GROUNDED
EXPERTISE

Report on Geotechnical Investigation

Green Square Stage 3

960A Bourke Street, Zetland

Prepared for Mirvac Green Square Pty Ltd

Project 72258.23

12 December 2025

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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

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1. Introduction

1.1 The Project

This report supports one of the detailed State Significant Development Applications (SSDA) (SSD-83899206) and concurrent rezoning being lodged with the Department of Planning, Housing and Infrastructure (DPHI) for the construction of three mixed-use Build-to-Rent buildings at 960A Bourke Street (the site). The site is also known collectively as Sites 7, 17 and 18 of the Green Square Town Centre (GSTC) and is legally described as Lot 6, DP 1199427. The proponent for the SSDA is Mirvac Green Square Pty Limited.

The proposal aims to:

- Respond to the housing challenges facing Sydney through the delivery of diverse housing types in a highly accessible location;
- Demonstrate the strategic and site-specific merit of accommodating the proposed height and FSR of development on the site;
- Contribute to the establishment of Green Square as a town centre through a mixed-use approach and use urban design principles to integrate residential and non-residential land uses;
- Improve the pedestrian connectivity throughout the site, while encouraging the direct connections to public transport and the existing street network; and
- Appropriately respond to neighbouring development and public domain within the GSTC through podium and tower forms with appropriate massing, which protect solar access and minimise environmental impacts.

1.2 This Report

This report presents the results of geotechnical investigations undertaken on the site.

It is understood that the development will include the construction of three residential buildings over a common basement, and pedestrianised laneways. The buildings will be up to 19 to 20-storeys and will be constructed over a common one-level basement which will be approximately 5 m below the ground surface levels. The basement will not cover the full site footprint and therefore some structure will be constructed at or near the ground surface.

Various investigations have been undertaken to provide information on the subsurface conditions on the site and have included the drilling of boreholes, the installation of groundwater monitoring wells, groundwater level monitoring, laboratory testing and engineering interpretation. Details of the previous field work and comments relevant to design and construction are given in this report.

Douglas Partners has previously completed the following geotechnical investigation reports on the wider Green Square Town Centre site:

- Report on Preliminary Geotechnical Investigation Rev 1 dated 1 March 2011 (Project 72258.00);
- Report on Geotechnical Investigation for GSTC Sites 7, 17 and 18 Rev 3 dated 27 April 2023 (Project 72258.05).

This current report, which supersedes the previous reports, uses selected results from the previous investigations and a copy of the relevant borehole logs is given in Appendix C.

This report does not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. It is understood that another consultant is undertaking the contamination assessment for the site.

2. Site Description

The site is legally known as Lot 6 DP 1199427 and is bounded by Tweed Place and a multi-storey residential building to the north-west, Ebsworth Street and multi-storey residential buildings to the north-east, Paul Street to the south-east, and Green Square Library and Plaza to the south-west. It has an area of approximately 5,130 m^2.

The ground surface on the site slopes gently downwards to the north and west at grades in the order of 2% to 3%. The surface levels vary from about RL 18.1 m relative to the Australian Height Datum (AHD) near the south-eastern corner of the site to RL 15.1 m AHD in the north-western corner.

The site is currently covered with asphalt and was recently used to house temporary site sheds and provide vehicle parking for an adjacent development. A temporary public walkway links Green Square Library and Plaza with Ebsworth Street through the centre of the site.

3. Regional Geology

The *Sydney 1:100 000 Geological Series Sheet* shows that the site is underlain by Quaternary-aged medium to fine-grained marine sands with podsols. Although not mapped, there is a significant depth of fill across the site associated with previous land uses as a clay/shale quarry and its subsequent backfilling.

An extract of the mapping is provided in Figure 1.

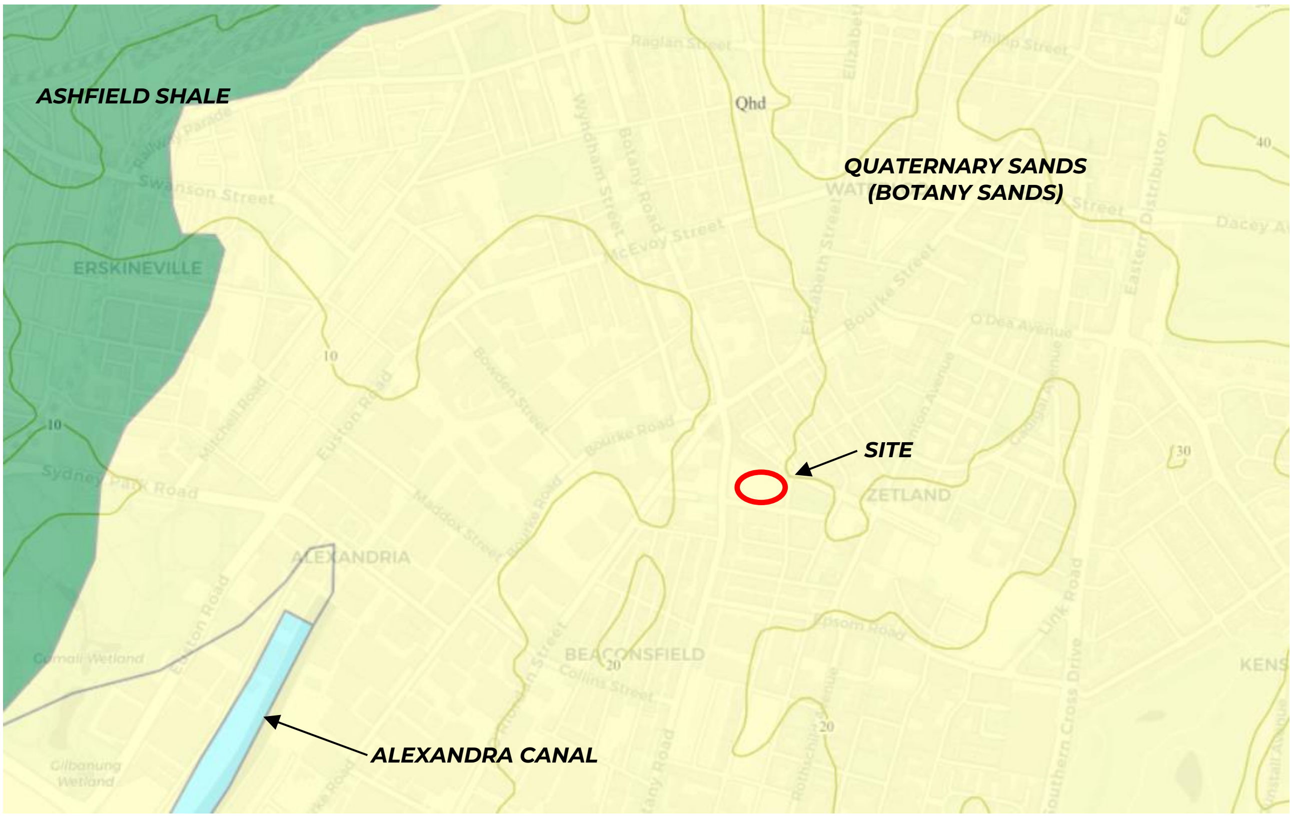

Figure 1: Extract from geological map with surface contours shown at 10 m intervals to AHD

4. Summary of Investigations

4.1 2011 Geotechnical Investigation

The field work for the 2011 preliminary geotechnical investigation on the wider Green Square Town Centre site included the drilling of three cored boreholes (P3, I3 and I4) to depths of between 14.9 m and 18.2 m using truck-mounted drilling rigs. The boreholes were labelled according to the site on which they were drilled; 'P' referring to the former Zetland Police complex site and 'I' referring to the former incinerator site.

4.2 2015 Geotechnical Investigation

The field work for the 2020 geotechnical investigation on the site included the drilling of seven cored boreholes (7-1 to 7-4, 17-1, 17-2 and 18-1) to depths of between 14.4 m and 18.2 m using truck-mounted drilling rigs.

Three boreholes (7-2, 7-3 and 18-1) were converted to temporary groundwater monitoring wells at the completion of drilling. This involved inserting Class 18 uPVC screen and casing to the required depth, backfilling the screened length with gravel, plugging the top of the gravel with bentonite pellets and backfilling the casing with drilling spoil.

The construction details of the groundwater monitoring wells are provided in Table 1.

Table 1: Construction Details of Groundwater Monitoring Wells

Well Location	RL of Ground Surface	RL of Top of Screen	RL of Base of Screen
7-2	17.2	13.2	1.2
7-3	15.1	9.7	0.7
18-1	18.1	17.1	2.1

Notes: All levels are in metres and relative to AHD

Slug testing was carried out in each monitoring well to assess the permeability of the surrounding soils. Both drawdown and inflow slug tests were undertaken. A drawdown slug test involves pumping water from the monitoring well and measuring the rate of recovery of the water level. An inflow slug test involves adding water to the monitoring well and measuring the rate of dissipation of the water. Both these methods are commonly used to estimate soil permeability rates at depth.

The rates of recovery and dissipation were measured using LevelTROLL 500 data loggers which were vented to allow atmospheric pressures to be taken into account in the water pressure readings. The loggers measured water levels at one second intervals during the testing programme.

LevelTROLL 500 vented data loggers were installed in the groundwater monitoring wells to monitor groundwater levels on the site. The loggers were installed on 5 June 2015 and recovered on 3 August 2015.

The borehole locations are shown on Drawing G1 in Appendix B. The ground surface levels at the bores were measured to AHD.

5. Field Work Results

5.1 Boreholes

The subsurface conditions encountered in the boreholes are presented in the borehole logs in Appendix C. Notes defining descriptive terms and classification methods are included in Appendix A. The boreholes encountered:

- FILL – sandy and clayey fill with varying proportions of ripped sandstone, brick, glass, charcoal, ash, rubber, wood, steel, lead and organic material to depths of between 4.4 m and 12.1 m. Numerous obstructions resulted in slow drilling progress;
- NATURAL SOILS – silty clay from 5.5 m to 11.1 m depth in bore 18-1. Sand, clayey sand, clay and sandy clay from 4.4 m to 12.5 m depth in bore P3. Silty sand and sand from 9.8 m to 12.3 m depth in bore I3. Natural soil was not encountered in the other boreholes where filling was directly underlain by bedrock;
- BEDROCK – sandstone, siltstone and laminite from depths of between 9.6 m and 12.3 m to the base of the bores at between 14.4 m and 18.2 m depth. In some bores the rock had a veneer of weathered material overlying medium and high strength rock, while in others the rock was medium or high strength from its surface.

Table 2 summarises the levels at which different materials were encountered in the boreholes. The rock has been classified in accordance with a system developed by Pells et al (1998) which classifies rock strata depending on strength, fracturing and defects. Class V rock is typically very low strength, highly weathered and highly fractured rock whereas Class I rock is typically high strength, fresh and unbroken rock.

Table 2: Summary of Material Strata Levels and Rock Classifications

Strata	RL of Top of Material Strata (m, AHD)									
	7-1	7-2	7-3	7-4	17-1	17-2	18-1	I3	I4	P3
Ground Surface/ Fill	17.0	17.2	15.1	16.1	17.9	17.9	18.1	17.2	15.5	17.5
Natural Soil	NE	NE	NE	NE	NE	NE	12.6	7.4	NE	13.1
Class V/IV Bedrock	6.2	5.5	5.5	4.0	5.8	7.1	7.0	4.9	7.0	5.0
Class III Bedrock	NE	NE	5.3	3.6	3.0	NE	4.9	4.1	5.7	2.7
Class II/I Bedrock	5.8	5.2	NE	3.1	2.2	5.1	3.9	3.5	5.0	1.5
Base of Borehole	0.4	0.0	0.7	-1.9	0.7	0.4	2.1	-1.0	0.6	-0.5

Notes: NE = not encountered; Rock classification in accordance with Pells et al (1998)

5.2 Groundwater Monitoring

Groundwater observations were made in the temporary groundwater monitoring wells installed following the completion of drilling and prior to permeability testing. A summary of these observations is provided in Table 3.

Table 3: Summary of Groundwater Observations in Groundwater Monitoring Wells

Date of Observation	RL of Groundwater (m, AHD)		
	DP7-2	DP7-3	DP18-1
5 June 2015	11.7	11.6	13.4

Groundwater levels were monitored using the vented loggers installed in the wells. The loggers were configured to record water levels at two-hourly intervals during the monitoring period.

A graphical summary of the monitoring data is shown in Figures 2 to 4. Daily rainfall information recorded by the Bureau of Meteorology at Sydney Airport is also included on the graphs. It should be noted that the daily rainfall totals are reported as rainfall in the 24 hours to 9 am rather than from midnight to midnight.

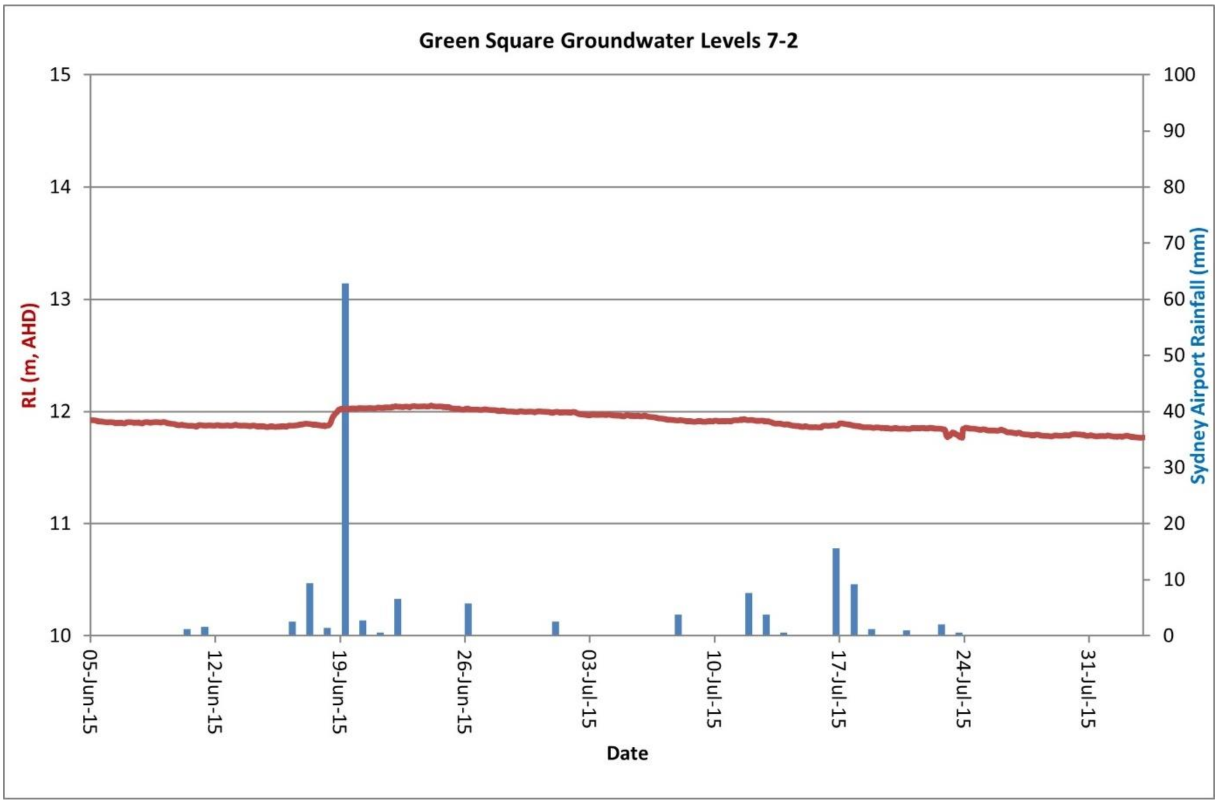

Figure 2: Results of Groundwater Monitoring in Monitoring Well 7-2

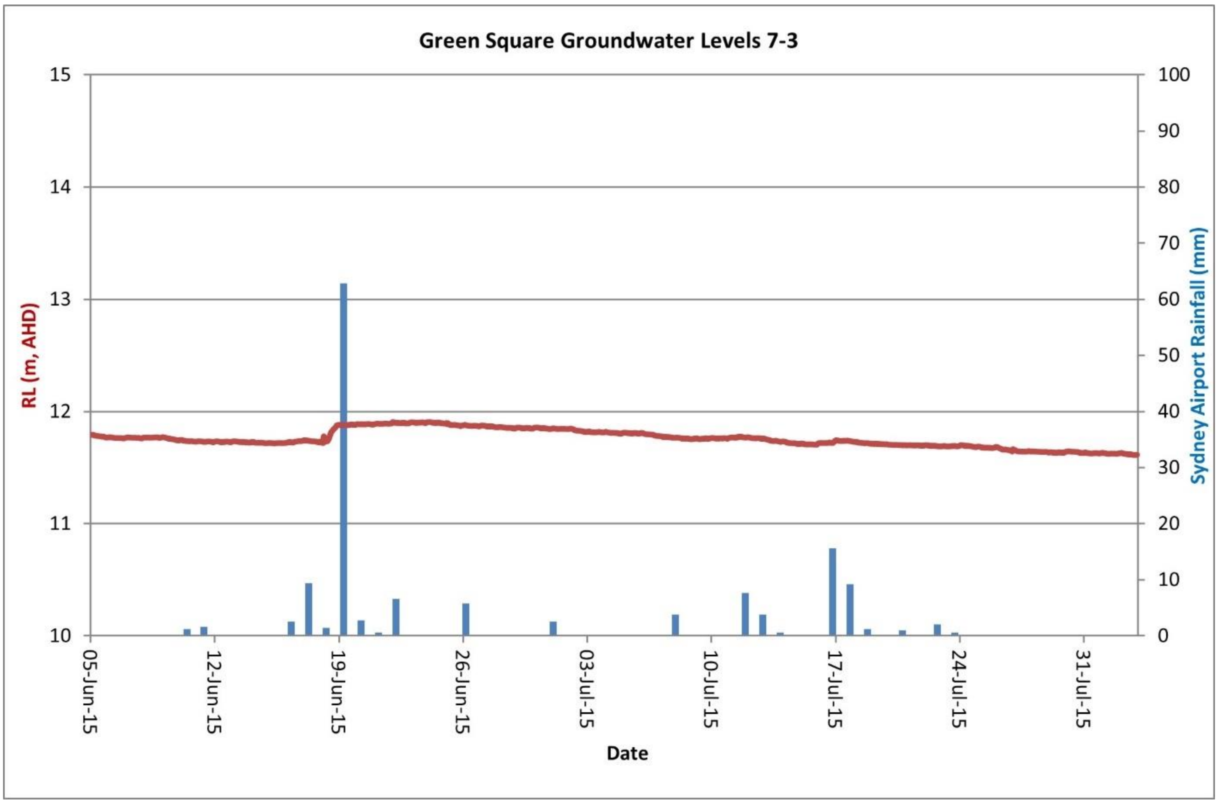

Figure 3: Results of Groundwater Monitoring in Monitoring Well 7-3

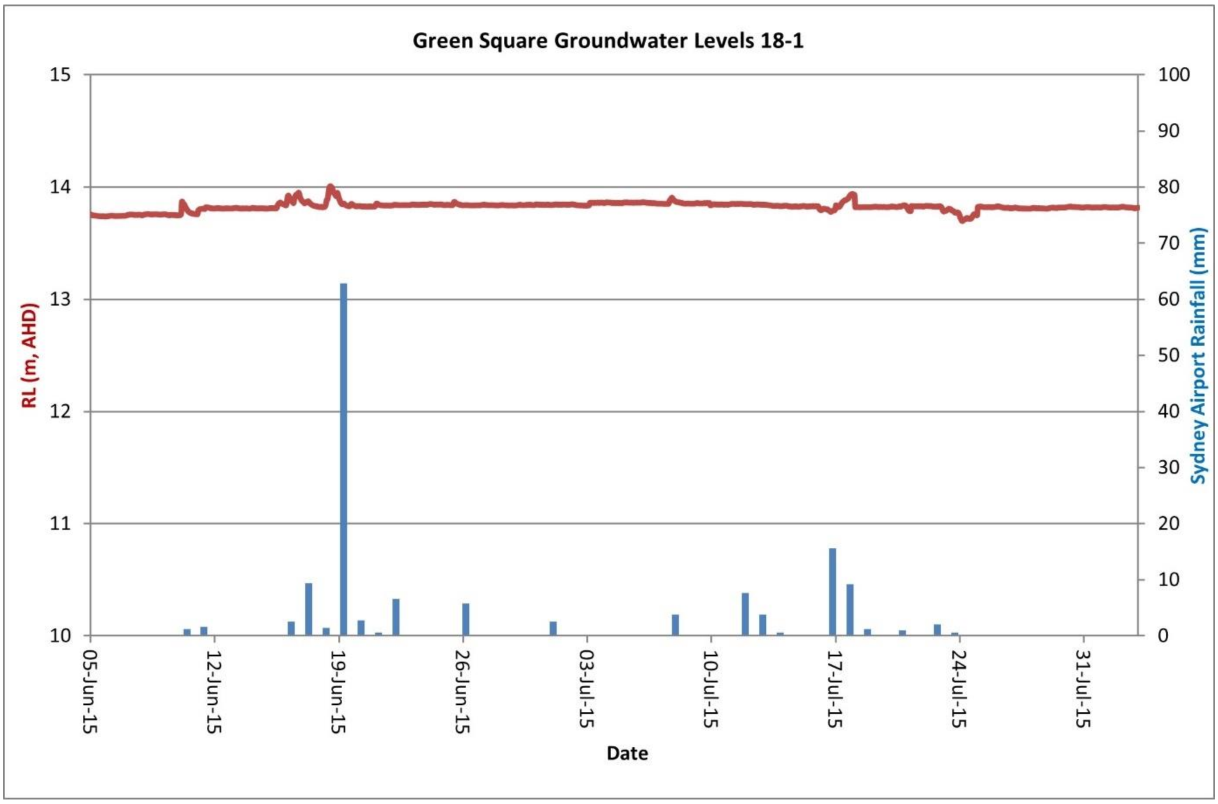

Figure 4: Results of Groundwater Monitoring in Monitoring Well 18-1

5.3 Permeability Testing

The results of the drawdown and inflow slug testing are shown in Figures 5 to 7. In each case, the data from the LevelTROLL loggers is plotted as water level against time. The water levels have been converted from pressure readings and the elapsed time is shown in seconds.

It should be noted that the shape of the graphs appear irregular in some cases which is due to the process of installing the monitors and removing water from or adding water to the monitoring wells during testing.

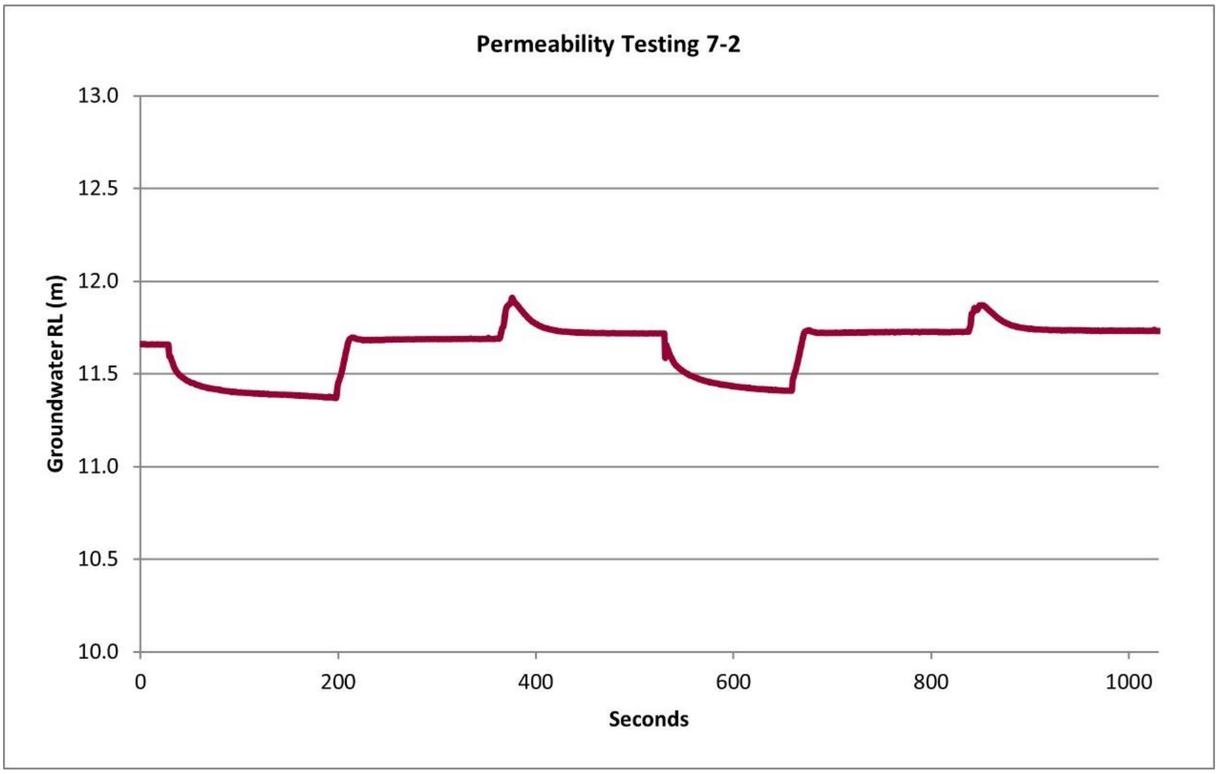

Figure 5: Results of Permeability Testing in Monitoring Well 7-2

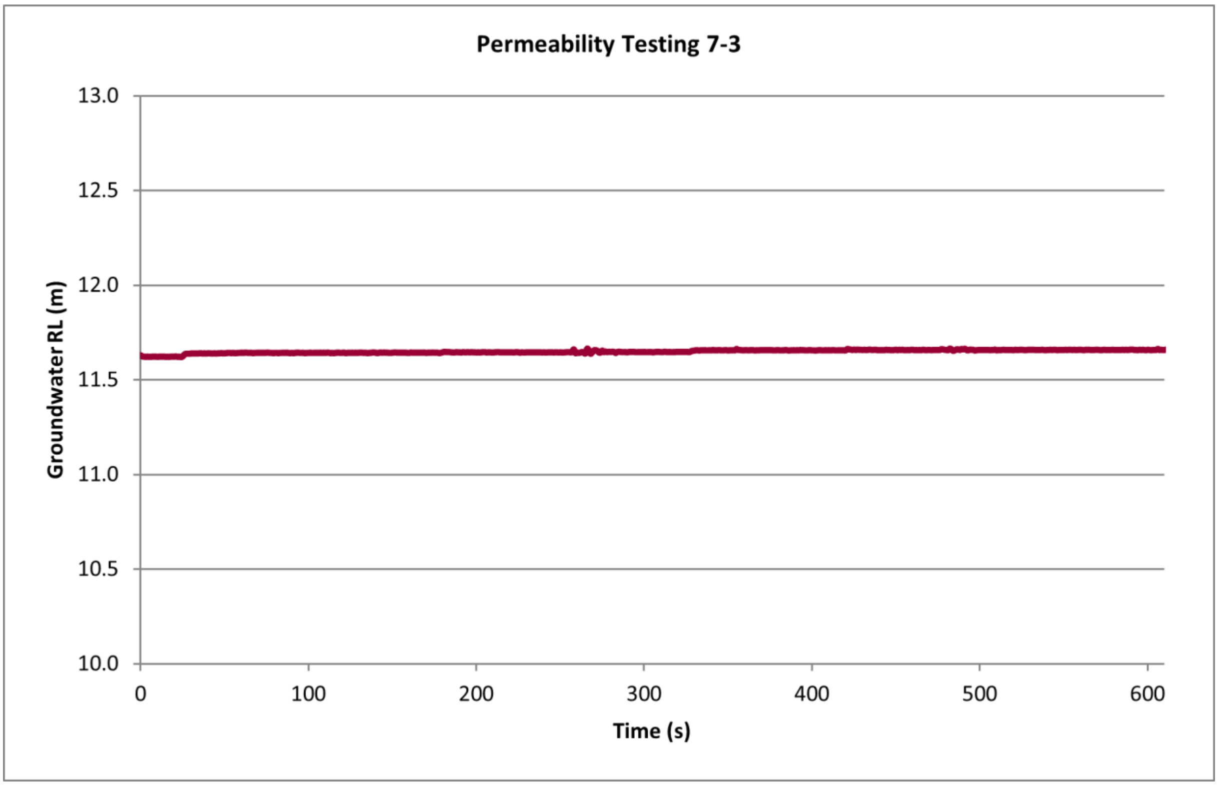

Figure 6: Results of Permeability Testing in Monitoring Well 7-3

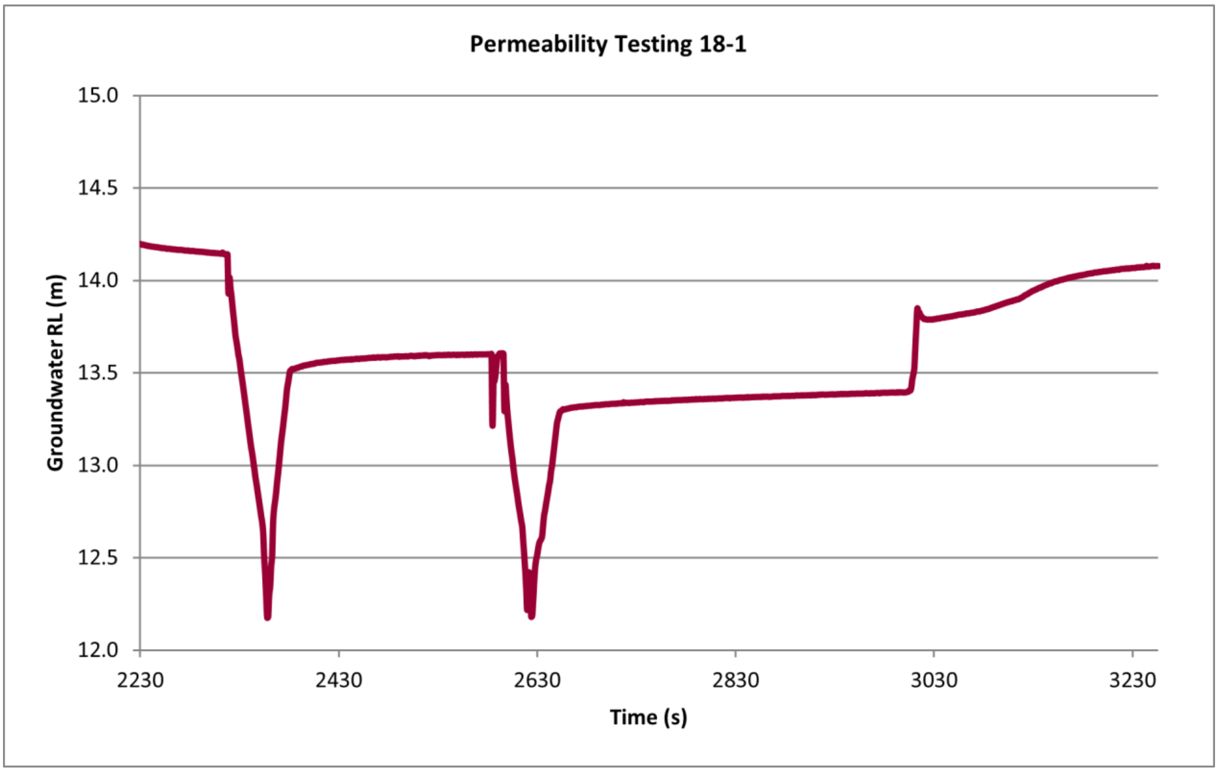

Figure 7: Results of Permeability Testing in Monitoring Well 18-1

The soil permeability adjacent to each monitoring well was assessed using the slug test results. The data plotted on Figures 2 to 4 was selectively analysed to determine representative values of soil permeability. The results of the analyses are shown in Tables 4 and 5.

Table 4: Results of Soil Permeability Analyses (m/s)

Well Location	Drawdown Permeability (m/s)	Injection Permeability (m/s)	Average Permeability (m/s)
7-2	4.3 x 10^{-5}	2.3 x 10^{-5}	3.3 x 10^{-5}
7-3	3.4 x 10^{-5}	6.1 x 10^{-4}	3.2 x 10^{-4}
18-1	2.1 x 10^{-5}	Incomplete data	2.1 x 10^{-5}

Table 5: Results of Soil Permeability Analyses (m/day)

Well Location	Drawdown Permeability (m/day)	Injection Permeability (m/day)	Average Permeability (m/day)
7-2	3.7	2.0	2.9
7-3	2.9	52.7	27.8
18-1	1.8	Incomplete data	1.8

6. Laboratory Testing

Sixty-five samples selected from the better-quality rock core were tested for axial point load strength index (Is_{50}). The results ranged between 0.1 MPa and 3.2 MPa which correspond to very low to low strength and very high strength rock, respectively. These Is_{50} results suggest an unconfined compressive strength (UCS) in excess of 60 MPa for the very high strength rock encountered during the investigation.

7. Geotechnical Model

The site is underlain by fill which appears to have been placed over natural soils and/or bedrock. The fill is generally a mixture of soil types with significant proportions of ripped sandstone and building rubble. Ash and charcoal were also encountered. The SPT results indicate the density of the fill is variable and ranges from the equivalent of very loose to dense sand. Numerous obstructions were encountered in the fill during drilling.

The natural soils (where present) comprise clays and sands. Natural soils were only encountered in the bores at the south-eastern end of the site, and filling was present directly over bedrock in the majority of cases.

The bedrock generally varied from very low strength to high strength siltstone, sandstone and laminite. The surface of the Class II/I bedrock typically varied from RL 5.8 m to RL 1.5 m AHD.

The groundwater levels on the site were measured at between RL 11.6 m and RL 14.0 m AHD during the monitoring period. The groundwater appears to dip towards the north-west and is likely to be influenced by the geometry of the former shale quarry, the Green Square railway station cavern and associated rail tunnel, as well as the surrounding groundwater regime.

This inferred geotechnical model is shown in Sections A-A and B-B in Drawings G2 and G3 in Appendix B.

8. Proposed Development

It is understood that the development will include the construction of three residential buildings over a common basement, and pedestrianised laneways. The buildings will be up to 19 to 20-storeys and will be constructed over a common one-level basement which will be approximately 5 m below the ground surface levels. The basement will not cover the full site footprint and therefore some structure will be constructed at or near the ground surface.

The geotechnical issues considered relevant to the proposed development include excavation, excavation support, backfilling, groundwater, foundations and pavements. Comments on potential impacts upon the Airport Rail Line tunnel, seismicity and aggressivity are also provided.

9. Comments

9.1 Excavation

Excavation for the basement will primarily be required within fill and should be readily achievable using conventional earthmoving equipment such as a hydraulic excavator with bucket attachment. Bulk excavation in rock will not be required and vibrations associated with such activities will therefore not be transmitted.

Depending on the design basement level, excavation works may need to be undertaken in conjunction with a dewatering programme to reduce the moisture content of the soils and allow machinery to work on the site. This may entail the use of a large pump connected to spear-points within the excavation, sumps within the excavation, or a combination of the two. An appropriate dewatering methodology can be developed once the design of the basement has been completed.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (NSW EPA, 2014).

9.2 Excavation Support

9.2.1 General

Vertical excavations in fill are not expected to be self-supporting for any extended period of time. Temporary batters may be able to support excavations in some areas of the site above the groundwater table and should be cut no steeper than 1.5H:1V in the fill materials, subject to assessment. Elsewhere, shoring support will therefore be required.

Suitable shoring systems where groundwater is temporarily below the proposed bulk excavation level include anchored contiguous pile walls and driven steel sheet piles. Contiguous pile walls can be constructed by installing concrete or grout-injected continuous flight auger (CFA) piles around the perimeter of the basement so that the adjacent piles are close or touching, thereby supporting the material behind the wall. Any gaps between piles can be plugged with grout as excavation proceeds.

Driven steel sheet piles are installed around the perimeter of the basement area prior to the commencement of excavation. The adjacent sheets are interlocked to provide support to the material behind the wall. Driving sheets through the filling may prove problematic and pre-drilling in some areas of the site may be necessary. Vibrations induced by driving equipment may also impact adjacent structures and detract from the suitability of this option.

Suitable shoring systems where groundwater is above the proposed bulk excavation level include anchored secant pile walls and diaphragm-type walls. Secant pile walls are constructed in a similar manner to contiguous pile walls except that the piles overlap to provide a water-tight seal. This can be undertaken by installing stronger piles between lower-strength piles (‘hard-soft’ type wall), stronger piles around the entire basement perimeter (‘hard-hard’ type wall) or by installing jet-grout between the stronger piles in lieu of lower-strength piles.

Diaphragm-type walls involve constructing a continuous wall below the ground surface prior to the commencement of excavation. This can be achieved using a large clamshell bucket with appropriate support for the sides of the excavation provided by either guide-walls or bentonite slurry. Concrete is then poured into the excavation and steel reinforcement added to create the wall. Alternatively, cutter-soil mixing (CSM) machines can be used to inject concrete and/or cement into the existing soils to construct the wall. Steel reinforcement is usually added by means of vertical steel sections. It is noted that CSM walls may not be suitable for the site due to the heterogeneous nature of the filling materials present.

All these wall types are likely to require the use of temporary ground anchors to provide lateral support during construction. Permanent lateral support would need to be provided by floor slabs.

9.2.2 Earth Pressures

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface down to the base of the excavation. Table 6A outlines material and strength parameters that could be used for the design of excavation support structures using the WALLAP program. Table 6B outlines parameters that could be used for finite element packages such as PLAXIS.

Table 6A: Material and Strength Parameters for Excavation Support Structures (WALLAP)

Material	Unit Weight (kN/m^3)	Def. Modulus (MPa)	Poisson's Ratio	Drained Friction Angle (°)	Drained Cohesion (kPa)	K_o for WALLAP	Ultimate Passive Pressure[2]
Existing Sandy Fill	20	10	0.35	28	1	0.6	K_p = 2.5
Loose Sands	20	20	0.3	30	0	0.5	K_p = 2.5
Firm/Stiff Clays	20	25	0.3	24	3	0.6	K_p = 2.5
Very Stiff/Hard Clay	20	50	0.3	26	5	0.6	K_p = 3.3
Class V/IV Rock	21	200	0.3	30	20	0.6	1000 kPa
Class III Rock	23	1000	0.25	38	300	1	3000 kPa
Class II/I Rock	24	2000	0.2	42	800	1	6000 kPa

Notes: [1] Unless unfavourably jointed; [2] Only below bulk excavation level and where jointing is favourable

Table 6B: Material and Strength Parameters for Excavation Support Structures (PLAXIS)

Material	Material Model	Unit Weight (kN/m^3)	Def. Modulus (MPa)	Poisson's Ratio	Cohesion (kPa)	Tension (kPa)	Friction Angle (°)
Existing Sandy Fill	M-C	18	15	0.35	1	0	28
Existing Clay Fill	M-C	18	25	0.3	3	0	25
New Pit Backfill	M-C	20	25	0.3	3	0	25
Class V/IV Rock	M-C	21	200	0.3	20	0	30
Class III Rock	M-C	23	1000	0.25	300	50	38
Class II/I Rock	M-C	24	2000	0.2	1000	300	43

Notes: M-C = Mohr-Coulomb

Pile sockets below the bulk excavation level for the purpose of passive restraint should have a minimum length of two pile diameters below the lowest level of any nearby excavation (including any detailed excavations).

Retaining walls with a single row of support could be designed by assuming a triangular lateral earth pressure distribution (increasing linearly with depth). The lateral pressure distribution on a multi-anchored or braced wall is complex and for preliminary design purposes a trapezoidal distribution where the maximum pressure acts over the central 60% of the wall could be assumed. It is recommended that a sophisticated software package such as WALLAP or PLAXIS be used to analyse the shoring system to refine the preliminary design prior to commencement of construction.

Lateral pressures due to surcharge loads from adjacent buildings, pavements, construction machinery etc. should be included where relevant. Hydrostatic pressure acting on the shoring walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

9.2.3 Ground Anchors

Where necessary, the use of declined tie-back (ground) anchors is suggested for the lateral restraint of the perimeter piled walls. Such ground anchors should be declined below the horizontal to allow anchorage into the stronger materials at depth. The design of temporary ground anchors for the support of piled wall systems may be carried out using the allowable average bond stresses at the grout-rock/soil interface given in Table 7.

Table 7: Bond Stresses for Anchor Design

Material Description	Allowable Bond Stress (kPa)	Ultimate Bond Stress (kPa)
Fill/Natural Soils	25	50
Class V/IV Rock	70	140
Class III Rock	300	600
Class II/I Rock	750	1500

It is unlikely that conventional anchors will have sufficient capacity unless they are installed in the bedrock. Secondary-grouted anchors could be used in the fill and natural soils to increase the anchor capacity. This technique involves installing a conventionally-grouted anchor and then, once cured, injecting grout into the anchor at a higher pressure to crack the primary grout and densify the surrounding materials. This technique is specialised and only experienced contractors should be engaged for the design and installation of secondary-grouted anchors.

Ground anchors should be designed to have a free length equal to their height above the base of the excavation and have a minimum 3 m bond length. After installation they should be proof loaded to 125% of the design working load and locked-off at no higher than 75% of the working load. Periodic checks should be carried out during the construction phase to ensure that the lock-off load is maintained and not lost due to creep effects or other causes.

The parameters given in Table 7 assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good anchoring practice. Careful installation and close supervision by a geotechnical specialist may allow increased bond stresses to be adopted during construction, subject to testing.

The excavation and anchoring methodology will need to be confirmed by the shoring wall designer, however it is common practice that excavation is only allowed to occur to a nominal depth of, say, 0.5 m below each design anchor elevation until the anchors have been installed and adequately stressed. The anchors should also be placed to avoid clashes with the basement slab levels.

In normal circumstances the building will restrain the basement excavation over the longer term and therefore ground anchors are expected to be temporary only. The use of permanent anchors would require careful attention to corrosion protection. Further advice on design and specification should be sought if permanent anchors are to be employed on this site.

It will be necessary to obtain permission from neighbouring landowners prior to installing anchors that will extend beyond the perimeter of the site. In addition, care should be taken to avoid damaging buried services and pipes during anchor installation.

9.3 **Groundwater**

The groundwater levels measured during the previous monitoring period vary between RL 11.6 m and RL 14.0 m AHD. It appears as though the groundwater in the south-eastern portion of the site (i.e. BH18-1) is on average at about RL 13.8 m AHD. The groundwater in the north-western portion of the site (i.e. BH7-2 and BH7-3) is on average at about RL 11.8 m AHD. A 2 m variation in levels has therefore been observed on the site.

As with the adjacent development sites, a design groundwater level of at least 2 m above the measured levels is recommended to account for increases in water levels over time. The design groundwater level in the south-eastern portion of the site will therefore be 2 m higher than in the north-western portion.

If the design groundwater level is above the proposed basement level, the basement will need to be designed and constructed to reduce water ingress into the finished structure. Two options that could technically be considered include: tanking the basement to a level equal to or above the adopted design groundwater level, or installing a cut-off wall around the perimeter of the basement to potentially reduce the inflow volumes to manageable quantities.

Tanking the basement involves constructing a water-tight floor slab and basement walls to limit ingress to negligible volumes. This may be able to be achieved by detailing a water-tight joint at the slab-wall interface or by constructing an integrated slab-wall structure without joints. The walls and slab will need to be designed to resist hydrostatic pressure both globally (i.e. uplift of the entire building) and locally (i.e. pressure between column/slab supports).

The provision of a cut-off wall to reduce inflow volumes will involve the construction of a water-tight wall around the perimeter of the basement down to and into the medium/high strength sandstone. Suitable wall types include secant-pile walls and diaphragm walls as discussed in Section 9.2, although secant-pile walls utilising jet-grout may be necessary due to issues associated with maintaining a water-tight piled structure at depth. Further, this option will not prevent water entering the basement as water will still flow through vertical joints within the bedrock, and long-term pumping of groundwater will be required. The issues associated with long-term pumping and discharge of groundwater will need to be considered when assessing the viability of this option; WaterNSW/DCCEEW may not allow long-term pumping.

9.4 Foundations

9.4.1 Spread Footings

Spread footings (e.g. pad footings and strip footings) will not be suitable for the site due to the presence of deep, uncontrolled filling. A raft slab is also unlikely to be suitable due to potential differential settlements in the uncontrolled fill material. Piles will therefore be required to support the structure.

9.4.2 Piles

Suitable pile types include concrete or grout-injected CFA piles, bored piles drilled with temporary or permanent casing, or driven pile-types such as precast concrete, steel tube or steel H-section piles. It should be noted that a CFA rig is unlikely to be able to achieve a significant socket in the high strength rock encountered on the site. If sockets are required for uplift resistance then a traditional bored pile, using steel casing to support the filling, may be required. A tremie system will be needed to place the concrete under water in this case. It should also be noted that the possibility of large inclusions in the filling may result in the requirement for pre-drilling of driven piles in some areas of the site.

CFA piles and bored piles could be designed using the parameters provided in Table 8. Parameters for both the working stress and limit-state design approaches have been provided.

Table 8: Design Parameters for CFA Piles

Material Description	Allowable End-Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)[1]	Ultimate End-Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)[1]
Class V/IV Rock	1000	50	3000	150
Class III Rock	3500	300	20000	800
Class II/I Rock	6000	600	60000	1500

Notes: [1]Reduce by 50% for uplift loads and ensure cone-pullout criteria are met

It should be noted that the serviceability limit-state is likely to govern the design of the piles and the ultimate bearing pressures provided in Table 8 are unlikely to be able to be achieved in practice.

Settlement of a pile is dependent on the loads applied to the pile and the foundation conditions in the socket zone and below the pile toe. The total settlement of a pile designed using the 'allowable' parameters provided in Table 8 would be expected to be less than 5 mm upon application of the design load.

Driven piles are often used to support high column loads on sites in which driving is practicable. The capacity of a pile driven to near-refusal in rock is likely to be governed by the structural capacity of the pile and the weight/efficiency of the driving equipment. The installation of test piles and pile load testing should then be undertaken to confirm driving conditions, pile set, pile capacity and an appropriate geotechnical strength reduction factor.

Settlement of a driven pile should be estimated using load test data obtained during the design confirmation stage of the piling process.

Vertical uplift loads could be resisted by socketing the piles into the bedrock (where possible) or by permanent anchors designed using the parameters provided in Section 9.2.3.

9.5 **Pavements**

The comments in this section will only be relevant to the site in the event that road pavements are to be constructed on the existing fill.

The site is underlain by significant depths of fill which is uncontrolled and, on average, equivalent in density to a loose to medium dense sand. This material is considered unsuitable for supporting road pavements in its current condition and some form of subgrade improvement should be undertaken to densify the subgrade.

The suggested subgrade improvement methodology involves excavation and replacement of a sufficient depth of fill to adequately compact the upper 1 m to 2 m of pavement subgrade. Once the fill has been removed and stockpiled, the exposed surface should be proof-rolled with a steel smooth-drum roller of at least 15 t weight in the presence of a geotechnical professional. Areas exhibiting unacceptable movement may require treatment to rectify the causes of the movement.

The fill could then be replaced after removing any deleterious materials (e.g. over-sized particles, organic matter etc.), placing the fill in 250 mm thick layers and compacting it to a dry density ratio of at least 100% relative to Standard compaction.

Inspections and testing of this work should be undertaken in accordance with the requirements of Australian Standard AS 3798 – 2007 *Guidelines on earthworks for commercial and residential developments*.

The CBR test results on surrounding sites in the same backfilled quarry zone indicate that the pavement subgrade is of relatively good quality when compacted to a dry density ratio of about 100% relative to Standard compaction. Provided that the subgrade improvement works are undertaken in accordance with the recommendations provided in this report, a design subgrade CBR of 8% is considered appropriate for the materials encountered during the investigation, allowing for some variability across the site.

9.6 **Potential Impact on Airport Rail Line Tunnel**

The site is at least 80 m from the Airport Rail Line tunnel at its closest point and therefore development on the site will not impact the tunnel structure. Specific analysis to assess the long-term impacts on the tunnel is therefore unwarranted.

9.7 **Seismicity**

A Hazard Factor (*Z*) of 0.08 would be appropriate for the development site in accordance with Australian Standard AS 1170.4 – 2024 *Structural design actions – Part 4: Earthquake actions in Australia*. The site sub-soil class would be Class C_e based on the strengths of the materials encountered in the boreholes.

9.8 **Aggressivity**

The laboratory test results from adjacent sites underlain by similar filling to Sites 7, 17 and 18 indicate that aggressive conditions exist for both concrete and steel piles below the groundwater table as described in AS 2159 – 2009 *Piling – Design and installation*. Appropriate allowances for concrete cover, concrete strength, steel-section loss and steel protection requirements should be made in the design of the piles.

9.9 **Acid Sulfate Soils**

The *Botany Bay 1:25 000 Acid Sulfate Soil Risk Map* indicates that acid sulfate soils are not expected to occur on the site. The geotechnical investigations undertaken on the site by Douglas Partners confirm this mapping.

The *Sydney Local Environmental Plan (Green Square Town Centre) 2013* (LEP) shows that the Green Square Town Centre is on Class 5 Land. Development consent is required for works on Class 5 land that are within 500 m of adjacent Class 1, 2, 3 or 4 land that is below RL 5 m AHD and for which the water table is likely to be lowered below RL 1 m AHD on the adjacent Class 1, 2, 3 or 4 land.

Temporary dewatering of the site will be required during construction works. This process is expected to limit groundwater drawdown to approximately RL 10 m AHD on the site and higher on adjacent sites. This is above the RL 1 m AHD level defined in the LEP as requiring development consent and it is therefore considered that development consent relating specifically to acid sulfate soils is not required.

10. **Limitations**

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at Zetland in line with Douglas' proposal dated 12 November 2025 and acceptance received from Mirvac Green Square Pty Ltd. This report is provided for the exclusive use of Mirvac Green Square 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 or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

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

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

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas 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 Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

This report provides specialist advice only and no part of it is considered a Regulated Design under the Design and Building Practitioner Act 2020 (NSW).The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill 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 fill may contain contaminants and hazardous building materials.

Appendix A

Notes About this Report

About this Report

November 2023

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

continued next page

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.

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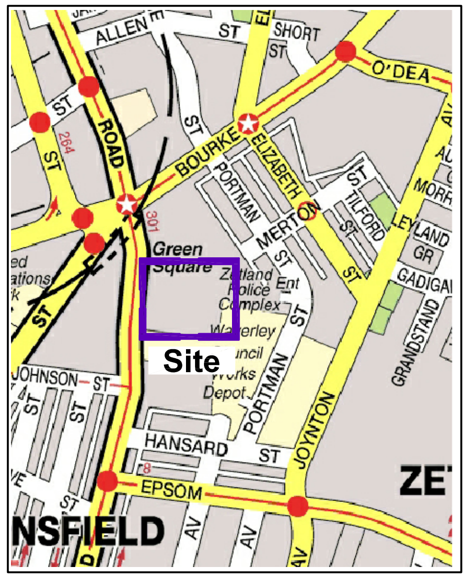
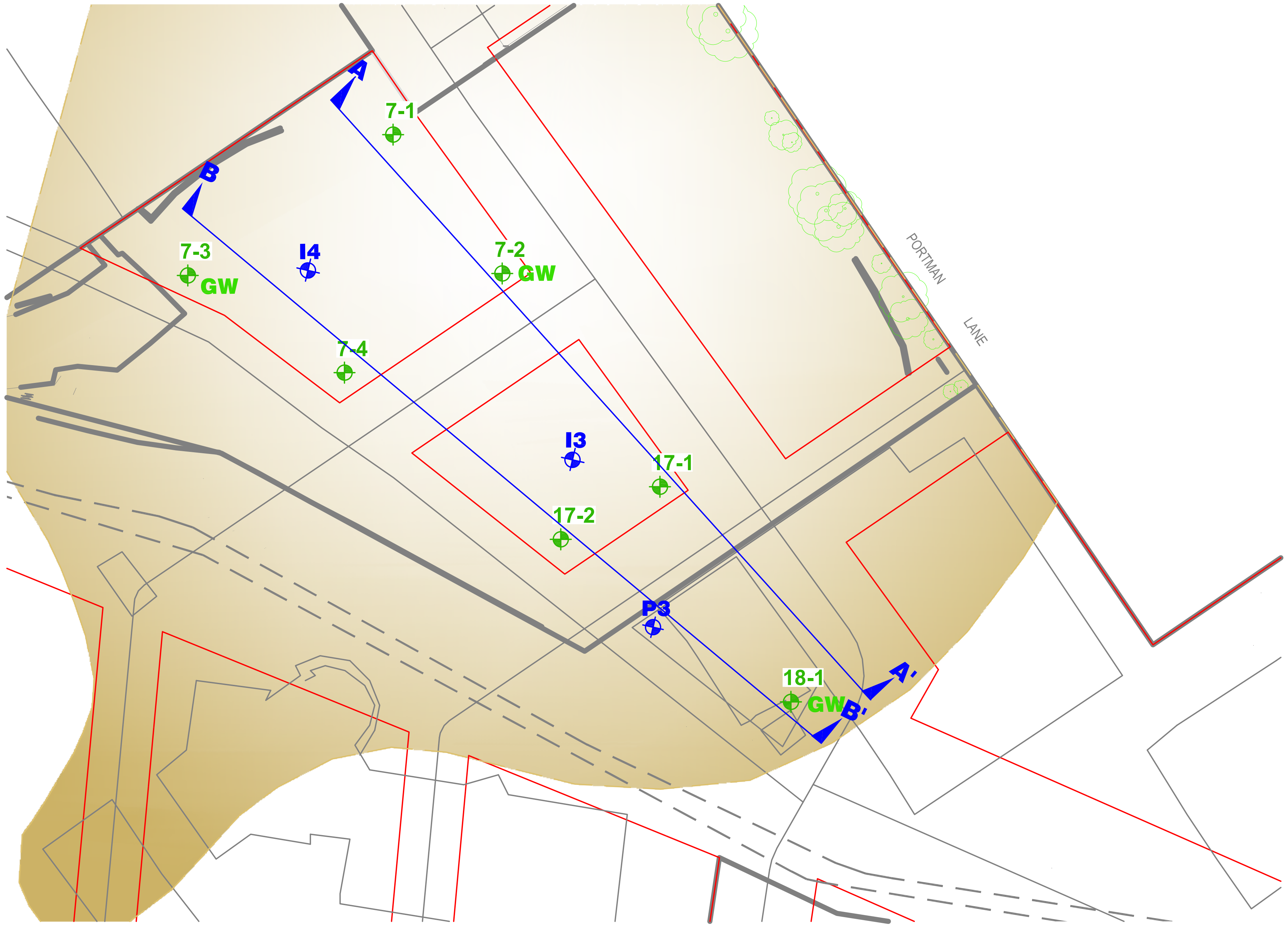
Appendix B

Drawings



Locality Plan



NOTE:
Base drawing from ADW Johnson Pty Ltd
(Drawing 7355-10 Detail)

0 10 20 30 40 50 75 100m

1:1000 @ A3

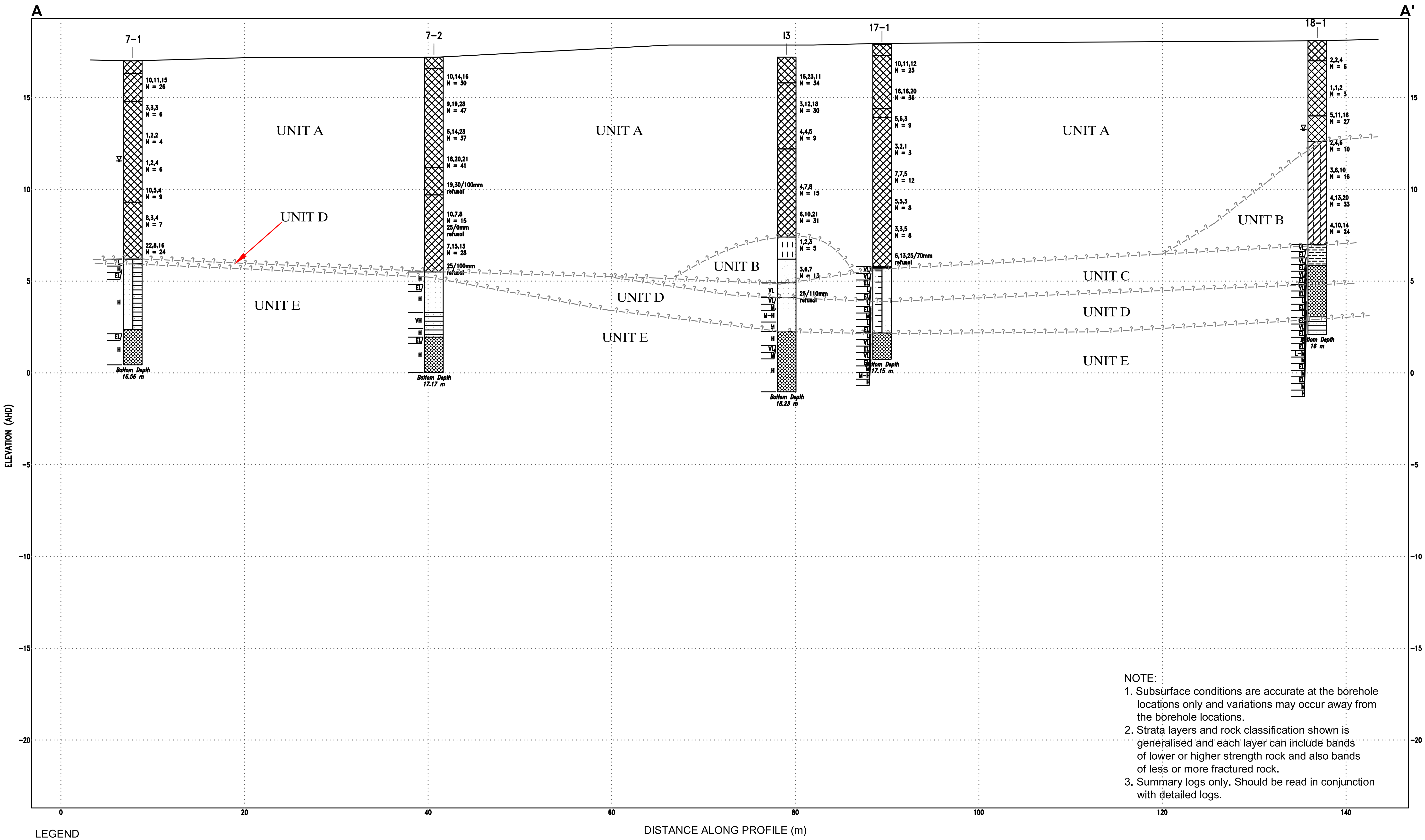
LEGEND

- ⊕ Current Borehole Location
- GW Current Groundwater Well Location
- ⊕ Previous Borehole Location (2011)
- ▨ Approximate location of former quarry and land fill based on previous investigations. Indicative only.

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Mirvac Green Square Pty Ltd		TITLE: **Locations of Boreholes** **Stage 3** **960A Bourke Street, Zetland**	PROJECT No: 72258.23
OFFICE: Sydney	DRAWN BY: PSCH		DRAWING No: G1
SCALE: As shown	DATE: 12.12.2025		REVISION: A

N



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown is generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

☒ Core Loss
▩ Filling
☰ Laminite
☐ Sand
▦ Sandstone coarse grained
☐ Sandstone fine grained
▤ Shale
▤ Siltstone
▨ Silty Clay
▥ Silty Sand

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP - Pocket penetrometer test value

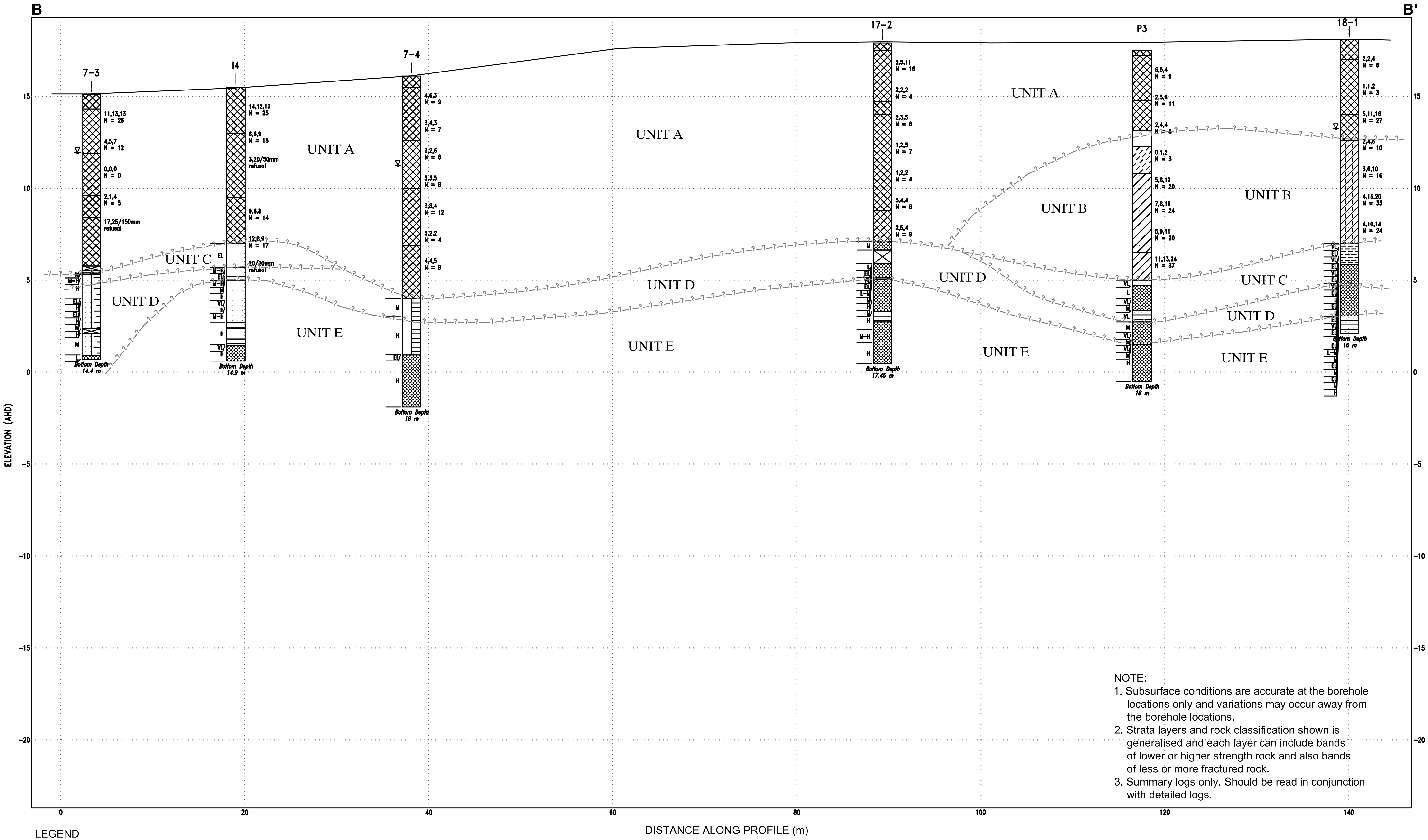
UNITS
A - FILLING
B - NATURAL SOILS
C - CLASS V/IV ROCK
D - CLASS III ROCK
E - CLASS II/I ROCK

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Green Square Pty Ltd
OFFICE: Sydney
DRAWN BY: PSCH
SCALE: 1:400 (H) 1:200 (V) @ A3
DATE: 12.12.2025

TITLE: **Cross-Section A-A'**
Stage 3
960A Bourke Street, Zetland

PROJECT No: 72258.23
DRAWING No: G2
REVISION: A



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown is generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

LEGEND
- ☒ Core Loss
- ▨ Clay
- ▨ Clayey Sand
- ▩ Filling
- ☰ Laminite
- ☐ Sand
- ▦ Sandstone coarse grained
- ☐ Sandstone fine grained
- ▨ Sandy Clay
- ▤ Shale
- ▨ Silty Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH- Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP- Pocket penetrometer test value

UNITS
A - FILLING
B - NATURAL SOILS
C - CLASS V/IV ROCK
D - CLASS III ROCK
E - CLASS II/I ROCK

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Green Square Pty Ltd
OFFICE: Sydney
DRAWN BY: PSCH
SCALE: 1:400 (H) 1:200 (V) @ A3
DATE: 12.12.2025

TITLE: **Cross-Section B-B'**
Stage 3
960A Bourke Street, Zetland

PROJECT No: 72258.23
DRAWING No: G3
REVISION: A

Appendix C

Borehole Logs

Sampling Methods

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Rock Strength

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

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

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Degree of Fracturing

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

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

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

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

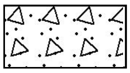
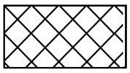
Other

fg	fragmented
bnd	band
qtz	quartz

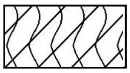
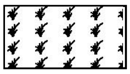
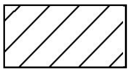
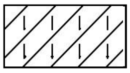
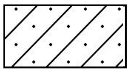
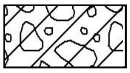
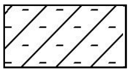
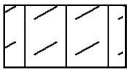
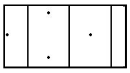
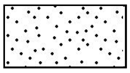
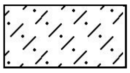
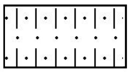
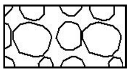
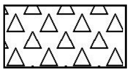
Symbols & Abbreviations

Graphic Symbols for Soil and Rock

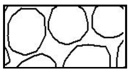
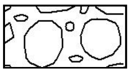
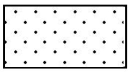
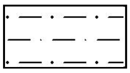
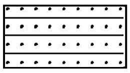
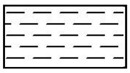
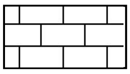
General

■	Asphalt
	Road base
	Concrete
	Filling

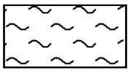
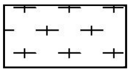
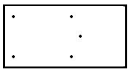
Soils

	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

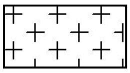
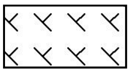
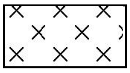
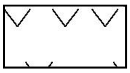
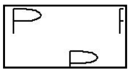
Sedimentary Rocks

	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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-1
PROJECT No: 72258.05
DATE: 26/5/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering EW HW MW SW FS FR	Graphic Log	Rock Strength Ex Low, Very Low, Low, Medium, High, Very High, Ex High	Water	Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
17		FILLING - light grey-brown, medium to coarse grained sand filling with some ripped sandstone gravel, humid							A A			
	0.7	FILLING - dark grey and brown, medium grained sand filling with some brick fragments and ripped sandstone gravel, damp							A			
16	1								S			10,11,15 N = 26
15	2											
	2.2	FILLING - light brown and light grey, sand filling with some brick fragments and fine grained sandstone gravel							S			3,3,3 N = 6
14	3											
13	4								S			1,2,2 N = 4
12	5											
		- orange-brown and wet below 5.5m				▼			S			1,2,4 N = 6
11	6											
10	7								S			10,5,4 N = 9
	7.7	FILLING - dark grey and brown, sandy gravel filling with some glass, charcoal and rubber fragments										
9	8								S			8,3,4 N = 7
8	9											

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 11.15m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 11.15m; NMLC-Coring to 16.56m

WATER OBSERVATIONS: Free groundwater observed at 5.5m whilst augering

REMARKS: No recovery from 7.0m SPT

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)

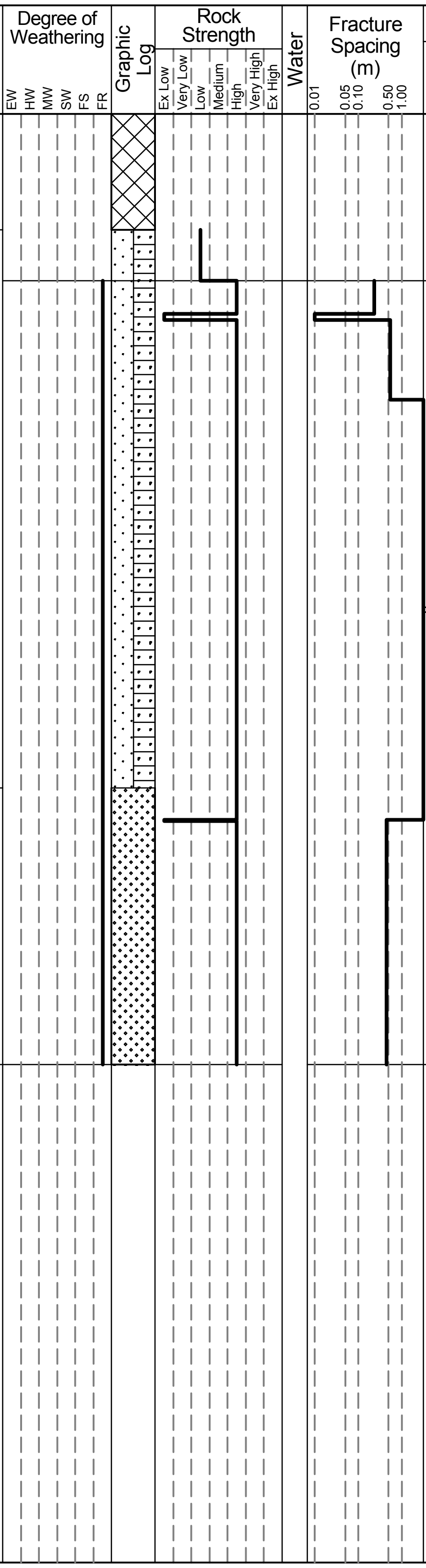
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-1
PROJECT No: 72258.05
DATE: 26/5/2015
SHEET 2 OF 2



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
	FILLING - dark grey and brown, sandy gravel filling with some glass, charcoal and rubber fragments *(continued)* - brick and ripped sandstone fragments below 10.0m	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			22,8,16 N = 24
10.8	INTERBEDDED SANDSTONE & LAMINITE - high strength, fresh, slightly fractured, light grey and dark grey, fine to medium grained sandstone interbedded with laminite	11.38m: B0°, cly, 40mm 11.97-12.57m: J80°, pl, ro, cln >>	C C	100 100	98 100	PL(A) = 2.1 PL(A) = 1.1 PL(A) = 2.7 PL(A) = 2.6 PL(A) = 1.1
14.65	SANDSTONE - high strength, fresh, slightly fractured, light grey and grey, medium to coarse grained sandstone	14.87m: B5°, cly, 10mm 15.32 & 16.16m: B5°, cly vn	C	100	100	PL(A) = 2.1 PL(A) = 1.7
16.56	Bore discontinued at 16.56m - target depth reached					

RL: 7, 6, 5, 4, 3, 2, 1, 0, -1, -2
Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 11.15m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 11.15m; NMLC-Coring to 16.56m
WATER OBSERVATIONS: Free groundwater observed at 5.5m whilst augering
REMARKS: No recovery from 7.0m SPT

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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-2
PROJECT No: 72258.05
DATE: 25/5/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
17		FILLING - light grey and grey-brown, fine to coarse grained sand filling with some clay and some gravel							A			
									A			
	0.6	FILLING - dark brown, grey-brown and red-brown, clayey, fine grained sand filling with some brick fragments and crushed sandstone gravel										
	1	- very dense and trace of charcoal and wood fragments below 1.0m							A			
16									S			10,14,16 N = 30
15	2											
		- steel and lead below 2.4m							S			9,19,28 N = 47
14	3											
13	4								S			6,14,23 N = 37
12	5								S			18,20,21 N = 41
11	6 / 6.0	FILLING - dark brown, red-brown and light brown-grey, clayey, fine to medium grained gravel filling with some brick fragments and glass fragments										
10	7								S			19,30/100mm refusal
	7.5	FILLING - dark grey and dark brown, gravelly sand filling with some brick fragments, rubber fragments and charcoal										
9	8								S			10,7,8 N = 15
8	9								S			25/0mm refusal

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 12.0m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.0m; NMLC-Coring to 17.17m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 16.0m (screen 4.0-16.0m; gravel 2.0-16.0m; bentonite 1.4-2.0m; 0.7m stick-up)

SAMPLING & IN SITU TESTING LEGEND

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

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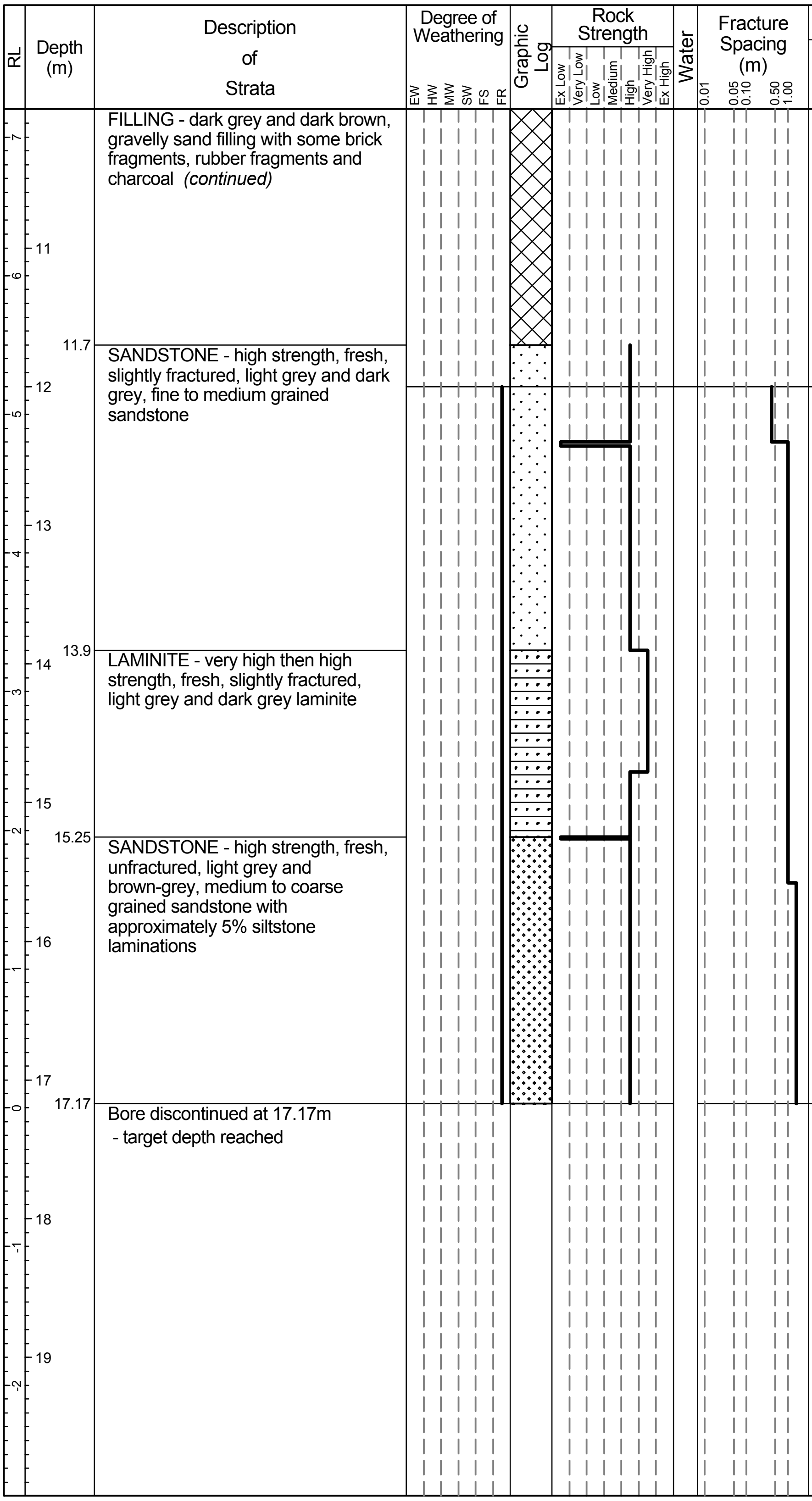
BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-2
PROJECT No: 72258.05
DATE: 25/5/2015
SHEET 2 OF 2



Discontinuities: B - Bedding, J - Joint, S - Shear, F - Fault

Depth (m)	Description of Strata	Discontinuities	Type	Core Rec. %	RQD %	Test Results & Comments
	FILLING - dark grey and dark brown, gravelly sand filling with some brick fragments, rubber fragments and charcoal *(continued)*	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			7,15,13 N = 28
			S			25/100mm refusal
11.7	SANDSTONE - high strength, fresh, slightly fractured, light grey and dark grey, fine to medium grained sandstone	12.4m: B0°, cly, 30mm	C	100	100	PL(A) = 2 PL(A) = 2.2 PL(A) = 3.2
13.9	LAMINITE - very high then high strength, fresh, slightly fractured, light grey and dark grey laminite	14.77m: B5°, cly vn	C	100	100	
15.25	SANDSTONE - high strength, fresh, unfractured, light grey and brown-grey, medium to coarse grained sandstone with approximately 5% siltstone laminations	15.25m: B0°, cly, 10mm 15.58m: B0°, cly vn	C	100	100	PL(A) = 1.4 PL(A) = 1.7
17.17	Bore discontinued at 17.17m - target depth reached					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 12.0m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.0m; NMLC-Coring to 17.17m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 16.0m (screen 4.0-16.0m; gravel 2.0-16.0m; bentonite 1.4-2.0m; 0.7m stick-up)

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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 15.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-3
PROJECT No: 72258.05
DATE: 14/5/2015
SHEET 1 OF 2

Depth (m)	Description of Strata	Water	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.0	FILLING - brown-grey and light brown, gravelly sand filling with a trace of silt, damp			A A			
0.8	FILLING - dark brown, red-brown and grey, clayey sand filling with some brick fragments and sandstone gravel, damp			A S			11,13,13 N = 26
				S			4,5,7 N = 12
3.2	FILLING - light brown and light grey, clayey sand filling with some gravel and a trace of sandstone boulders, wet	▼		S			0,0,0 N = 0
5.5	FILLING - dark brown, red-brown and light grey, sandy, fine to medium grained gravel filling with some brick fragments and glass fragments			S			2,1,4 N = 5
6.7	FILLING - light grey-brown and light grey, sandy clay with some sandstone boulders			S			17,25/150mm refusal
			Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	- some metal fragments, brick fragments and charcoal below 8.95m			C	77	0	
9.33			9.33m: CORE LOSS: 250mm				
9.58	INTERBEDDED SANDSTONE/SILTSTONE -		9.62m: J50°, pl, ro, cln				
9.6							
9.8			9.71m: CORE LOSS:	C	94	87	PL(A) = 1

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 4.0m; HQ to 9.6m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 8.5m; NMLC-Coring to 14.4m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS: 100% water loss from 5.5m to 9.6m. Standpipe installed to 14.4m (screened 5.4-14.4m; gravel 5.0-14.4m; bentonite seal 4.0-5.0m; 0.8m stick-up)

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)

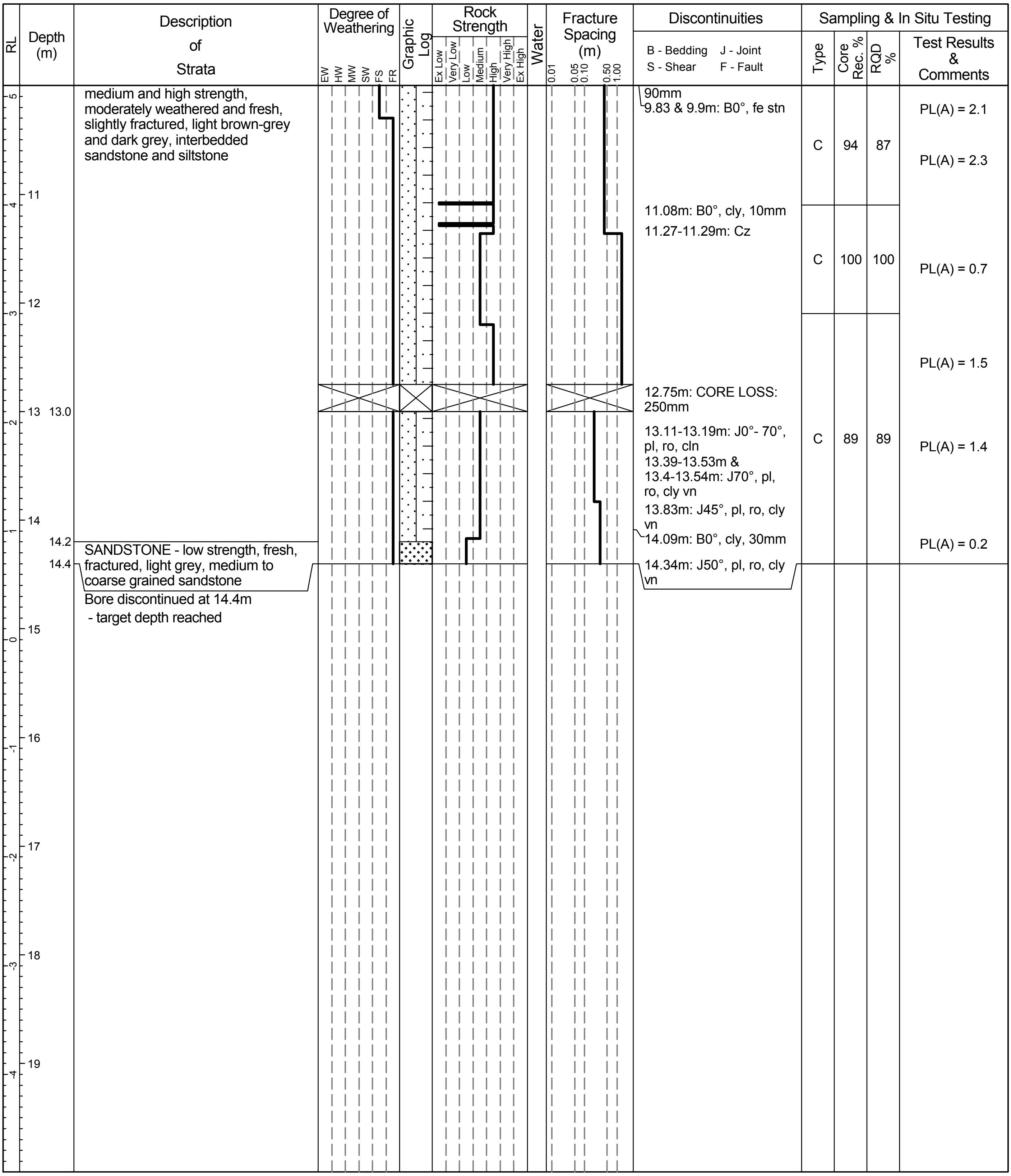
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 15.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-3
PROJECT No: 72258.05
DATE: 14/5/2015
SHEET 2 OF 2



Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	medium and high strength, moderately weathered and fresh, slightly fractured, light brown-grey and dark grey, interbedded sandstone and siltstone	90mm 9.83 & 9.9m: B0°, fe stn	C	94	87	PL(A) = 2.1 PL(A) = 2.3
11		11.08m: B0°, cly, 10mm 11.27-11.29m: Cz	C	100	100	PL(A) = 0.7
12		12.75m: CORE LOSS: 250mm				PL(A) = 1.5
13.0		13.11-13.19m: J0°- 70°, pl, ro, cln 13.39-13.53m & 13.4-13.54m: J70°, pl, ro, cly vn 13.83m: J45°, pl, ro, cly vn 14.09m: B0°, cly, 30mm	C	89	89	PL(A) = 1.4 PL(A) = 0.2
14.2	SANDSTONE - low strength, fresh, fractured, light grey, medium to coarse grained sandstone	14.34m: J50°, pl, ro, cly vn				
14.4	Bore discontinued at 14.4m - target depth reached					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 4.0m; HQ to 9.6m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 8.5m; NMLC-Coring to 14.4m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS: 100% water loss from 5.5m to 9.6m. Standpipe installed to 14.4m (screened 5.4-14.4m; gravel 5.0-14.4m; bentonite seal 4.0-5.0m; 0.8m stick-up)

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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 16.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-4
PROJECT No: 72258.05
DATE: 21/5/2015
SHEET 1 OF 2

Depth (m)	Description of Strata	Water	Sampling Type	Test Results & Comments
0.0	FILLING - light grey-brown, medium to coarse grained sand filling with some clay and some ripped sandstone gravel, humid		A A	
0.6	FILLING - dark grey and red-brown, gravelly sand filling with some brick fragments and ripped sandstone gravel, damp		A S S	 4,6,3 N = 9 3,4,3 N = 7
3.5	FILLING - dark grey, light brown and red-brown, sandy gravel filling with some brick, glass and rubber fragments - wet below 4.9m	▼ (4.9m)	S S	3,2,6 N = 8 3,3,5 N = 8
6.1	FILLING - light brown and light grey, sandy clay filling with some brick fragments and ripped sandstone gravel		S S	3,8,4 N = 12 5,2,2 N = 4
9.2	FILLING - dark grey and red-brown, sand filling with some ripped sandstone gravel and a trace of sandstone boulders			

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 12.5m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.5m; NMLC-Coring to 18.0m
WATER OBSERVATIONS: Free groundwater observed at 4.9m whilst augeirng
REMARKS: 80%-100% water loss from 5.5m to 12.5m

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)

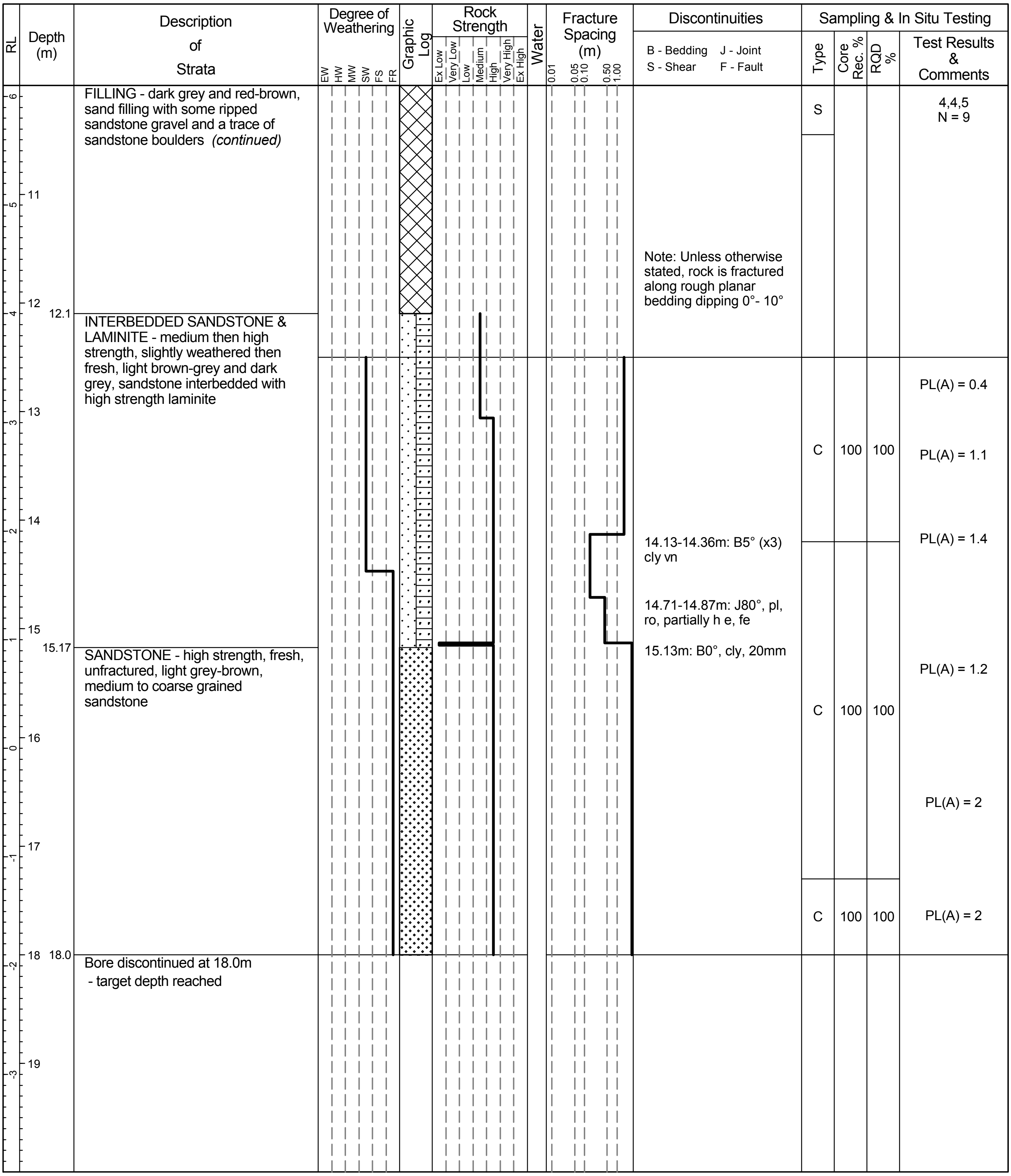
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 16.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7-4
PROJECT No: 72258.05
DATE: 21/5/2015
SHEET 2 OF 2



Depth (m)	Description of Strata	Discontinuities	Type	Core Rec. %	RQD %	Test Results & Comments
	FILLING - dark grey and red-brown, sand filling with some ripped sandstone gravel and a trace of sandstone boulders *(continued)*	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			4,4,5 N = 9
12.1	INTERBEDDED SANDSTONE & LAMINITE - medium then high strength, slightly weathered then fresh, light brown-grey and dark grey, sandstone interbedded with high strength laminite	14.13-14.36m: B5° (x3) cly vn 14.71-14.87m: J80°, pl, ro, partially h e, fe 15.13m: B0°, cly, 20mm	C	100	100	PL(A) = 0.4 PL(A) = 1.1 PL(A) = 1.4
15.17	SANDSTONE - high strength, fresh, unfractured, light grey-brown, medium to coarse grained sandstone		C	100	100	PL(A) = 1.2 PL(A) = 2
			C	100	100	PL(A) = 2
18.0	Bore discontinued at 18.0m - target depth reached					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m; HQ to 12.5m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.5m; NMLC-Coring to 18.0m
WATER OBSERVATIONS: Free groundwater observed at 4.9m whilst augeirng
REMARKS: 80%-100% water loss from 5.5m to 12.5m

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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 17-1
PROJECT No: 72258.05
DATE: 11/5/2015
SHEET 1 OF 2

Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	FILLING - light brown-grey, slightly gravelly, fine to medium grained sand filling with a trace of clay, damp						A A			
0.6	FILLING - dark grey-brown, fine grained sand filling with a trace of gravel, glass and brick fragments, damp - sandstone boulder 0.65m to 0.85m						A S			10,11,12 N = 23
							S			16,16,20 N = 36
3.5	FILLING - dark brown and red-brown, sandy clay filling with some brick fragments and sandstone gravel, damp									
4.0	FILLING - dark brown-grey, red-brown and grey, clayey gravel filling with some sand and some brick fragments, crushed sandstone, wood fragments and charcoal						S			5,6,3 N = 9
							S			3,2,1 N = 3
							S			7,7,5 N = 12
							S			5,5,3 N = 8

RIG: DT 100 **DRILLER:** SM **LOGGED:** MP **CASING:** HW to 4.0m; HQ to 12.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 12.1m; NMLC-Coring to 17.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering. 80%-100% water loss between 6.50m and 12.05m

REMARKS: No SPT recovery at 5.5m or 7.0m

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
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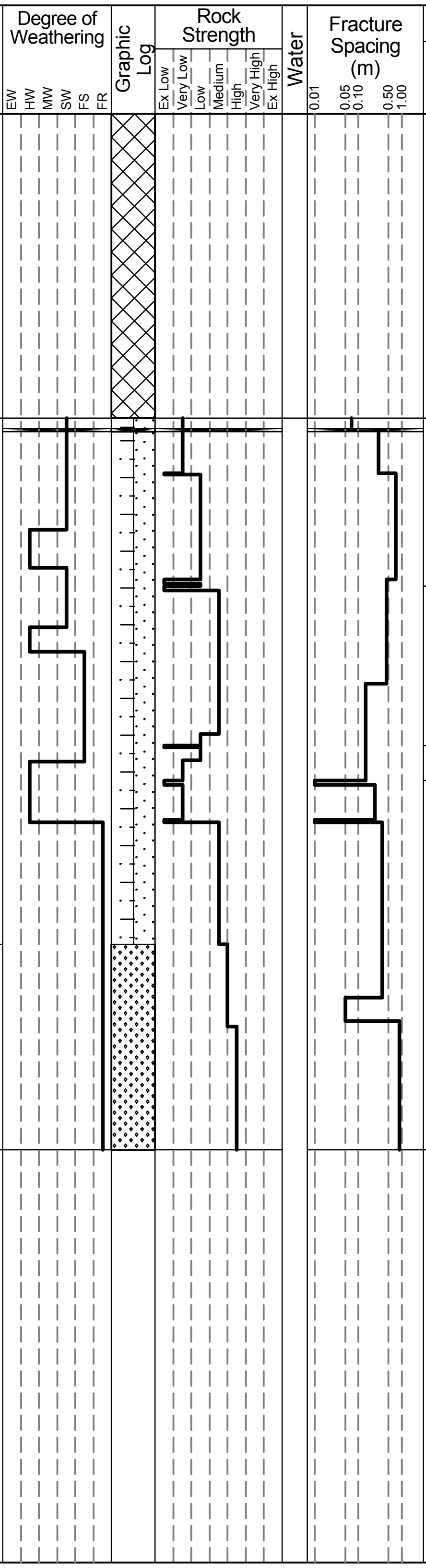
BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 17-1
PROJECT No: 72258.05
DATE: 11/5/2015
SHEET 2 OF 2



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
7 6	11 12	FILLING - dark brown-grey, red-brown and grey, clayey gravel filling with some sand and some brick fragments, crushed sandstone, wood fragments and charcoal *(continued)*	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S S			3,3,5 N = 8 6,13,25/70mm refusal
5 4 3	12.1 12.19 13 14 15	INTERBEDDED SILTSTONE/SANDSTONE - low then medium strength, slightly weathered then freshly stained, slightly fractured, light brown-grey, dark grey and orange-brown, interbedded siltstone and sandstone with some extremely low and very low strength bands	12.17m: CORE LOSS: 20mm 12.48 & 13.21m: B0°, cly, 10mm 13.03m: J60°, pl, ro, fe stn, cly vn 13.26m: B0°, cly, 30mm 13.93 & 14.18m: B0°, cly vn 14.26 & 14.29m: J45°, pl, ro, fe stn 14.36m: B0°, cly, 10mm 14.6m: Ds, 30mm 14.87m: Ds, 20mm	C C	99 100	99 95	PL(A) = 0.1 PL(A) = 0.5 PL(A) = 0.4 PL(A) = 0.1 PL(A) = 0.5
2 1	15.73 16 17	SANDSTONE - medium to high then high strength, fresh, slightly fractured, light grey and dark grey, medium to coarse grained sandstone	16.1-16.26m: B0° (x4), cly 16.91m: B0°, cly, 10mm	C	100	90	PL(A) = 1 PL(A) = 1.3
0 -1 -2	17.15 18 19	Bore discontinued at 17.15m - target depth reached					

RIG: DT 100 **DRILLER:** SM **LOGGED:** MP **CASING:** HW to 4.0m; HQ to 12.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 12.1m; NMLC-Coring to 17.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering. 80%-100% water loss between 6.50m and 12.05m

REMARKS: No SPT recovery at 5.5m or 7.0m

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 17-2
PROJECT No: 72258.05
DATE: 19/5/2015
SHEET 1 OF 2

Degree of Weathering: EW HW MW SW FS FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01 0.05 0.10 0.50 1.00
Discontinuities: B - Bedding, J - Joint, S - Shear, F - Fault

Depth (m)	Description of Strata
	FILLING - light grey-brown and light grey, gravelly sand filling with a trace of silt, humid
0.4	FILLING - dark brown, red-brown and light grey, fine to medium grained sand filling with some silt and some crushed sandstone gravel, damp - with a trace of charcoal and rootlets below 0.55m
3.2	FILLING - dark brown and light grey, sandy clay filling with some brick fragments and wood fragments, damp
3.9	FILLING - dark brown, orange-brown and light grey, clayey sand filling with some crushed sandstone gravel and brick fragments, damp - sandstone boulder at 4.5m - wet below 5.0m
9.1	FILLING - light grey, brown-grey and red-brown, sandy clay with some gravel and brick fragments and a trace of sandstone boulders

Type	Test Results & Comments
A	
A	
A	
S	2,5,11 N = 16
S	2,2,2 N = 4
S	2,3,5 N = 8
S	1,2,5 N = 7
S	1,2,2 N = 4
S	5,4,4 N = 8

RIG: Scout 1 **DRILLER:** SS/GP **LOGGED:** MP **CASING:** HW to 7.5m; HQ to 10.8m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 10.8m; NMLC-Coring 17.45m
WATER OBSERVATIONS: No free groundwater observed whilst augering. 90%-100% water loss from 5.5m to 10.8m
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)

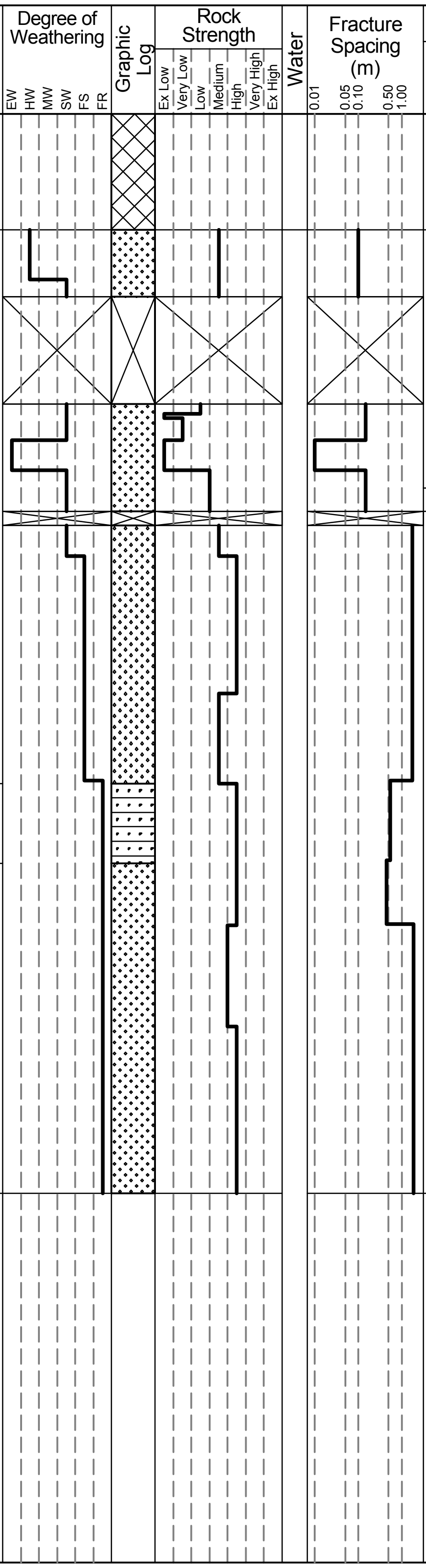
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 17-2
PROJECT No: 72258.05
DATE: 19/5/2015
SHEET 2 OF 2



Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	FILLING - light grey, brown-grey and red-brown, sandy clay with some gravel and brick fragments and a trace of sandstone boulders *(continued)*	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			2,5,4 N = 9
10.8	SANDSTONE - medium and high strength, highly then slightly weathered, slightly fractured, red-brown, pale grey and dark grey, medium to coarse grained sandstone	10.85-11.16m: B (x4) 0°, fe 11.26m: CORE LOSS: 740mm	C	58	52	PL(A) = 0.4 PL(A) = 0.6
12.0	- clay from 12.25m to 12.46m	12.03-12.22m: J80°-90°, ir, ro, fe stn 12.44m: B0°, cly, 20mm, fe				PL(A) = 0.3
12.74 12.84		12.58m: B0°, cly, 30mm 12.74m: CORE LOSS: 100mm	C	97	97	PL(A) = 1.5 PL(A) = 0.8
14.62	LAMINITE - high strength, fresh, unfractured, dark grey and light grey laminite	14.6m: B0°, fe stn				PL(A) = 1.2
15.17	SANDSTONE - high and medium to high strength, fresh, fractured, brown-grey and light grey, medium to coarse grained sandstone	15.15 & 15.59m: B0°, cly, 10mm	C	100	100	PL(A) = 1 PL(A) = 2.3
17.45	Bore discontinued at 17.45m - target depth reached					

RIG: Scout 1 **DRILLER:** SS/GP **LOGGED:** MP **CASING:** HW to 7.5m; HQ to 10.8m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 10.8m; NMLC-Coring 17.45m
WATER OBSERVATIONS: No free groundwater observed whilst augering. 90%-100% water loss from 5.5m to 10.8m
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: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 18-1
PROJECT No: 72258.05
DATE: 21/5/2015
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				
		FILLING - dark grey and light brown, clayey sand filling with some brick fragments and ripped sandstone, damp							A			
									A			
									A			
	1.1	FILLING - dark grey, light grey and orange-brown, sandy clay filling with some brick fragments, organic material and charcoal, damp							S			2,2,4 N = 6
									S			1,1,2 N = 3
									S			5,11,16 N = 27
	4.1	FILLING - dark grey, light grey and brown, gravelly sand filling with some charcoal, ash and glass fragments, wet										
						▼						
	5.5	SILTY CLAY - stiff, light grey and grey-brown, silty clay							S			2,4,6 N = 10
		- very stiff below 7.0m							S			3,6,10 N = 16
		- light grey and red-brown with some ironstone gravel below 8.5m							S			4,13,20 N = 33

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 11.1m; NMLC-Coring to 16.0m

WATER OBSERVATIONS: Free groundwater observed at 4.9m whilst augering

REMARKS: Standpipe installed to 16.0m (screened 1.0-16.0m; gravel 0.8-16.0m; bentonite seal 0.3-0.8m; 0.8m stick-up)

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)

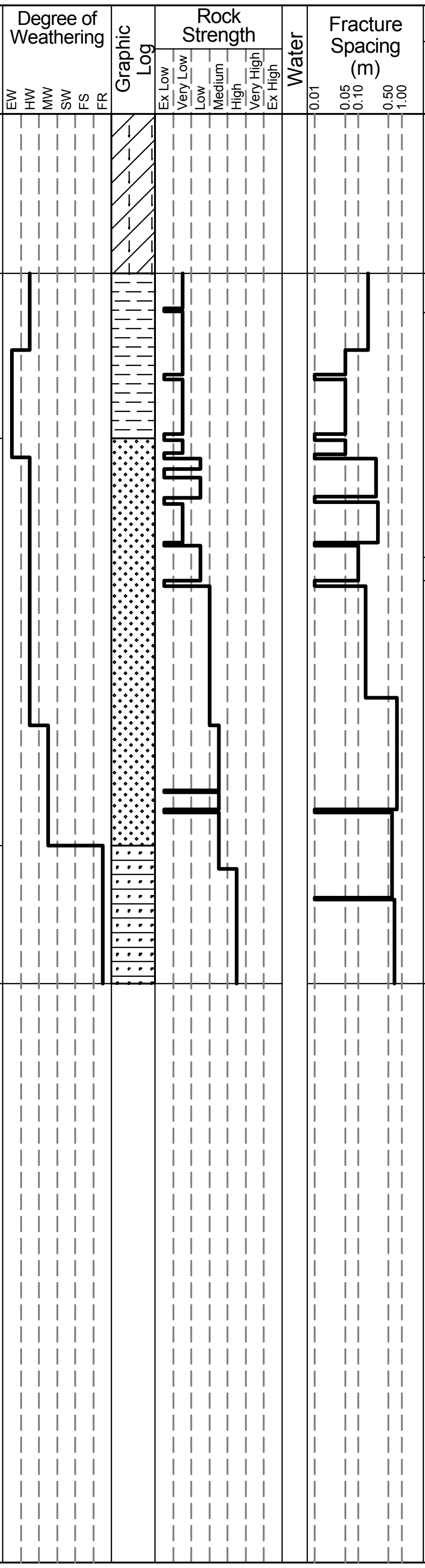
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Green Square Pty Ltd
PROJECT: Green Square Town Centre - Sites 7, 17, 18
LOCATION: Corner Bourke St and Botany Rd, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 18-1
PROJECT No: 72258.05
DATE: 21/5/2015
SHEET 2 OF 2



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
8		SILTY CLAY - stiff, light grey and grey-brown, silty clay *(continued)*	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			4,10,14 N = 24
7	11 11.1	SHALE - very low strength, highly and extremely weathered, slightly fractured, light grey and dark grey shale with some extremely low strength bands	11.34m: B0°, cly, 20mm 11.37m: J45°, pl, ro, cly	C	100	60	PL(A) = 0.1 PL(A) = 0.1
6	12 12.24	SANDSTONE - low then medium strength, highly then moderately weathered, slightly fractured, brown-grey, orange-brown and light grey, medium to coarse grained sandstone with some extremely low strength bands	12.96m: B0°, cly, 20mm 13.06m: B0°, cly, 20mm 13.22m: B0°, cly, 40mm				PL(A) = 0.1
5 4	13 14		13.72-14.03m: B0° (x4), fe stn 14.8m: B0°, cly, 20mm	C	100	98	PL(A) = 0.3 PL(A) = 0.4
3	15 15.05	LAMINITE - medium then high strength, fresh, slightly fractured, light grey and dark grey laminite	15.41 & 15.95m: B0°, cly, 10mm				PL(A) = 1.2 PL(A) = 2.5
2	16 16.0	Bore discontinued at 16.0m - target depth reached					
1	17						
0	18						
-1	19						

RIG: Scout 1 **DRILLER:** SS **LOGGED:** MP **CASING:** HW to 5.5m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 11.1m; NMLC-Coring to 16.0m
WATER OBSERVATIONS: Free groundwater observed at 4.9m whilst augering
REMARKS: Standpipe installed to 16.0m (screened 1.0-16.0m; gravel 0.8-16.0m; bentonite seal 0.3-0.8m; 0.8m stick-up)

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

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-1 **PROJECT 72258.05** **MAY 2015**

11.15 – 15.00m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-1 **PROJECT 72258.05** **MAY 2015**

15.00 – 16.56 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-2 PROJECT 72258.05 MAY 2015

12.00 – 16.00m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-2 PROJECT 72258.05 MAY 2015

16.00 – 17.17 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

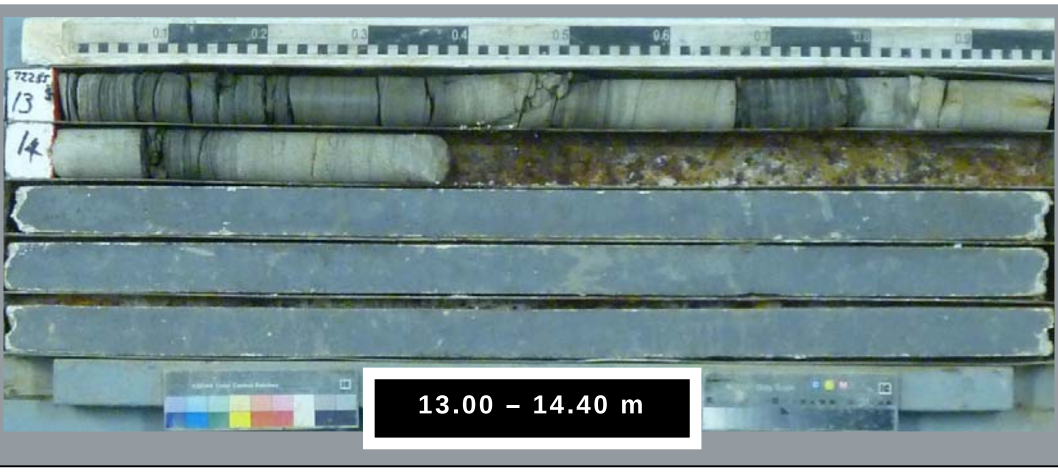
BORE 7-3 PROJECT 72258.05 MAY 2015

8.50 – 13.00 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-3 PROJECT 72258.05 MAY 2015



13.00 – 14.40 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-4 **PROJECT 72258.05** **MAY 2015**

12.50 – 17.00m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 7-4 **PROJECT 72258.05** **MAY 2015**

17.00 – 18.00 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 17-1 PROJECT 72258.05 MAY 2015

12.10 – 16.00m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 17-1 PROJECT 72258.05 MAY 2015

16.00 – 17.15 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 17-2 **PROJECT 72258.05** **MAY 2015**

10.8 – 15.00m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

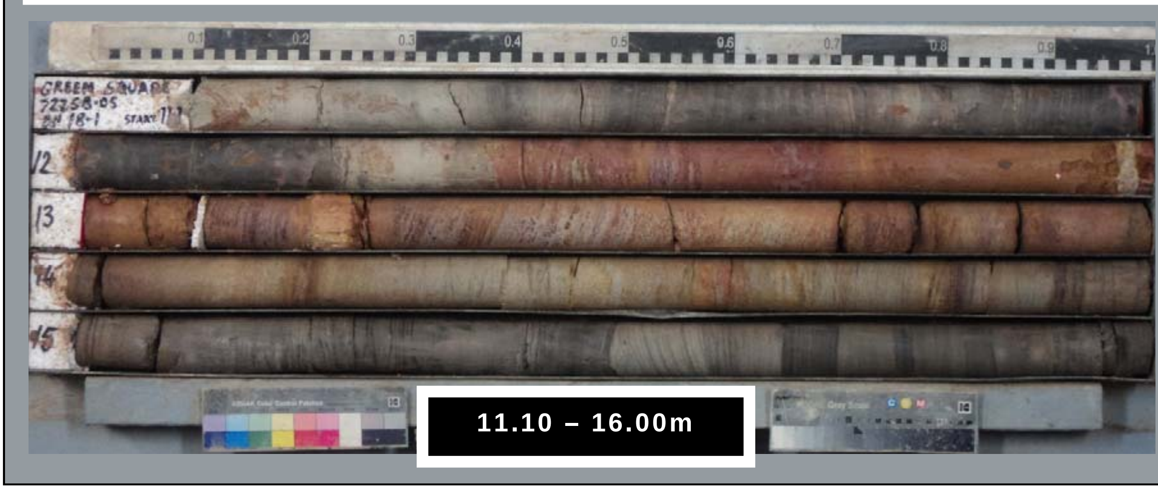
BORE 17-2 **PROJECT 72258.05** **MAY 2015**

15.00 – 17.45 m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE – SITES 7, 17, 18

BORE 18-1 **PROJECT 72258.05** **MAY 2015**



11.10 – 16.00m

BOREHOLE LOG

CLIENT: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 17.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: P3
PROJECT No: 72258
DATE: 1/2/2011
SHEET 1 OF 2

Depth (m)	Description of Strata
0.3	FILLING - grey sandy silt filling with some wood chips and organic matter
2.75	FILLING - moderately compacted, grey brown, sandy gravel filling with some clay and brick fragments
4.35	FILLING - poorly compacted, dark grey to black coalwash/ash filling
5.25	SAND - very loose, grey to dark grey, fine grained sand with some organic clay bands, moist
6.7	CLAYEY SAND - loose, light grey, fine to medium grained clayey sand
	SANDY CLAY - very stiff, orange red brown and light grey, fine to medium grained sandy clay with a trace of ironstone gravel, moist

Type	Test Results & Comments
A	
A	
A	
S	6,5,4 N = 9
A	
A	
S	2,5,6 N = 11
A	
A	
S	2,4,4 N = 8
A	
A	
S	0,1,2 N = 3
A	
S	5,8,12 N = 20
S	7,8,16 N = 24
S	

RIG: Scout 2 **DRILLER:** JS **LOGGED:** SI **CASING:** HW to 6.0m
TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.8m; NMLC-Coring to 18.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: 10% water loss at 15.0m

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

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

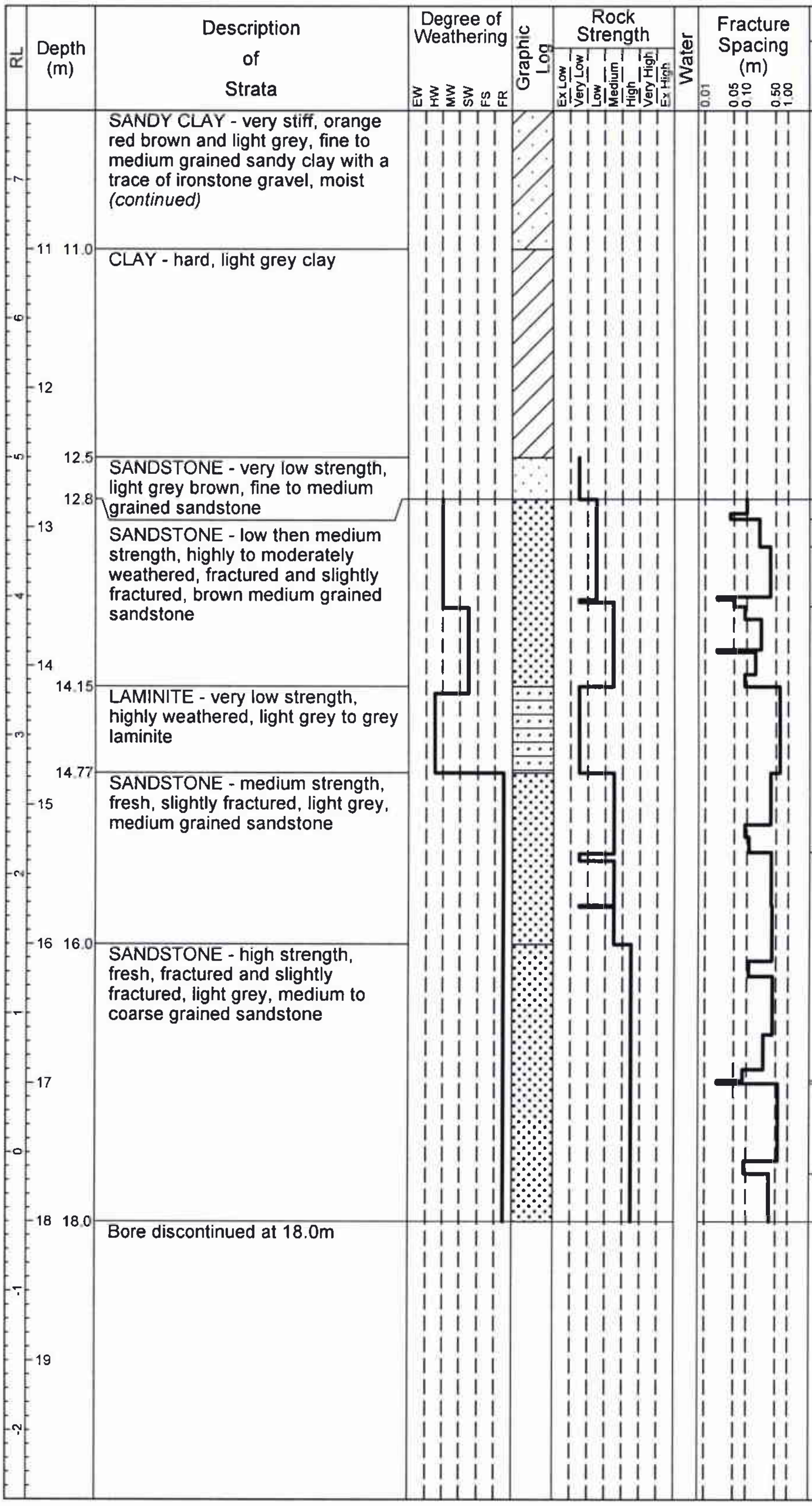
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 17.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: P3
PROJECT No: 72258
DATE: 1/2/2011
SHEET 2 **OF** 2



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
	SANDY CLAY - very stiff, orange red brown and light grey, fine to medium grained sandy clay with a trace of ironstone gravel, moist *(continued)*		S			5,9,11 N = 20
11.0	CLAY - hard, light grey clay	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			11,13,24 N = 37
12.5	SANDSTONE - very low strength, light grey brown, fine to medium grained sandstone					
12.8	SANDSTONE - low then medium strength, highly to moderately weathered, fractured and slightly fractured, brown medium grained sandstone	12.9m: J25°, pl, ro, fe 12.94m: B10°, fe 13.14m: B5°, fe 13.52m: B10°, fe, Ds (10mm) 13.57-14.15m: B (x6) 5°-10°, fe	C	100	57	PL(A) = 0.2 PL(A) = 0.6
14.15	LAMINITE - very low strength, highly weathered, light grey to grey laminite	14.15m: J, sv, cu, ro, fe				PL(A) = 1
14.77	SANDSTONE - medium strength, fresh, slightly fractured, light grey, medium grained sandstone	14.77m: J, sv, un, ro, cly 15.23m: J45°, pl, ro, cly 15.34m: J60°, pl, ro, Ds (50mm) 15.72m: B0°, Ds (5mm)				PL(A) = 0.7
16.0	SANDSTONE - high strength, fresh, fractured and slightly fractured, light grey, medium to coarse grained sandstone	16.12m: J35°, pl, ro, cln 16.65m: J, sv, un, ro, cln 16.9m: B5°, Ds (10mm) 16.98m: B5°, Ds (20mm) 17.0-17.47m: J (x2), sv, cu, ro, cln 17.56m: J25°, cly, co 17.65-18.0m: J, sv, un, ro, cln	C	100	89	PL(A) = 1.8 PL(A) = 1.4
18.0	Bore discontinued at 18.0m					

RIG: Scout 2 **DRILLER:** JS **LOGGED:** SI **CASING:** HW to 6.0m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 12.8m; NMLC-Coring to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: 10% water loss at 15.0m

SURVEY DATUM:

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: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 17.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: I3
PROJECT No: 72258
DATE: 4/2/2011
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering EW HW MW SW FS FR	Graphic Log	Rock Strength Ex Low Very Low Low Medium High Very High Ex High	Water	Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
17		FILLING - grey to dark grey, gravelly silty sand filling							E			
									E			
	1								E			
16									S			16,23,11 N = 34
	1.4	FILLING - brown then grey brown, crushed sandstone filling with some medium to coarse grained sand										
	2								E			
15												
									S			3,12,18 N = 30
	3								E			
14												
	4								E			
13									S			4,4,5 N = 9
	5 5.0	FILLING - moderately compacted, grey brown crushed sandstone filling with some sand and clay										
12												
						▼						
	6											
11												
	7								E			
10									S			4,7,8 N = 15
	8											
9												
									S			6,10,21 N = 31
	9											
8												
	9.8											

RIG: Scout 1 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 10.0m
TYPE OF BORING: Solid flight auger to 7.0m; Rotary to 13.1m; NMLC-Coring to 18.23m
WATER OBSERVATIONS: Free groundwater observed at 5.4m whilst augering
REMARKS: Groundwater monitoring well installed to 18.23m

SURVEY DATUM:

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)

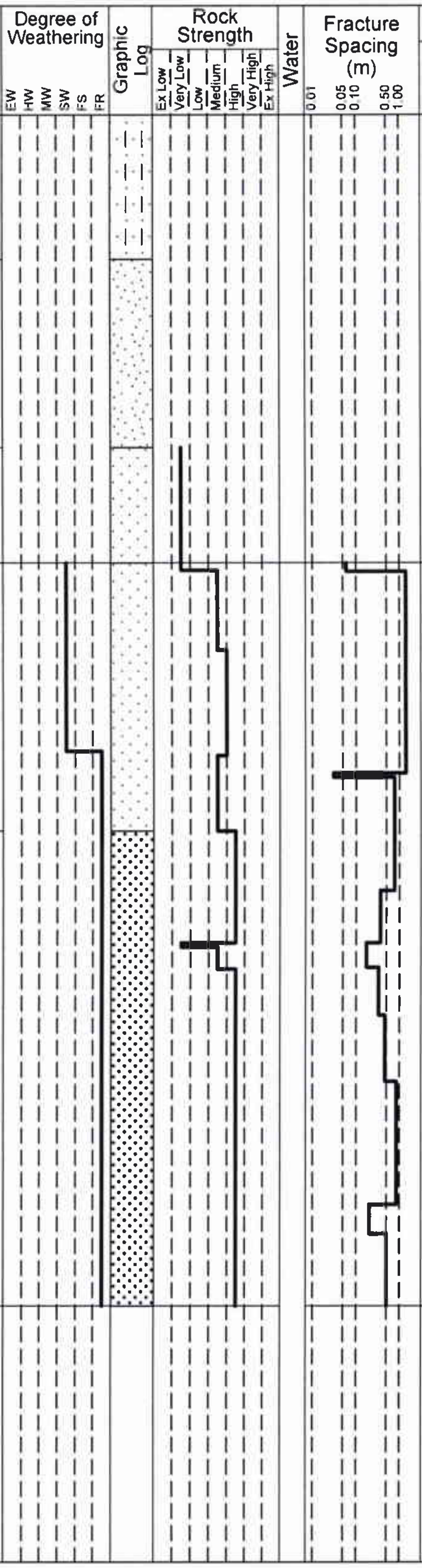
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 17.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: I3
PROJECT No: 72258
DATE: 4/2/2011
SHEET 2 **OF** 2



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
		SILTY SAND - loose, light brown, fine to medium grained silty sand, moist to wet *(continued)*		S			1,2,3 N = 5
	11.0	SAND - medium dense, brown, fine to medium grained sand with some silt, moist to wet		S			3,6,7 N = 13
	12.3	SANDSTONE - very low to low strength, light grey, fine to medium grained sandstone	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			25/110mm refusal
	13.1	SANDSTONE - medium and medium to high strength, slightly weathered then fresh, slightly fractured and unbroken, light grey brown to grey, fine to medium grained sandstone	13.16m: B0°, fe	C	100	91	PL(A) = 0.5
				C	100	100	PL(A) = 1
		14.53-14.95m: laminite band	14.55 & 14.58m: B (x2) 5°, cly, co				PL(A) = 0.9
	14.95	SANDSTONE - high strength, fresh, slightly fractured, light grey to grey, medium to coarse grained sandstone	15.36m: J45°, pl, ro, cln				PL(A) = 1.2
		15.72-15.9m: laminite band	15.72m: B0°, cly, co 15.89m: J45°, pl, sm, cly, co 16.22m: B10°, cly, vn	C	100	98	
			16.68m: J15°, pl, ro, cln				PL(A) = 2.9
			17.53 & 17.73m: B (x2) 0°, cly, vn				PL(A) = 1.8
							PL(A) = 2.1
	18.23	Bore discontinued at 18.23m					

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19
RL scale: 7, 6, 5, 4, 3, 2, 1, 0, -1, -2

RIG: Scout 1 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 10.0m
TYPE OF BORING: Solid flight auger to 7.0m; Rotary to 13.1m; NMLC-Coring to 18.23m
WATER OBSERVATIONS: Free groundwater observed at 5.4m whilst augering
REMARKS: Groundwater monitoring well installed to 18.23m

SURVEY DATUM:

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: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 15.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: I4
PROJECT No: 72258
DATE: 7 - 8/2/2011
SHEET 1 **OF** 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
15.5	0.0	FILLING - moderately compacted, grey sandy gravelly clay filling with glass fragments and grass rootlets							A A A			
									S			14,12,13 N = 25
									A			
13	2.5	FILLING - brown and light grey, crushed sandstone filling with some sandy clay							S			6,6,9 N = 15
									A			
						▼						
									A S			3,20/50mm refusal
									A			
												5.7-6.0m: C
9.5	6.0	FILLING - brown sandy clay and crushed sandstone gravel filling							S			9,6,8 N = 14
									S			12,8,9 N = 17
7	8.5	SANDSTONE - extremely low strength, light grey brown, fine to medium grained sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10° 9.88m: J, sv, cu, ro, he, cln	S			20/20mm refusal
	9.8							9.95m: Ds (20mm) J90°, pl, ro, cln	C	100	91	

RIG: Scout 2 **DRILLER:** JS **LOGGED:** SI **CASING:** HW to 9.75m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 9.8m; NMLC-Coring to 14.9m

WATER OBSERVATIONS: Free groundwater observed at 3.6m whilst augering

REMARKS: Groundwater monitoring well installed to 5.7m

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

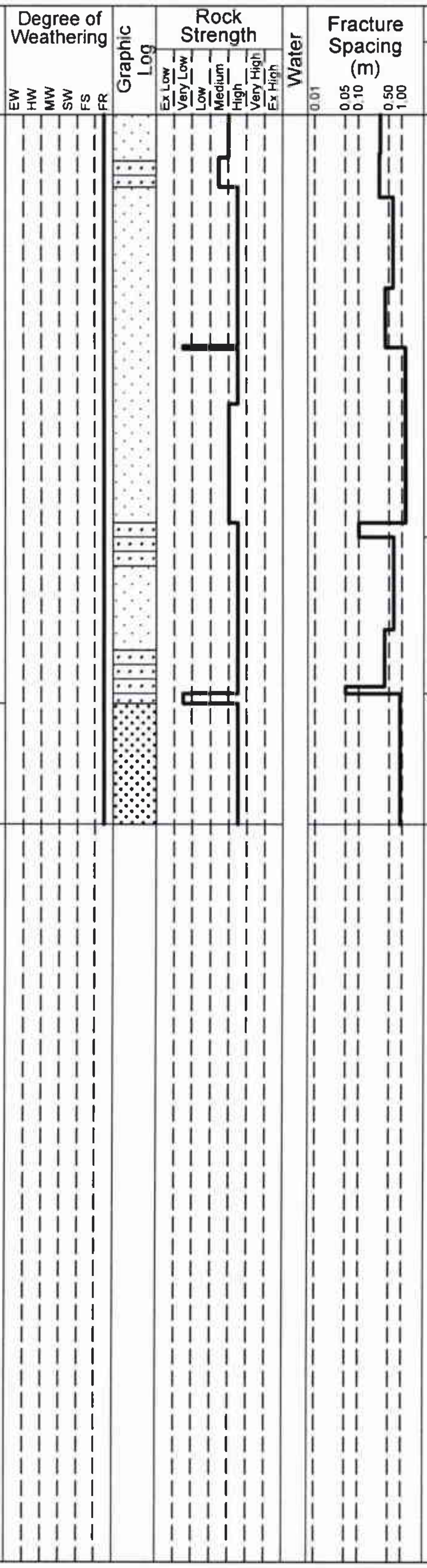
BOREHOLE LOG

CLIENT: Green Square Consortium Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: Green Square Town Centre, Zetland

SURFACE LEVEL: 15.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: I4
PROJECT No: 72258
DATE: 7 - 8/2/2011
SHEET 2 **OF** 2

RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
5 4	10.32 10.5 11 12	SANDSTONE - medium to high and high strength, fresh, slightly fractured, light grey to grey, fine to medium grained sandstone. Some medium strength laminite bands at 10.32 to 10.5m; 12.82 to 13.12m; 13.6-13.7m and 13.9 to 14.07m *(continued)*	10.27m: J, sv, pl, ro, cln 10.57m: J, sv, pl, ro, cln 11.2m: B0°, cly, vn 11.61m: J30°, pl, sm, Cz (20mm)	C	100	91	PL(A) = 1 PL(A) = 1.7
3 2	12.82 13 13.12 13.7 14		12.82m: B0°, cly, vn 12.92m: B0°, cly, vn 13.56m: J80°, pl, ro, cln 13.95m: B0°, cly, vn 14m: B0°, Cz (50mm)	C	100	96	PL(A) = 0.7 PL(A) = 1.9
1	14.07	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium to coarse grained sandstone					PL(A) = 1.5
0 -1 -2 -3 -4	14.9 15 16 17 18 19	Bore discontinued at 14.9m					



RIG: Scout 2 **DRILLER:** JS **LOGGED:** SI **CASING:** HW to 9.75m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 9.8m; NMLC-Coring to 14.9m

WATER OBSERVATIONS: Free groundwater observed at 3.6m whilst augering

REMARKS: Groundwater monitoring well installed to 5.7m

SURVEY DATUM:

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,	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

DOUGLAS PARTNERS PTY

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE P3 PROJECT 72258 FEB 2011

12.8 – 17.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE P3 PROJECT 72258 FEB 2011

17.0-18.0m

DOUGLAS PARTNERS PTY

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE I3 PROJECT 72258 FEB 2011

13.1 – 17.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE I3 PROJECT 72258 FEB 2011

17.0- 18.23m

DOUGLAS PARTNERS PTY

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE I4 PROJECT 72258 FEB 2011

9.8 – 14.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE TOWN CENTRE - ZETLAND

BORE I4 PROJECT 72258 FEB 2011

14.0- 14.9m