and weathered shale should be readily achieved using conventional earthmoving equipment such as bulldozers or excavators, if any igneous dykes are intersected by the works they may contain much harder rock which could require rock hammers for excavation.

Excavation of in situ rock below depths of approximately 3.5 m will intersect medium and possibly high strength shale and interbedded siltstone and sandstone. Extensive ripping is likely in this material prior to removal by excavator and truck, or scraper if sufficient material break-down has occurred during ripping.

It should be noted that any off-site disposal of spoil, if required, will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (NSW EPA 2014). Further advice can be obtained with reference to DP's environmental report for this project (refer report reference 86545.00.R.002.Rev0).

8.4 Retaining Walls

During bulk excavation and earthworks, it is recommended that temporary batter slopes do not exceed 1H:1V (45 degrees) within the filling and natural clay soils for batters up to 4 m high. For permanent batters, a maximum grade of 2H:1V (26 degrees) is suggested, reducing to 3H:1V (18 degrees) if maintenance access is required (i.e. mowing, or similar).

Retaining walls may be designed on the basis of an average unit weight of 20 kN/m^3 for the filling and natural clays, with a triangular earth pressure distribution calculated using an active earth pressure coefficient (K_a) value of 0.3 where some wall movement is acceptable, or an 'at-rest' earth pressure coefficient (K_o) value of 0.5 where wall movement is to be reduced. A coefficient of passive earth pressure (K_p) equal to 2.5 may be assumed within very stiff to hard clay and well compacted filling, to which a factor of safety must be applied in recognition of the fact that large movements are required to mobilise the full passive resistance.

The pressure distribution given above does not include hydrostatic pressure due to groundwater behind retaining walls, which should be included in the design unless adequate drainage is provided to prevent the build-up of hydrostatic pressures.

The design of batter slopes and retaining walls should account for surcharge loads, including storage of construction materials, adjacent pavements, access roads, buildings or similar. Design should also consider the effects of plant operating above the excavation and/or retaining wall during construction.

8.5 Foundations

It is likely that the construction of the Oakdale East estate will require significant cutting and filling of the site to form large level pads for warehouse construction. Accordingly, foundations are likely to be formed from exposed soil and rock in cuttings and on engineered filling elsewhere. Allowable bearing capacities will vary across soil and rock foundations within a typical range of 150 kPa (soil) to 1000 kPa (rock), possibly higher.

For lightly loaded structures, the varying foundation types are likely to represent Class S through to Class H1 conditions, when assessed in accordance with AS2870 Residential Slabs and Footings. Any areas underlain by existing uncontrolled filling would be Class P and would need to be reworked and compacted as engineered filling.

To reduce the magnitude of shrink and swell movement on new structures, consideration could be given to placing a 0.5 m thick layer of ripped rock across the surface of the natural clay and filled areas. This would also have a beneficial effect on increasing the available California bearing ratio (CBR) value of the subgrades below pavements and hardstand areas.

Subject to final design levels and the proposed footing types, it is anticipated that footings for the new warehouses will most likely comprise shallow pads founding within the upper 0.5 m to 1 m of the new controlled filling, natural clays and weathered bedrock. Alternatively, bored piles founding within the bedrock could be adopted, particularly in areas of deep filling, subject to column loads.

The parameters listed in Table 3 are suggested for footing design.

Table 3: Suggested Footing Design Parameters

Soil / Rock Profile	End Bearing		Shaft Adhesion	
	Allowable	Ultimate	Allowable	Ultimate
Compacted Filling	150	500	15	20
Stiff / Very Stiff Clay	150	500	15	25
ELS (Class V) Bedrock	700	3000	50	100
VLS / LS (Class IV) Bedrock	1000	3500	100	150

Notes: The values listed in Table 3 are subject to confirmation during construction.
Values for Extremely Low Strength (ELS) bedrock assume a minimum 0.5 m penetration of the footing into bedrock.
Values for Very Low Strength / Low Strength (VLS / LS) bedrock assume a minimum 2 m average penetration of the footing into bedrock, although actual depths to Class IV bedrock must be confirmed during construction.

To confirm the appropriateness of the adopted design footing parameters, it is recommended that all pad footing excavations bearing in soil are subjected to geotechnical inspection and dynamic cone penetrometer (DCP) testing during construction to verify that the listed allowable bearing pressures are available.

Shallow footings founding near excavations (i.e. lift wells, service trenches or similar) must have all loads transferred to below an influence line inclined upwards at 45 degrees commencing from the lowest and closest side of the excavation or trench base. Pad footings can be deepened to accommodate this load transfer or alternatively pile footings may be used.

Local variations in rock strength and depth may occur across the site. All pile or footing excavations in weathered rock should be inspected by a geotechnical engineer or engineering geologist and approved prior to concreting to confirm reduced pressures are not warranted due to extensively weathered or jointed zones.

8.6 Slope Stability

Site topography below the stock-in-trade stockpiles is generally undulating with relatively gentle hillslopes. Slope instability is not considered to be a significant issue for this site. Provided future batters and cuttings are appropriately designed, graded or retained, the proposed development is unlikely to cause any adverse effects on the land with respect to slope instability.

8.7 Pavements and Drainage

Subject to earthworks and the final condition of the soils within the upper 1 m of design subgrade level, natural and filled subgrades at this site can be assigned a preliminary design CBR value of 3%, which is higher than the lowest laboratory test results of 1% and 1.5% to account for variations in the filling and the probability that some gravel content will result from mixing of the soils and underlying weathered bedrock during excavation and filling. To maintain this design value, or any other amended/alternate design CBR value, it will be necessary to prepare the subgrade soils into a well compacted condition that is free of significant adverse long-term or differential settlements and/or deflection under service loading. It is noted that some subgrade improvement, or the placement of a

surface capping layer may be required to increase the CBR value of the subgrade to the minimum design value of 3%, or to a higher value to enhance the economy of the pavement construction (e.g. placement of 300 mm or so of CBR 20% material on CBR 3% material may achieve an effective CBR of 5%).

The pavement designer should consider the following:

- The loads applied to the various pavements over their design life, including normal road vehicle pavements, commercial in-service truck loads and possibly construction machinery loads.
- The magnitude and frequency of load repetitions of the various vehicles using each pavement.
- The need to provide edge constraints to the pavement, particularly along the crest of batters, immediately behind retaining walls and along the edge of landscaped areas.
- The position and grading of subsurface drainage lines, particularly with reference to pavement edges and internal landscaped openings.
- Pavement surface gradients and water flow to drainage lines. One-way cross fall pavements may be beneficial, otherwise regularly spaced and centralised drainage collection pits should be installed.
- The backfilling and compaction of service trenches, particularly below heavily loaded pavements.
- The ability of any filled subgrade to carry the load of the pavement.

DP advises that the relatively low CBR value materials on the site indicate that some trafficability issues may eventuate during construction if the soils become wet following rainfall. Capping the site with a suitable granular filling may prove highly beneficial during the earthworks programme. The possibility that the soils on the site will lose considerable strength if they become wet reinforces the need for appropriate drainage to be installed across the pavement and hardstand areas. Subsoil drains should be installed around the perimeter of all pavement areas, including any internal pavement openings (e.g. for landscaped garden beds, or similar).

In addition, a regular and long-term inspection and maintenance programme of the pavement should be adopted by the operator of the pavement. This maintenance program should be primarily aimed at limiting the amount of moisture infiltrating to the subgrade (e.g. inspecting drainage lines and repairing as required, maintaining construction joints and sealing or repairing cracks as they develop).

8.8 Groundwater

Based on the deep open quarry on the site, the regional groundwater table within Oakdale East is expected to be at about 30-50 m depth, subject to surface levels. However, there has been some visible evidence of seepage occurring on some of the mid-slopes of the quarry faces and there is a possibility of natural springs, as evidenced from an adjoining project. These springs suggest that the flow of natural seepage through the soils above the weathered rock has met a barrier of lower permeability, which causes the water to flow out of the ground surface rather than continuing through the soils.

The field investigation did not encounter any significant subsurface seepage flows and it is considered that such flows are likely to be intermittent and of a relatively minor concern.

The groundwater below the site is expected to be moderately saline due to the mineral salts contained within the Bringelly Shales.

8.9 Salinity

Access to the natural soil overburden on the site is precluded across most of the site due to the presence of existing large stockpiles. Samples were, however, collected from four test pits and were subjected to salinity testing to determine the salinity levels. All laboratory test results indicated non saline to slightly saline conditions, which is generally below that indicated by the salinity potential map. Further salinity testing should be undertaken after removal of the stockpiles so that the site can be adequately categorised and the earthworks appropriately engineered. Based on the results of the additional salinity assessment, the need for a site specific Salinity Management Plan (SMP) can be ascertained.

8.10 Soil Aggressivity

Provided the samples analysed represent the broader soils present at the site, then the soil conditions can be considered as being non-aggressive to buried steel elements and mildly aggressive (based on pH) to buried concrete elements. The laboratory test results were compared to the criteria listed within Australian Standard AS2159 (2009).

8.11 Erosion

The soils on the site are typically moderately erodible with the soils along the drainage lines identified as highly erodible. Surface and subsurface drainage will need to be designed to avoid concentrated flows of water which could accelerate the effects of soil erosion.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at 224-398 Burley Road, Horsley Park in accordance with DP's proposal SYD180799 dated 4 September 2018 and acceptance received from Mr Guy Smith of Goodman Pty Ltd dated 10 September 2018. The work was carried out in accordance with the agreed terms of the professional services agreement for this project. This report is provided for the exclusive use of Goodman Pty Ltd 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, other sites 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 subsurface 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. Subsurface 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.

This report must be read in conjunction with all of the attached notes 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.

The scope for work for this report did not include the assessment of surface or subsurface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

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.

Appendix B

Drawings

Goodman

BRICKWORKS

EXISTING AUSTRAL BRICKWORKS BUILDING

MILLNER AVENUE

FUTURE MILLNER AVE EXTENSION

OLD WALLGROVE ROAD

ELECTRICAL TRANSMISSION EASEMENT

STORAGE HARDSTAND

FUTURE DEVELOPMENT

WAREHOUSE 1

MASONRY PLANT

NEW ESTATE ROAD

WAREHOUSE 2

WAREHOUSE 3A

WAREHOUSE 3B

WAREHOUSE 4

OSD BASIN

FUTURE SOUTHERN LINK ROAD

SBA ARCHITECTS

Oakdale EAST

Horsley Park

Proposed Development

SSDA Masterplan

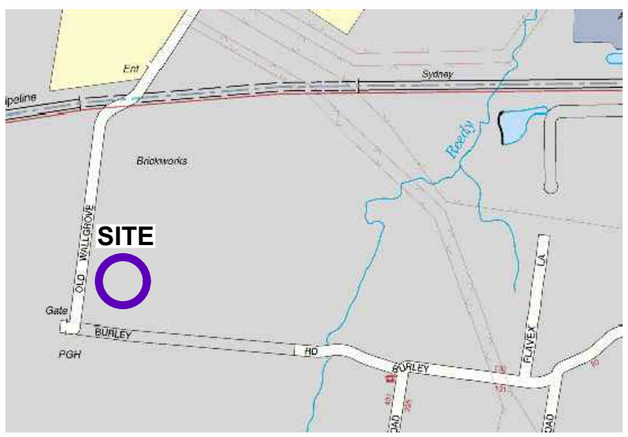
0 50 250

1:2500 @ A1
1:5000 @ A3

6 March 2019

OAK-E MP02 (D)

Job No. 18226



Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 30.10.2018)
2: Test locations are approximate only and are shown with reference to existing features.

0 10 20 30 40 60 80 100 150 200 250m

1:2500 @ A3

LEGEND

- Test pit location
- Borehole location

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Goodman Pty Ltd		TITLE: **Approximate Locations of Tests**	PROJECT No: 86545.01
OFFICE: Sydney	DRAWN BY: PSCH	**Oakdale East Industrial Estate**	DRAWING No: 1
SCALE: 1:2500 @ A3	DATE: 11.12.2018	**224-398 Burley Road, HORSLEY PARK**	REVISION: 1

Appendix C

Field Work Results

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.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and 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 test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

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

* 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
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

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 some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or better. 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

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

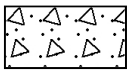
Symbols & Abbreviations

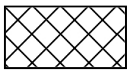
Graphic Symbols for Soil and Rock

General

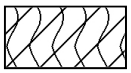

Asphalt

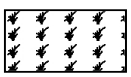

Road base

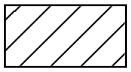

Concrete

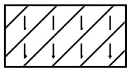

Filling

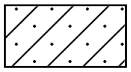
Soils


Topsoil

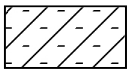

Peat

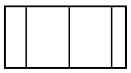

Clay

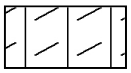

Silty clay

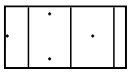

Sandy clay

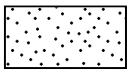

Gravelly clay

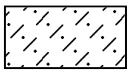

Shaly clay

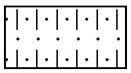

Silt


Clayey silt


Sandy silt

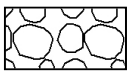

Sand

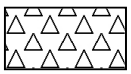

Clayey sand


Silty sand


Gravel

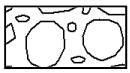

Sandy gravel


Cobbles, boulders

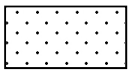

Talus

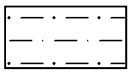
Sedimentary Rocks

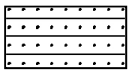

Boulder conglomerate

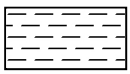

Conglomerate


Conglomeratic sandstone

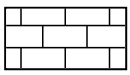

Sandstone


Siltstone

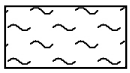

Laminite

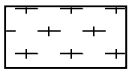

Mudstone, claystone, shale

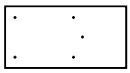

Coal


Limestone

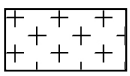
Metamorphic Rocks

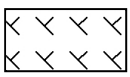

Slate, phyllite, schist

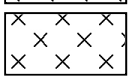

Gneiss

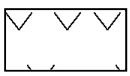

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 85.33 AHD
EASTING: 298941
NORTHING: 6254842
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86545.01
DATE: 22/10/2018
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
85	0.3	FILLING: dark grey-brown clay filling with some shale gravel (fragments)							A			
		SILTY CLAY: apparently stiff, orange-brown silty clay, moist							A			
84	1.25	SHALE: extremely low strength, grey-brown shale						Unless otherwise stated rock is fractured along rough, planar bedding dipping 0°-10°	A S			6,14,23 N = 37
	1.45	SHALE: very low to low strength, highly weathered, fragmented and slightly fractured, grey-brown shale						1.45-1.60m: fg 1.7m: B 0°, fe, cly 20mm 2.1m: J 30°, pl, sm, cly 10mm	C	94	0	PL(A) = 0.1
83	2.3											
	2.35	SHALE: very low strength, highly to moderately weathered, slightly fractured, grey and brown shale with some medium strength bands						2.25m: CORE LOSS: 50mm 2.6m: J 70°, un, ro, cly 5mm 2.85m: J 70°, he, cly 3.30-3.45m: Cs 3.52-3.65m: Cs 3.75-3.78m: Cs	C	100	10	PL(A) = 0.3
82												
81	3.95	SHALE: medium strength, slightly weathered, fractured, grey-brown shale						3.93m: B 0°, cly, fg 10mm 4.25m: J 45°, pl, ro, fe 4.4m: J 45°, pl, ro, fe 4.65-4.90m: B (x2) 10°, fe	C	100	75	PL(A) = 0.5
80								5.13m: J 80°, un, ro, cln 5.25m: J 35°, pl, sm, fe				PL(A) = 0.6
79	6.5	INTERBEDDED SILTSTONE AND SANDSTONE: medium and medium to high strength, slightly weathered and fresh, fractured and slightly fractured, pale grey to grey and brown, fine grained sandstone interbedded and laminated with grey siltstone						6.10&6.15m: J 50°, un, ro, fe 6.30-6.45m: fg, fe 6.4m: J 85°, pl, ro, cln 6.52m: J 85°&45°, st, ro, fe 6.7m: J 45°-65°, un, ro, cln 7m: J 70°, pl, sm, fe 7.5m: J 70°, pl, ro, fe 8.1m: J 80°, un, ro, fe	C	100	98	PL(A) = 0.6 PL(A) = 0.8
78												
77												PL(A) = 0.6
76	9.7	SHALE: (see next page)						8.67m: B 0°, cly 10mm & J sv, pl, ro, fe 9.25m: J 85°, un, ro, cln 9.70-9.84m: B (x2) 0°, cly, ro	C	100	92	PL(A) = 1.1

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 1.0m

TYPE OF BORING: Solid flight auger to 1.0m, rotary wash-bore to 1.45m, NMLC-coring to 10.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 85.33 AHD
EASTING: 298941
NORTHING: 6254842
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86545.01
DATE: 22/10/2018
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
75	10.05	SHALE: very low strength, slightly weathered, slightly fractured, grey shale *(continued)*										
		Bore discontinued at 10.05m										
74	11											
73	12											
72	13											
71	14											
70	15											
69	16											
68	17											
67	18											
66	19											

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 1.0m

TYPE OF BORING: Solid flight auger to 1.0m, rotary wash-bore to 1.45m, NMLC-coring to 10.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: 1 PROJECT: HORSELY PARK OCTOBER 2018

1.45 – 6.00m

BORE: 1 PROJECT: HORSELY PARK OCTOBER 2018

6.0 – 10.05m

BOREHOLE LOG

CLIENT: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 87.35 AHD
EASTING: 299104
NORTHING: 6254819
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 86545.01
DATE: 23/10/2018
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
87	0.2	FILLING: grey silty clay filling with some fine sand and roadbase gravel and grass roots, moist							A			
		CLAY: apparently stiff to very stiff, red-brown clay with a trace of ironstone gravel, moist							A			
86	1.0	CLAY: very stiff to hard, red-brown clay, slightly silty with ironstone gravel, damp							A			
	1.4	SHALE: very low then very low to low strength, light grey-brown shale							S			8,19,25/50 refusal
	2	2.0m: becoming very low to low strength						Unless otherwise stated rock is fractured along rough planar bedding dipping 0°-10°	A			
85	2.35	LAMINITE: very low to low strength, highly to moderately weathered, fractured, grey-brown laminite with approximately 20% medium strength sandstone laminations and bands						2.35-3.15m: B (x10) 0°, fe, cly 3-10mm				PL(A) = 0.4
	3.3	SANDSTONE: medium and high strength, moderately weathered, fractured, grey-brown medium grained sandstone with some very high strength siltstone and very low strength sandstone bands						3.3m: B 0°, cly 5mm 3.5m: J 75°, pl, sm, cln	C	100	50	PL(A) = 3.4
84	4							4m: J 45°, pl, ro, fe 4.1m: J 45°, pl, ro, fe 4.25-4.75m: B (x5) 0°-5°, cly 5-10mm				PL(A) = 0.5
83	5							5.20-5.35m: B (x5) 0°, cly 5-10mm 5.5m: J 45°, pl, ro, fe				PL(A) = 1.1
82	6											PL(A) = 1.3
81	6.5	INTERBEDDED SHALE AND SANDSTONE: medium and high strength, slightly weathered and fresh stained, slightly fractured, pale grey, fine sandstone interbedded with shale with very low strength bands						6.55-6.62m: Ds	C	100	95	
80	7							6.9m: J 85°, un, ro, fe 7.04m: J 85°, pl, ro, fe 7.28m: J 65°, pl, ro, fe				PL(A) = 2.6
	8							7.66-7.98m: B (x2) 0°, fe, cly 10mm				PL(A) = 0.5
79								8.4m: B 0°, fe, cly 10mm				PL(A) = 0.1
78	9							8.8m: J 45°, un, ro, cly 8.85-8.87m: Cs 8.9m: B 10°, fe, cly 5mm 9.12m: B 5°, fe 9.3m: J 35°, pl, ro, fe 9.62m: J 25°, pl, ro, fe, cly 5mm	C	100	85	PL(A) = 1.5

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.35m

TYPE OF BORING: Solid flight auger to 2.35m, NMLC-coring to 10.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 87.35 AHD
EASTING: 299104
NORTHING: 6254819
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 86545.01
DATE: 23/10/2018
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
		SHALE AND SANDSTONE: (as above)						10.05m: B 5°, fe	C	100	85	PL(A) = 1.3
	10.25	Bore discontinued at 10.25m										

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.35m

TYPE OF BORING: Solid flight auger to 2.35m, NMLC-coring to 10.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

BORE: 2 PROJECT: HORSELY PARK OCTOBER 2018

2.35 – 7.00m

BORE: 2 PROJECT: HORSELY PARK OCTOBER 2018

7.0 – 10.25m

BOREHOLE LOG

CLIENT: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 88.15 AHD
EASTING: 298984
NORTHING: 6254973
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 86545.01
DATE: 23/10/2018
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
88	0.3	FILLING: light grey-brown clay and shale gravel filling, moist							A			
		FILLING: poorly compacted, light grey shale gravel filling, damp							A			
87	1								A			
									S			4,3,4 N = 7
									A			
86	2								A			
	2.0	FILLING: poorly compacted, light grey-brown clay filling with a trace of shale gravel, moist							S			3,3,4 N = 7
85	3											
	4.0	FILLING: apparently moderately compacted, light grey-brown ripped shale fragment filling, damp							S			5,8,7 N = 15
84	4											
	5											
83									S			3,7,9 N = 16
	6											
82	7											
81												
	8											
	8.0	CLAY: very stiff, mottled brown and light grey clay with ironstone gravel							S			6,11,16 N = 27
80	9											
79												
	10.0											

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Goodman Pty Ltd
PROJECT: Austral Brick Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Eastern Creek

SURFACE LEVEL: 88.15 AHD
EASTING: 298984
NORTHING: 6254973
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 86545.01
DATE: 23/10/2018
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
78		SHALY CLAY: hard shaly clay							S			10,19,25 N = 44
	10.45	Bore discontinued at 10.45m										
77	11											
76	12											
75	13											
74	14											
73	15											
72	16											
71	17											
70	18											
69	19											

RIG: Explora **DRILLER:** SS **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 89.0 AHD
EASTING: 298971
NORTHING: 6254958

PIT No: TP1
PROJECT No: 86545.00
DATE: 23/10/2018
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 mm)
89		FILLING: grey, fine to coarse sand and ripped shale filling		A/E	0.2				
	0.3	FILLING: apparently moderately compacted, mottled brown and pale grey to grey clay and ripped shale filling, moist		A/E	0.5				
88	1			A/E	1.0				1
				A/E	1.5				
87	2			A/E	2.0				2
	2.5	FILLING: apparently stiff, mottled brown light grey clay filling with a trace of shale fragments, moist							
86	3			A/E	3.0				3
	3.2	Pit discontinued at 3.2m							
85	4								4

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 76.2 AHD
EASTING: 298927
NORTHING: 6255053

PIT No: TP2
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.25	FILLING: grey silty sandy clay filling, with some brick fragments and grass roots, moist		A/E	0.2				
		FILLING: apparently very stiff, grey clay filling with some crushed brick fragments (gravel to boulder sized angular to sub-angular), damp		A/E	0.8				
	1			A/E	1.0				1
75	1.2	FILLING: grey-brown clay/silty clay filling with a trace of brick/paver fragments, moist		A/E	1.5				
	1.8	CLAY: apparently stiff, mottled brown light grey clay, moist							
74	2			A/E	2.0				2
		2.5m: becoming shaly clay							
	2.8	SHALE: very low to low strength, grey-brown shale						23-10-18	
73	3			A/E	3.0				3
	3.0	Pit discontinued at 3.0m							
72	4								4

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed at 2.8m

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 78.5 AHD
EASTING: 298874
NORTHING: 6255069

PIT No: TP3
PROJECT No: 86545.00
DATE: 23/10/2018
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 mm) 5 10 15 20
78	0.0	FILLING: light grey-brown clay and ripped shale/brick fragment filling with concrete slab							
	0.8	Pit discontinued at 0.8m - Auger refusal on concrete slab							
	1								1
77									
	2								2
76									
	3								3
75									
	4								4
74									

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 78.5 AHD
EASTING: 298863
NORTHING: 6255076

PIT No: TP3A
PROJECT No: 86545.00
DATE: 23/10/2018
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)
78.5	0.0	FILLING: light brown silty clay and ripped shale fragment filling, angular, sub-angular and rectangular, moist		A/E	0.2				
	0.3	FILLING: apparently variably compacted, clay and ripped shale filling with some sandstone boulders, moist		A/E	0.5				
78									
	1			A/E	1.0				
77				A/E	1.5				
	1.8	FILLING: apparently moderately compacted, clay filling with a trace of brick and paver gravel (brick waste), moist to wet		A/E	2.0				
	2								
	2.3	FILLING: apparently well compacted, brick fragment filling with some clay							
76									
	3			A/E	3.0				
	3.0	Pit discontinued at 3.0m							
75									
	4								
74									

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 78.7 AHD
EASTING: 298818
NORTHING: 6255076

PIT No: TP4
PROJECT No: 86545.00
DATE: 23/10/2018
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)
78	0	FILLING: grey to grey-brown clay filling (brick waste) with shale gravel, angular, rectangular, medium to coarse with some sandstone and paver boulders, moist		A/E	0.2				
				A/E	0.5				
	1	1.0m: becoming wet		A/E	1.0			23-10-18	1
	1.5	FILLING: grey-brown clay, silty clay filling with large brick , timber, fabric, and metal wire, wet		A/E	1.5				
77	2			A/E	2.0				2
76	2.7	Pit discontinued at 2.7m		A/E	2.7				
	3								3
75	4								4
74									

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed at 1.0m

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 79.1 AHD
EASTING: 298802
NORTHING: 6255000

PIT No: TP5
PROJECT No: 86545.00
DATE: 22/10/2018
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	FILLING: grey-brown silty clay and ripped/crushed shale gravel filling, angular, subangular, moist		A/E	0.2				
				A/E	0.5				
	0.6	FILLING: brown, silty sand and brick/pavers, concrete slab silling, gravel to boulder in size, angular, rectangular, moist							
78	1			A/E	1.0				1
	1.5	Pit discontinued at 1.5m		A/E	1.5				
77	2								2
76	3								3
75	4								4

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/221018

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 79.9 AHD
EASTING: 298793
NORTHING: 6254981

PIT No: TP5A
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.8	FILLING: variably compacted, grey-brown silty clay with a trace of shale fragments/gravel and cobble size, angular, rectangular, moist		A/E	0.2				
				B A/E	0.5				
	1.0	FILLING: apparently well compacted, light grey and grey shale fragment filling, gravel to boulder size, damp		A/E	0.8				
		Pit discontinued at 1.0m - Excavator bucket refused on shale at 1.0m							

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 80.5 AHD
EASTING: 298857
NORTHING: 6254862

PIT No: TP6
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.2	TOPSOIL: grey to grey-brown silty clay topsoil with grass roots, moist							
		SILTY CLAY: stiff, orange-brown silty clay with a trace of ironstone gravel, moist		A/E	0.2				
				A/E	0.5				
	0.8	SHALY CLAY: hard, light grey-brown shaly clay with ironstone band							
	1			A/E	1.0				1
	1.3	SHALE: very low and low strength, grey-brown shale							
79				A/E	1.5				
	1.6	Pit discontinued at 1.6m - Excavator bucket refused on shale at 1.6m							
	2								2
78									
	3								3
77									
	4								4
76									

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 84.3 AHD
EASTING: 298919
NORTHING: 6254849

PIT No: TP7
PROJECT No: 86545.00
DATE: 23/10/2018
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 mm)
84	0.15	TOPSOIL: grey-brown silty clay topsoil with a trace of fine gravel and grass roots, moist							
		CLAY: stiff, mottled brown light grey clay with a trace of ironstone gravel, moist		A/E	0.2				
				B A/E*	0.5				
	0.8	SHALY CLAY: hard, light grey-brown shaly clay with ironstone bands		A/E	0.8 1.0				
83	1.4	SHALE: very low and low strength grey-brown shale		A/E	1.5				
	1.6	Pit discontinued at 1.6m - Excavator bucket refused on shale at 1.6m							
82									
81									
80									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3, 4

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD3/231018

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 87.0 AHD
EASTING: 299030
NORTHING: 6254831

PIT No: TP8
PROJECT No: 86545.00
DATE: 23/10/2018
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 mm)
87	0.0	FILLING: light grey-brown silty clay shale gravel filling, moist		A/E	0.1				
	0.5	CLAY: apparently stiff to very stiff, brown clay, slightly silty, moist		A/E	0.5				
86	1 1.0	SHALY CLAY: hard, light grey and brown shaly clay with ironstone bands, damp		A/E	1.0				1
	1.4	SHALE: very low and low strength, light grey-brown shale with ironstone bands		A/E	1.5				
	1.6	Pit discontinued at 1.6m - Excavator bucket refused on shale at 1.6m							
85	2								2
84	3								3
83	4								4

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 82.8 AHD
EASTING: 299199
NORTHING: 6254801

PIT No: TP9
PROJECT No: 86545.00
DATE: 23/10/2018
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)
	0.2	FILLING: light grey-brown silty clay filling, with a trace of roadbase gravel, humid		A/E*	0.1				
82	1	CLAY: stiff then very stiff, brown clay, slightly silty with ironstone gravel, moist		A/E	0.5				
				A/E	1.0				1
	1.2	SHALY CLAY: hard, light grey and brown shaly clay with ironstone bands, damp							
	1.5	SHALE: very low strength, light grey-brown shale with ironstone bands		A/E	1.5				
81	1.7	Pit discontinued at 1.7m - Excavator bucket refused on shale at 1.9m							
	2			A/E	2.0				2
80	3								3
79	4								4
78									

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD2/231018

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 78.8 AHD
EASTING: 299170
NORTHING: 6254918

PIT No: TP10
PROJECT No: 86545.00
DATE: 23/10/2018
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)
78	0.4	CLAY: stiff, red-brown clay, with some grass, grass roots, moist		A/E	0.2				
	1.0	CLAY: very stiff, orange-brown clay, slightly silty with a trace of ironstone gravel, moist		A/E	0.5				
77	1.4	SHALY CLAY: very stiff to hard, light grey-brown shaly clay with ironstone bands, damp		A/E	1.0				
	2.0	SHALE: extremely to very low strength, light grey-brown shale with ironstone bands		A/E	1.5				
76		Pit discontinued at 2.0m							
75									
74									

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 78.2 AHD
EASTING: 299220
NORTHING: 6254897

PIT No: TP11
PROJECT No: 86545.00
DATE: 23/10/2018
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)
78	0.1	TOPSOIL: grey, silty clay topsoil with some grass/grass roots, moist		A/E	0.1				
		CLAY: stiff, red-brown clay, moist		A/E	0.5				
	0.8	SILTY CLAY: very stiff, mottled brown-light grey silty clay with some ironstone gravel, moist		A/E	1.0				
77	1								1
	1.4	SHALE: very low and low strength, grey-brown shale		A/E	1.5				
	1.6	Pit discontinued at 1.6m							
76	2								2
75	3								3
74	4								4

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 74.8 AHD
EASTING: 299277
NORTHING: 6254822

PIT No: TP12
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.15	TOPSOIL: grey silty clay topsoil, with some fine gravel and grass/grass roots, moist							
		CLAY: stiff and very stiff, brown clay, moist		A/E	0.2				
				A/E	0.5				
	0.8	CLAY: very stiff, mottled brown and light grey clay, damp							
	1			A/E	1.0				1
	1.2	SILTY CLAY: hard, mottled orange-brown light grey silty clay with some ironcemented gravel, damp							
				A/E	1.5				
	1.6	SHALY CLAY: hard, light grey-brown shaly clay, damp							
73	1.8	Pit discontinued at 1.8m		A/E	1.8				
	2								2
72	3								3
71	4								4
70									

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 74.6 AHD
EASTING: 299194
NORTHING: 6254965

PIT No: TP13
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.4	FILLING: grey silty clay and ripped shale filling, angular, tabular, rectangular gravel to boulder size, humid		A/E	0.2				
	0.9	CLAY: very stiff, red-brown clay, damp		A/E	0.5				
	1	SILTY CLAY: hard, yellow-brown silty clay with ironstone bands		A/E	1.0				
	1.3	SILTSTONE: very low and low to medium strength, light brown siltstone with ironstone bands		A/E	1.5				
73	1.6	Pit discontinued at 1.6m							
72	2								
71	3								
70	4								

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 73.8 AHD
EASTING: 299189
NORTHING: 6255060

PIT No: TP14
PROJECT No: 86545.00
DATE: 23/10/2018
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	FILLING: light grey-brown silty clay filling, with some sand and ripped sandstone gravel to cobble size, moist							5 10 15 20
	0.2	FILLING: apparently well compacted, light grey-brown ripped shale filling with silty clay, damp		A/E	0.2				
				A/E	0.5				
	1			A/E	1.0				1
	1.1	CLAY: apparently very stiff then hard, red-brown clay, moist							>>
				A/E	1.5				
72	2	2.0m: mottled brown, light grey, hard		A/E	2.0				2
	3								
	3.0	GRAVELLY CLAY: apparently hard, orange-brown gravelly (ironstone) clay, moist		A/E	3.0				3
71	3.5	CLAY: apparently stiff, light grey mottled brown clay, moist							
70	4								4
	4.0	Pit discontinued at 4.0m		A/E	4.0				
69									

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 71.8 AHD
EASTING: 299302
NORTHING: 6254956

PIT No: TP15
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.3	FILLING: light brown, silty clay filling, moist		A/E	0.2				
		FILLING: apparently well compacted, light grey-brown shale fragments and clay filling, damp		A/E	0.5				
	1.0			A/E	1.0				
		FILLING: apparently well compacted, grey shale fragment filling with some fine grained sandstone boulders, damp							
	1.5	Pit discontinued at 1.5m		A/E	1.5				
70	2								
69	3								
68	4								
67									

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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: Goodman Pty Ltd
PROJECT: Plant 3 Redevelopment
LOCATION: 224-398 Burley Road, Horsely Park

SURFACE LEVEL: 66.3 AHD
EASTING: 299307
NORTHING: 6255020

PIT No: TP16
PROJECT No: 86545.00
DATE: 23/10/2018
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	0.5	FILLING: poorly compacted, light grey-brown sandy clay and sandstone boulders, moist		A/E	0.2				
		SHALE: very low and low to medium strength, grey shale		A/E	0.5				
65	1.0	Pit discontinued at 1.0m		A/E	1.0				
64	2								
63	3								
62	4								

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

RIG: 3.5t Excavator - 450mm bucket

LOGGED: SI

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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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Appendix D

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: mick.gref@douglaspartners.com.au

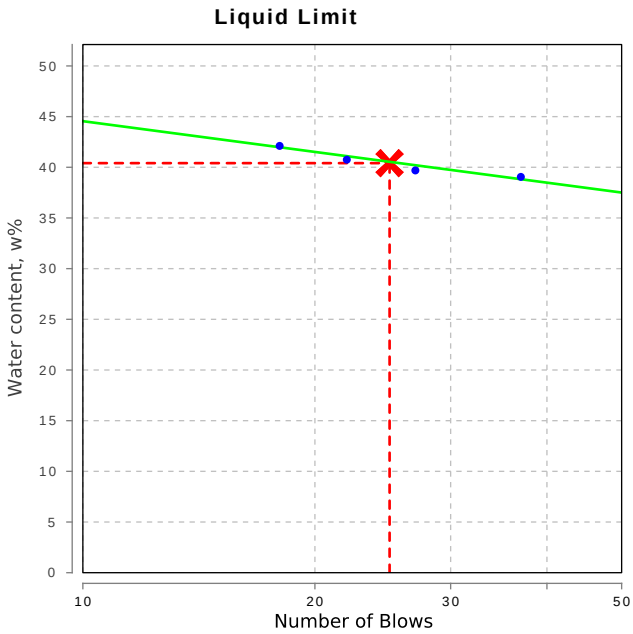
Accredited for compliance with ISO/IEC 17025 - Testing

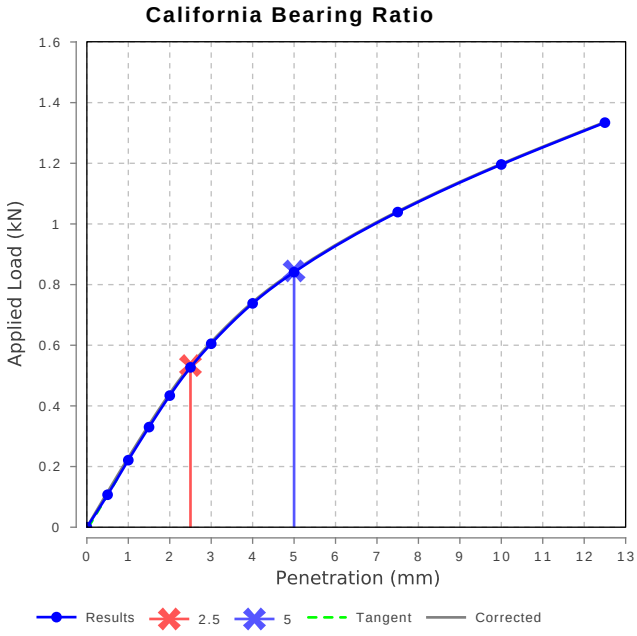
Approved Signatory: Mick Gref
Senior Technician
NATA Accredited Laboratory Number: 828

Report Number: **86545.01-1**
Issue Number: 1
Date Issued: 19/11/2018
Client: Goodman Py Ltd
Level 17, Sydney NSW 2000
Contact: Guy Smith
Project Number: 86545.01
Project Name: Plant 3 Redevelopment
Project Location: 224-398 Burley Road, Horsley Park
Work Request: 3824
Sample Number: 18-3824A
Date Sampled: 22/10/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **TP5A (0.2 - 0.8m)**
Material: FILLING: Grey-brown silty clay with a trace of shale fragments/gravel and cobbles

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	18		
Plasticity Index (%)	**22**		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.77		
Optimum Moisture Content (%)	17.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.76		
Field Moisture Content (%)	16.2		
Moisture Content at Placement (%)	17.7		
Moisture Content Top 30mm (%)	20.0		
Moisture Content Rest of Sample (%)	19.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	216		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		





Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
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Accredited for compliance with ISO/IEC 17025 - Testing

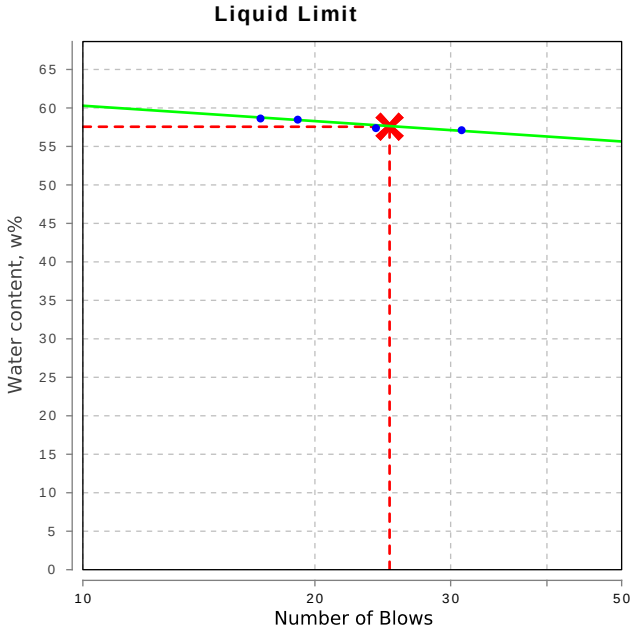
NATA
WORLD RECOGNISED ACCREDITATION

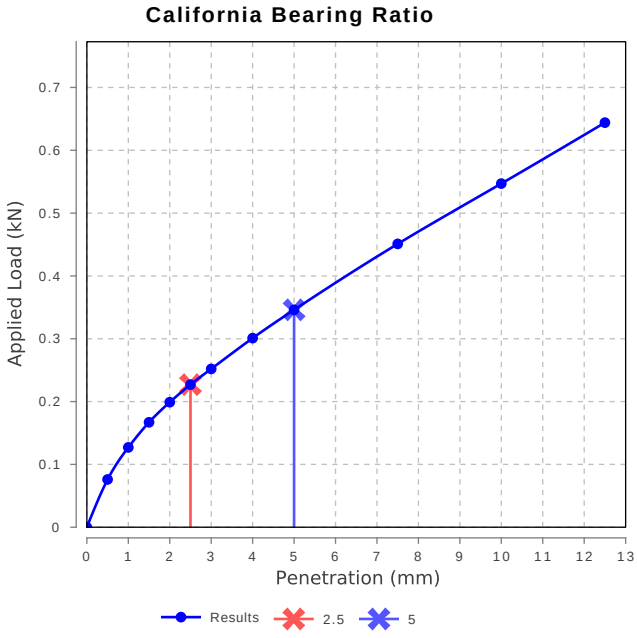
Approved Signatory: Mick Gref
Senior Technician
NATA Accredited Laboratory Number: 828

Report Number: **86545.01-1**
Issue Number: 1
Date Issued: 19/11/2018
Client: Goodman Py Ltd
Level 17, Sydney NSW 2000
Contact: Guy Smith
Project Number: 86545.01
Project Name: Plant 3 Redevelopment
Project Location: 224-398 Burley Road, Horsley Park
Work Request: 3824
Sample Number: 18-3824B
Date Sampled: 22/10/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **TP7 (0.2 - 0.8m)**
Material: CLAY: Mottled brown light grey clay with a trace of ironstone gravel

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	58		
Plastic Limit (%)	22		
Plasticity Index (%)	**36**		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.61		
Optimum Moisture Content (%)	23.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.57		
Field Moisture Content (%)	25.3		
Moisture Content at Placement (%)	22.9		
Moisture Content Top 30mm (%)	31.6		
Moisture Content Rest of Sample (%)	25.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	168		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		





Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
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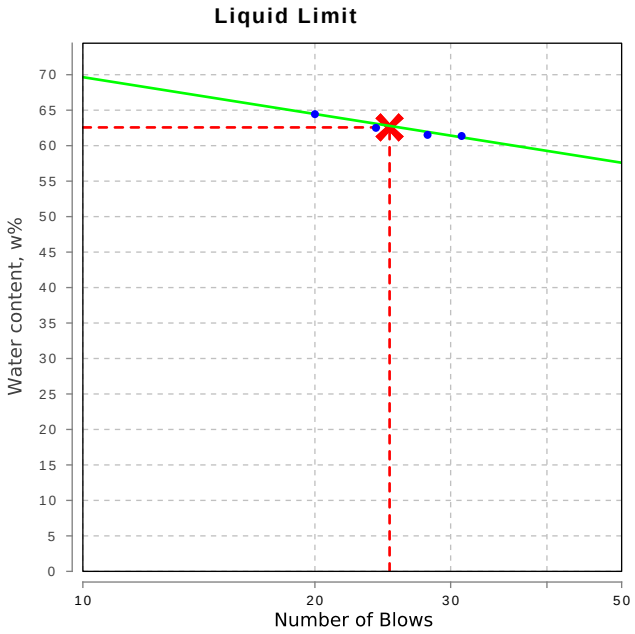
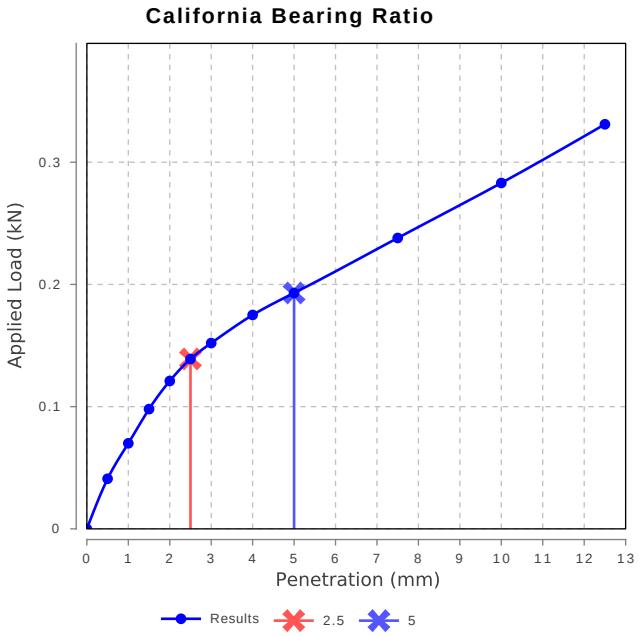
Senior Technician
NATA Accredited Laboratory Number: 828

Report Number: **86545.01-1**
Issue Number: 1
Date Issued: 19/11/2018
Client: Goodman Py Ltd
Level 17, Sydney NSW 2000
Contact: Guy Smith
Project Number: 86545.01
Project Name: Plant 3 Redevelopment
Project Location: 224-398 Burley Road, Horsley Park
Work Request: 3824
Sample Number: 18-3824C
Date Sampled: 22/10/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **TP9 (0.3 - 0.8m)**
Material: CLAY: Brown clay, slightly silty with ironstone gravel

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	63		
Plastic Limit (%)	21		
Plasticity Index (%)	**42**		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**1.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.62		
Optimum Moisture Content (%)	22.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.56		
Field Moisture Content (%)	23.5		
Moisture Content at Placement (%)	22.3		
Moisture Content Top 30mm (%)	34.3		
Moisture Content Rest of Sample (%)	24.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	312		
Swell (%)	4.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		





Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
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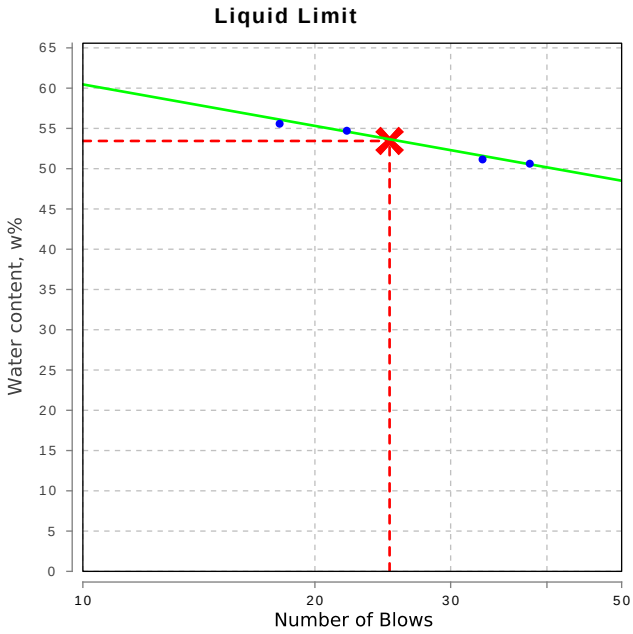
Accredited for compliance with ISO/IEC 17025 - Testing

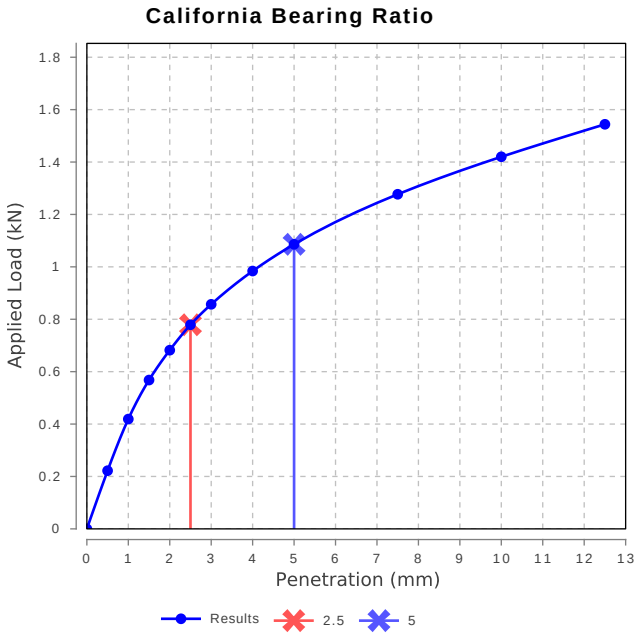
Approved Signatory: Mick Gref
Senior Technician
NATA Accredited Laboratory Number: 828

Report Number: **86545.01-1**
Issue Number: 1
Date Issued: 19/11/2018
Client: Goodman Py Ltd
Level 17, Sydney NSW 2000
Contact: Guy Smith
Project Number: 86545.01
Project Name: Plant 3 Redevelopment
Project Location: 224-398 Burley Road, Horsley Park
Work Request: 3824
Sample Number: 18-3824D
Date Sampled: 22/10/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **TP13 (0.4 - 0.9m)**
Material: CLAY: Red-brown clay

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	53		
Plastic Limit (%)	18		
Plasticity Index (%)	**35**		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**6**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	20.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.67		
Field Moisture Content (%)	15.5		
Moisture Content at Placement (%)	19.9		
Moisture Content Top 30mm (%)	22.1		
Moisture Content Rest of Sample (%)	21.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	216		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		





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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
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CERTIFICATE OF ANALYSIS 204312

Client Details

Client	Douglas Partners Pty Ltd
Attention	Ray Blinman
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86545.01, Oakdale East Industrial Estate**
Number of Samples	4 Soil
Date samples received	30/10/2018
Date completed instructions received	30/10/2018

Analysis Details

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

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

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

Report Details

Date results requested by	06/11/2018
Date of Issue	02/11/2018

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

Soil Aggressivity					
Our Reference		204312-1	204312-2	204312-3	204312-4
Your Reference	UNITS	TP8	TP9	TP10	TP11
Depth		1.0	0.5	0.5	1.0
Date Sampled		23/10/2018	23/10/2018	24/10/2018	24/10/2018
Type of sample		Soil	Soil	Soil	Soil
pH 1:5 soil:water	pH Units	5.6	5.0	5.3	5.2
Electrical Conductivity 1:5 soil:water	µS/cm	200	500	260	390
Chloride, Cl 1:5 soil:water	mg/kg	210	600	240	400
Sulphate, SO4 1:5 soil:water	mg/kg	39	150	68	140

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. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Soil Aggressivity					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	102	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[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.

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; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.