Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Mixed-Use Development
469-483 Balmain Road, Lilyfield

Prepared for
Roche Group Pty Ltd

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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 Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Table of Contents

Page

Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed mixed-use development at 469-483 Balmain Road, Lilyfield. The investigation was commissioned by a Services Order dated 23 January 2019 by Mr. Thomas Scarf of Roche Group Pty Ltd, and was undertaken in accordance with our proposal SYD181259.P.001.Rev1, dated 22 January 2019. This report has been prepared to accompany a 'Concept Proposal' and 'Detailed (Stage 1) Development Application' at the site.

It is understood that development at the site will include partial demolition of the existing buildings and structures within the site, and excavations to between 6.4 m and 8.9 m below existing surface levels (assumed bulk excavation level of RL 25.9 m). It is understood that the current proposal is for the construction of five multi-storey, mixed-use buildings comprising residential and light industrial buildings, with up to six above ground levels and two levels of basement carparking. The excavation footprint is proposed to extend near to the property boundaries, except at the north-eastern corner where two existing 'character buildings' are to be retained.

A geotechnical investigation was undertaken at the site in conjunction with a detailed site investigation (DSI) for contamination, to provide information on the subsurface profile for the assessment of excavation and groundwater conditions, and for the design of the basement excavation, shoring systems and foundations. The investigation comprised seven deep boreholes cored into the underlying rock, installation of four standpipe piezometers (Boreholes BH1, BH2, BH3 and BH14A), and laboratory testing of selected soil, rock and water samples. Details of the field work, together with comments relevant to design and construction, are given in this report.

2. Site Description

The site, known as Lot 2 in deposited plan DP 1015843, is an approximately rectangular shape with a total area of 6824 m^2. The site is bounded by Balmain Road to the north-west, Alberto Street to the south-west, Cecily Street to the north-east and Fred Street to the south-east.

The site is occupied by single and double-level industrial warehouse and factory units (accessed from either Balmain Road, Alberto Street or Fred Street: refer Plates 1-3 and Plate 9 in Appendix B), with a slightly sloping open-air carpark at a lower elevation on the southern portion of the site (refer Plate 4). The ground surface for the surrounding area grades down slightly to the south and east. Based upon the provided survey levels (Beuthien de Nett Pty Ltd, reference 9179A, dated 22 March 2005: measured relative to the Australian Height Datum (AHD)), the ground surface level along the Balmain Road frontage ranges between RL 34.2 and RL 35.0 m, reducing to an elevation of RL 31.5 m in the southern corner of the site (i.e. adjacent to Alberto Street).

Entry to a loading dock is present at the north-eastern end of the carpark. A low height retaining wall (retained height about 1 m) was present along the south-eastern property boundary, adjacent to a residential development (refer Plates 4 and 5). A second (ramped) loading dock is present near the intersection of Fred Street and Cecily Street.

Concrete floor slabs within the buildings appear to be slabs on ground, with the ground level for the south-eastern part of the site having been raised (beneath the buildings) by about 1.5 m. Dip / Fill points associated with underground storage tanks were observed at two locations along Alberto Street, and at another two locations within a loading dock adjacent to Fred Street. Photographs of the site, including within the buildings (i.e. Plates 5-8), are included in Appendix B. Additional photographs obtained by our buried service scanning sub-contractor have also been included in Appendix B.

A search of our project archives indicates that the neighbouring residential development (i.e. 14-22 Alberto Street) has a single-level underground carpark / garage with a basement floor slab level of approximately RL 29 - RL 30 m, and that underpinning was completed during its construction, presumably along the length of the south-eastern portion of the warehouse, adjacent to the property boundary.

3. Geology

Reference to the Sydney 1:100 000 Geological Series Sheet (Ref. 1) indicates that the site is underlain by Hawkesbury Sandstone, and that it is north-east of a geological contact with the Triassic-Aged Ashfield Shale (and Mittagong Formation which is transitional between the two formations). The extension / trace of a west-north-west trending lineament is inferred to extend near to the site, which may be indicative of a regional fault.

The Mittagong Formation consists of interbedded shale, laminite and fine grained quartz sandstone, and the underlying Hawkesbury Sandstone typically comprises horizontally bedded and vertically jointed, massive and cross-bedded, medium grained quartz sandstone with minor shale and laminite layers.

Reference to the 1:25 000 Acid Sulphate Soil Risk map for Prospect-Parramatta (Ref. 2) indicates that the site is not located within or close to an area where acid sulfate soils are known or expected to occur.

The conditions encountered during the investigation confirmed the presence of interbedded sandstone and siltstone, inferred to belong to the Mittagong Formation, overlying Hawkesbury Sandstone.

4. Field Work

4.1 Methods

The field work for the geotechnical investigation was completed between 18 and 26 February 2019, in conjunction with a contamination detailed site investigation (DSI). Site work included a walkover by an engineering geologist, drilling of eighteen boreholes (BH1 to BH17, and BH14A), and the installation of four standpipe piezometers at the locations shown on Drawing 1 in Appendix C. Four of the boreholes were drilled using hand tools (i.e. BH11, BH14, BH16 and BH17), with the other fourteen drilled using a tracked, short masted drilling rig. Ten shallow boreholes were drilled for environmental purposes within

soils only (i.e. Boreholes BH4, BH5, BH7, BH9 - BH13, BH16, BH17: to depths of between 0.4 and 2.6 m), with some of these boreholes encountering shallow refusal on obstructions within the fill materials. It is noted that Borehole BH14 was drilled adjacent to an underground storage tank, and that two concrete slabs were encountered in Boreholes BH12 and BH14.

Following coring of surface concrete slabs, dynamic cone penetrometer (DCP) testing was undertaken within soils to a maximum depth of 1.2 m, to indicate the soil strength and to probe for the depth to the underlying rock. The DCP test results are shown on the non-cored borehole logs, and the test results are included in Appendix D.

Following completion of auger drilling in soils, seven of the boreholes were then cased and advanced into the underlying sandstone using NMLC-sized diamond core drilling equipment to obtain 50 mm diameter, continuous samples of the rock for identification and strength testing purposes. The boreholes were terminated at depths in the range 4.33 - 10.0 m (typically 9 - 10 m), with Borehole BH8 terminated at 4.33 m depth due to time constraints. Selected soil samples obtained during auger drilling were submitted to an analytical laboratory, with the analytes including pH, sulphate and chloride concentrations.

To monitor the groundwater levels within the rock, standpipe piezometers were installed in four of the completed boreholes to measure groundwater levels in the longer term. Slotted casing was installed from the base of the hole up to 0.55 - 1.4 m below the top of rock, backfilled with gravel then a bentonite pellet seal placed around the PVC pipe, and a ‘gatic’ cover installed at ground level (refer to borehole logs for specific details). It is noted that due to hole collapse and other site issues during installation, within Boreholes BH3 and BH14A the bentonite pellet seal was installed to a maximum depth of 0.6 m (i.e. within sand or clay soils).

On completion, each standpipe was flushed and the standpipes subsequently pumped using low flow techniques, lowering the water level to between 0.4 and 1 m above the base of the standpipe (requiring the extraction of between 8 and 30 litres of water, before the standpipes were considered to be “dry”). The water levels were subsequently measured on 6 March 2019, about 1 - 2 weeks following standpipe installation and development.

The positions and surface levels of boreholes external to the site buildings were determined using a high precision GPS instrument. Co-ordinates for boreholes within the buildings were determined relative to site features and using Google Earth Pro software, with the surface elevations surveyed from known points on site using levelling techniques. The borehole positions are shown on Drawing 1 and the co-ordinates are recorded on the borehole logs. The co-ordinates are considered to have an accuracy of 1 m in plan and 0.1 m in elevation.

4.2 Results

The subsurface conditions encountered in the boreholes are presented in the borehole logs in Appendix D, together with notes defining descriptive terms, classification methods used, and photographs of the recovered rock core.

The subsurface conditions encountered in the boreholes can be summarised as:

FILL	External to the footprint of the existing buildings: sand or silty sand filling (trace glass, earthenware and concrete fragments and ash) or roadbase overlying silty clay filling, to depths in the range 0.5 - 1.3 m; Within the footprint of the existing buildings: concrete slabs (0.1 - 0.2 m thick: two slabs encountered in both BH12 and BH14), overlying sand, gravelly sand, silty clay, gravel or cobble filling with anthropogenic materials (including concrete, earthenware fragments, slag, black tar, glass, fibre cement fragments, sandstone, brick, tile, ash), to depths in the range 0.3 - 2.1 m; overlying
SANDY CLAY (residual)	Fine to medium grained sandy clay with ironstone bands, to a depth of 1.9 m in Borehole BH4 (inferred to overlie sandstone);
SILTY CLAY (residual)	Silty clay, with or without sand and ironstone bands, to depths in excess of 2.6 m (i.e. 0.25 - 0.8 m thick: inferred to overlie interbedded siltstone and sandstone); overlying
SILTSTONE or INTERBEDDED SILTSTONE AND SANDSTONE	Initially extremely low strength and extremely weathered, with thin iron-cemented bands of medium and high strength siltstone interbedded with fine to medium grained sandstone, becoming low and medium strength with numerous thin seams of clay and extremely weathered siltstone and sandstone; overlying
SANDSTONE	Medium to coarse grained sandstone, initially low and medium strength and highly weathered, becoming generally medium or high strength (to very high strength in Borehole BH3: at 9.1 m depth) and slightly weathered or fresh, with numerous closely spaced defects and a typically wider defect spacing below the top of (consistent) medium strength rock.

Most of the DCP tests were terminated within soils at 1.2 m depth, or refused above this depth on obstructions within the filling, however, the test results at Borehole BH16 indicate that the top of rock is at a depth of approximately 1 m below the current ground surface level (i.e. an elevation of RL 33.7 m).

The zones of core loss in the cored boreholes are interpreted to be zones of extremely low strength rock, which were ground up or washed away during coring.

The medium and high strength sandstone encountered in the boreholes was generally highly fractured to fractured, being less fractured in the boreholes drilled on the northern portion of the site. In addition, the presence of a deep weathering profile and a thick zone of extremely low strength sandstone with numerous and closely-spaced clay seams in Borehole BH3 may indicate the presence of a geological fault within the site.

The rock defects observed in the stronger sections of the siltstone and sandstone core samples were predominantly thin, closely-spaced clay seams up to 300 mm thick, and sub-vertical and iron-stained joints, or low angle (20-40°) and clay-coated joints. Widely-spaced, sub-horizontal clay-coated bedding parting defects and thin clay seams are present in the medium and high strength, medium to coarse grained sandstone.

The elevations at which the different materials were encountered in the boreholes (i.e. filling, residual soil, top of interbedded siltstone and sandstone, and top of sandstone) is summarised in Table 1. Filling materials (with or without a concrete slab) were encountered from the surface at each borehole location, as depicted in the geotechnical cross-sections included in Appendix C.

Table 1: Summary of Depths / Elevations of Soil and Rock Materials

Borehole ID	Elevation of Top of Borehole (RL, AHD)	Top of Stratum					
		Residual soil		Interbedded Siltstone and Sandstone		Sandstone	
		Depth (m)	Elevation (RL)	Depth (m)	Elevation (RL)	Depth (m)	Elevation (RL)
BH1	34.4	0.5	33.9	0.6	33.8	3.3	31.1
BH2	33.6	0.6	33.0	ne[1]	ne[1]	0.8	32.8
BH3	32.9	0.7	32.2	ne[1]	ne[1]	0.9	32.0
BH4	32.3	1.3	31.0	-	-	-	-
BH5	34.7	0.3	34.4	0.6	34.1	-	-
BH6	34.7	0.4	34.3	0.7	34.0	4.0	30.7
BH7	34.8	0.8	34.0	-	-	-	-
BH8	34.7	0.6	34.1	1.4	33.3	2.4	32.3
BH9	34.7	1.3	33.4	-	-	-	-
BH10	34.6	2.1	32.5	-	-	-	-
BH11	34.6	>0.7	<33.9	-	-	-	-
BH12	34.8	1.1	33.7	-	-	-	-
BH13	34.8	1.0	33.8	-	-	-	-
BH14	34.8	>0.9	<33.9	-	-	-	-
BH14A	34.8	1.1	33.7	1.7	33.1	3.0	31.8
BH15	34.8	0.6	34.2	1.0	33.8	3.7	31.1
BH16	34.7	0.3	34.4	-	-	-	-
BH17	34.5	>0.4	<34.1	-	-	-	-

Notes: (1) "ne" indicates this material was not encountered.
(2) "-" indicates the borehole was not extended through this material.

Free groundwater was not observed during auger drilling and the use of drilling fluids prevented groundwater observations during rotary coring.

Water levels from the standpipes measured on 6 March 2019 are summarised in Table 2.

Table 2: Groundwater Observations

Borehole ID	Surface Elevation (RL, AHD)	Standing Water Level Measurements 6 March 2019		Material Types below Bentonite Seal
		Depth (m)	Elevation (RL)	
BH1	34.4	3.47	30.9	Interbedded sandstone and siltstone, and sandstone
BH2	33.6	8.00	25.6	Sandstone
BH3	32.9	5.22	27.7	Filling, sandy clay, sandstone
BH14A	34.8	3.25	31.6	Filling, silty clay, siltstone, and sandstone

Groundwater quality parameters obtained during sampling are summarised in Table 3 and field sheets included in Appendix D.

Table 3: Summary of Groundwater Quality Parameters

Borehole ID	Temperature (°C)	DO[2] (mg/L)	EC[3] (µS/cm)	pH	Turbidity (NTU)[4]	Redox potential (mV)	Water colour
BH1	22.2	2.59	594	6.2	67	41	Clear
BH2	22.0	3.80	684	3.9	155	23	Pale Yellow
BH3	22.3	0.21	496	4.2	74	89	Clear
BH14A	22.0	0.33	635	6.3	45	46	Clear

Notes: (1) The values shown are the final values obtained during sampling.
(2) "DO" denotes Dissolved Oxygen.
(3) "EC" denotes Electrical Conductivity.
(4) "NTU" denotes Nephelometric Turbidity Unit.

5. Laboratory Testing

5.1 Rock Core

Selected samples of the rock cores were tested for point load strength index (Is_{50}) to assist with rock strength classification. The test results are shown on the borehole logs at the appropriate depths. The Is_{50} values for the rock (70 axial tests) ranged between 0.08 MPa to 4.6 MPa, indicating that the samples were of very low strength to very high strength. The corresponding uniaxial compressive strength (UCS) values are in the range 1.6 MPa to 92 MPa, based on an approximate Is_{50} multiplier of 20.

5.2 Chemical Analysis

One groundwater sample and four soil samples were tested in a NATA-accredited analytical laboratory to determine soil and groundwater aggressivity (pH, electrical conductivity, sulphate and chloride ion concentrations).

The soil aggressivity results are summarised in Table 4, with the laboratory test reports included in Appendix E.

Table 4: Laboratory Test Results for Soil and Groundwater Aggressiveness to Buried Concrete and Steel

Sample ID	Sample Description	Elevation of Sample[1] (RL m)	pH	EC[2] (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH4, 0.5m	Silty clay, with gravel, trace anthropogenic inclusions (Filling)	31.8	8.7	280	26	280
BH4, 1.5m	Sandy Clay (Residual)	30.8	8.4	180	<10	100
BH13, 0.4m	Sand, slightly gravelly with anthropogenic inclusions (Filling)	34.4	9.1	1200	24	2900
BH16, 0.7m	Silty Clay (Residual)	34.0	6.1	35	<10	20
BH1 (standpipe)	Water	27.4	6.9	530	36[3]	48[3]

Notes: (1) Elevation quoted is for the 'top' of the sample.
(2) EC = Electrical Conductivity.
(3) Chloride and Sulphate concentrations for groundwater are in mg/L.
(4) Analysed soils were tested as a 1:5 mixture of soil:water.

In accordance with AS 2159-2009 (Ref. 3), the results of the chemical testing indicate non-aggressive conditions for buried concrete. With respect to buried steel, the field groundwater quality parameters and the results of chemical testing indicate:

- the clay filling is mildly aggressive;
- the groundwater in Borehole BH1 (inferred source: interbedded sandstone and siltstone) is moderately aggressive; and
- the sand filling (with anthropogenic inclusions), and the groundwater from boreholes BH2 and BH3 (inferred source: sandstone) is severely to very severely aggressive (based on groundwater pH).

Testing of fibre cement fragments in a NATA-accredited analytical laboratory confirmed that these material samples contained asbestos. Laboratory test results are presented in Appendix E. Refer to the DSI report (Ref. 6) for further information.

6. Geotechnical Model

The geotechnical model for the site is characterised by a layer of filling (between 0.3 m and 2.1 m thick), over residual sandy clay or silty clay, over either interbedded siltstone and sandstone, or sandstone (refer inferred geotechnical cross-sections A-A' to D-D' in Appendix C). The alignments of the sections have been selected to be parallel to the site boundaries, and to pass through the recently drilled cored boreholes. It is noted that the geological interpretation between the boreholes could vary from that shown on the cross-sections.

The thickness of filling increases in a southerly direction (i.e. away from Balmain Road: to 1.3 m thick in the southern corner of the site). An additional layer of filling, with a greater proportion of anthropogenic inclusions, is present within the building footprint (up to 2.1 m total thickness: refer Section B-B'). Residual sandy clays are present beneath the filling within the southern and south-western part of the site (i.e. Boreholes BH1, BH3 and BH4: 0.1 m to 0.6 m thick), elsewhere the filling is underlain by residual silty clay (0.3 m to 0.8 m thick). As encountered in Borehole BH14, the backfilling around the underground storage tanks is likely to be loose to very loose sand, overlying a thin concrete layer or slab.

The elevation of the top of rock varies between RL 34.1 m in borehole BH5 (i.e. adjacent to the intersection of Balmain Road and Alberto Street), to about RL 30.0 m adjacent to Borehole BH4 in the southern corner of the site. Interbedded siltstone and sandstone was encountered beneath the residual soils over most of the site, being absent in the southern corner and up to 3 m thick in the northern corner of the site. Where present, the interbedded sandstone and siltstone (inferred to be the lower part of the Mittagong Formation, and with a slight apparent dip to the west) is underlain by medium to coarse grained sandstone (inferred to be the Hawkesbury Sandstone).

The interbedded siltstone and sandstone is extremely weathered and extremely low strength within 1 - 2.5 m below the top of rock (i.e. 2 - 3 m depth, with some medium and high strength, iron-cemented bands), with a further 2 m depth of low to medium strength rock with numerous seams of clay / extremely weathered siltstone. The underlying low and medium strength, highly weathered sandstone (i.e. below 3 - 4 m depth) is highly fractured, typically becoming medium and high strength, moderately weathered and slightly fractured below 3.5 - 5 m depth. It is noted that the sandstone encountered in Borehole BH3 was highly variable to 9.1 m depth, with closely spaced joints, thick clay seams and extremely low strength zones, overlying iron-cemented sandstone of very high strength. As noted in Section 4.2, this may indicate the presence of a fault within the sandstone, within a discrete zone / area of the site.

The rock materials encountered in the geotechnical boreholes have been classified in accordance with the procedures given in Pells et. al. (1998: Ref. 4), and Bertuzzi and Pells (2002: Ref. 5). The interpreted depth and reduced level at the upper surface of the various bedrock classes is shown in Table 5. It should be noted that the profiles are accurate at the borehole locations only, and that variations must be expected away from the boreholes. The strata units or layers have been shown on the cross-section as inferred strata boundaries only. In the process of preparing the rock classes and geotechnical model, some of the encountered rock classes have been downgraded due to significant weak seams, with intervals of Class IV sandstone present within Class V rock in Boreholes BH3 and BH8.

Table 5: Summary of Geotechnical Model

Borehole ID	Top of Stratum[1]									
	Class V [2]		Class IV [2]		Class III [2]		Class II [2]		Class I [2]	
	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)
BH1	0.6	33.8	3.3	31.1	4.2	30.2	-	-	-	-
BH2	0.8	32.8	2.5	31.1	4.6	29.0	-	-	-	-
BH3	0.9	32.0	-	-	-	-	-	-	-	-
BH4	>1.9	<30.4	-	-	-	-	-	-	-	-
BH5	0.6	34.1	-	-	-	-	-	-	-	-
BH6	0.7	34.0	4.0	30.7	4.7	30.0	7.6	27.1	-	-
BH7	>1.5	<33.3	-	-	-	-	-	-	-	-
BH8	1.4	33.3	-	-	-	-	-	-	-	-
BH9	>1.8	<32.9	-	-	-	-	-	-	-	-
BH10	>2.6	<32.0	-	-	-	-	-	-	-	-
BH11	>0.7	<33.9	-	-	-	-	-	-	-	-
BH12	>1.6	<33.2	-	-	-	-	-	-	-	-
BH13	>1.8	<33.0	-	-	-	-	-	-	-	-
BH14	>0.9	<33.9	-	-	-	-	-	-	-	-
BH14A	1.7	33.1	4.2	30.6	4.5	30.3	6.7	28.1	-	-
BH15	1.0	33.8	2.6	32.2	3.7	31.1	6.8	28.0	7.7	27.1
BH16	1.1	33.6	-	-	-	-	-	-	-	-
BH17	>0.4	<34.1	-	-	-	-	-	-	-	-

Notes: (1) Depths are in metres (elevations are in m AHD).
(2) Rock Classification based on Pells et. al (1998), and Bertuzzi and Pells (2002).
(3) " - " = not encountered

7. Proposed Development

The proposed development (for both a 'Concept Proposal', and a 'Stage 1 Detailed Development Application) is understood to include mixed-use residential and light industrial spaces, together with:

- partial demolition of existing site buildings and structures within the site;
- site preparation works (e.g. relocation of infrastructure and buried services);

- excavation of the site for a two-level carparking basement (with mezzanine and loading dock), with the exception of the northern corner of the site (i.e. adjacent to the intersection between Balmain Road and Cecily Street);
- adaptive re-use of the existing two-level buildings in the northern corner of the site; and
- construction of five buildings, of between 3 and 6 storeys in height.

The proposed development would also include communal open spaces, landscaping, tree planting, accessible through-site links, and creative spaces, incorporating existing 'character buildings'.

The proposed outline of the development and footprint of the basements, taken from the architectural drawings prepared for the development by CHROFI Architects (their project 21049, 32-drawing set including generalised cross-sections, Revision 2, dated 8 March 2023), are included on Drawing 1 in Appendix C.

Based upon a design finished floor level of RL26.2 m for the lowest basement level (shown on Drawings 2 to 5 in Appendix C), plus an additional 0.3 m depth to reach the assumed bulk excavation level, excavation for the basement will be required to depths of between 6.4 m and 8.9 m below existing surface levels. Further localised deepening by about 0.5-1.0 m will be required at the locations of lift over-runs.

The geotechnical issues considered relevant to the proposed development include excavation and associated vibration, excavation support, groundwater, foundations and seismic site classification.

8. Comments

8.1 Site Preparation and Trafficability

It is anticipated that the proposed bulk excavation will encounter filling, residual clay, interbedded siltstone and sandstone (extremely low to low strength with high strength bands, over low to medium strength), and low up to high strength sandstone. It is noted that the filling materials within the footprint of the existing buildings are likely to include anthropogenic inclusions such as asbestos fibre cement fragments and coal tar (and underground storage tanks), for which additional control measures will be required. Subject to the findings and waste classification presented within the contamination DSI (Ref. 6), chemical contaminants may also be present within the filling for which remediation works or specific procedures during excavation are likely to be required.

Where exposed during excavation works, the in situ clayey filling materials may heave under the applied loading of construction vehicles with tyres, posing challenges to such plant and vehicles. It is anticipated that tracked machines will be able to safely traverse and work upon this material while it is exposed, although it would be prudent to incorporate a rockfill layer of at least 300 mm thickness over these materials to enable "all-weather" access for trucks. The thickness of (rockfill) working platforms for cranes and tracked piling rigs (where required) will generally require specific geotechnical assessment.

Consideration should be given to the effect of the excavation on the foundation systems of nearby buildings within the inferred "zone of influence" (i.e. the nearby residential development between Fred and Alberto Streets and its below-ground car parking basement), and the buildings retained in the

northern corner of the site. The shoring should be designed to minimise ground movements at the building's foundation level. It is likely that the footings of the nearby buildings are high level footings founded on either very stiff clay or extremely low to very low strength sandstone (to be confirmed).

8.2 Excavation

Following demolition of the existing buildings, removal of concrete slabs and underground fuel storage tanks, excavation for the basement is expected to be required through up to about 3 m of sand or clay filling (with some cobbles and possibly boulders) and residual clay soil, with the potential to encounter some ironstone bands of locally higher strength followed by rock of varying strength including high strength sandstone.

The fill materials and clay soil should be readily excavated using conventional earthmoving equipment, however, the use of heavy ripping equipment or rock hammers will be required to excavate medium strength and stronger rock. There are some widely-spaced clay seams and sub-horizontal rock defects within the high strength sandstone, which may aid extraction.

Rippability of the sandstone is dependent upon the spacing of bedding and vertical joints, as well as on strength. Effective removal of the medium or higher strength sandstone to the required bulk excavation levels should be achieved by heavy bulldozers or excavators with rippers and rock hammers, however, excavation contractors should make their own assessment of likely productivity depending on their equipment capabilities and operator skills. Detailed footing excavations adjacent to boundary lines can be achieved by the use of hydraulic rotary rock saws, or milling heads. Rock saws could also be used along the site boundaries to minimise over-break, and to control construction vibration.

Any off-site disposal of material will require assessment for re-use or classification of the soil in accordance with *Waste Classification Guidelines:* (NSW EPA, 2014: Ref. 7), prior to disposal to an appropriately licensed landfill or other lawful facility/site. Refer to the contamination DSI report (Ref. 6) for further information.

8.3 Batter Slopes and Excavation Support

8.3.1 General

It is understood that the depth of excavation at this site will be to between 6.4 m and 8.9 m below existing surface levels, for a 2-level basement. As indicated on the supplied architectural drawings, excavation will be required over most of the site footprint and close to property boundaries.

Where space permits, it is usually most practical to batter the sides of excavations, as vertical excavations in filling, soil and weathered siltstone and sandstone will not remain stable for an extended period of time. In such circumstances, the sides of the excavation within residual clay and down to the top of low strength rock (extending to around 3 m depth) would be expected to remain stable only with batters not exceeding 1H:1V during construction, and in the longer term with batter grades not exceeding 2H:1V. Material stockpiles and machinery / equipment should not be stored at the crest of unsupported excavations. Note that with protection such as steel mesh or fibre-reinforced shotcrete, in conjunction with soil nails (within soils) or temporary rock bolts drilled and grouted into medium strength rock, it may be possible to steepen these short-term slopes.

Based upon the proposed setback distances, however, and based on the proposed excavation depth and proximity to nearby roads and neighbouring buildings, it is considered impractical to batter the slopes of the entire excavation, because these batters would cross the site boundaries. The sides of the excavation will therefore require lateral support during excavation and as part of the final construction.

In view of the depth of the proposed excavation, it is considered that temporary support would be required during construction in the form of soldier pile shoring walls, spaced at approximately 2 m to 2.5 m centres, with the panels between the piles to be progressively shotcreted in lifts of approximately 2 m as excavation proceeds, to reduce the risk of local slippages and collapse between piles. Given the variability in rock strength within some of the cored boreholes, the shoring piles should be taken to below bulk excavation levels. Closer spacing of piles may be required to reduce wall movements, or prevent collapse of filling materials, particularly where pavements, structures or buried services are located in close proximity to the excavation.

To minimise lateral deflections or deformation of the shoring walls, the piles could be connected around the perimeter of the basement by a capping beam and internal props. Alternatively, installation of temporary ground anchors could be considered, in conjunction with the passive resistance of the soldier piles. For the permanent situation, the basement structure usually provides the required lateral support to the perimeter excavation following de-stressing of the temporary anchors.

For an excavation of up to about 8 m below the top of rock, some inward horizontal movement due to stress relief effects could be expected. It is impracticable to provide restraint for any relatively high in-situ horizontal stresses present within medium or high strength Hawkesbury Sandstone. Release of stresses due to the excavation may generally cause horizontal movement along the rock bedding surfaces and partings, however, the deeply weathered profile and possible previous faulting in the area indicate that stress-relief related movements may be minimal, possibly in the order of 5-10 mm along the perimeter of the northern and southern parts of the excavation.

Regular monitoring of survey targets along the excavation perimeter during construction, such as following each successive ‘drop’ in excavation level, should be undertaken to monitor the effects of stress relief and any wall movements. The wall designer should predict the expected movements, and if monitoring suggests higher movements are occurring, a review of the design / construction methodology should be undertaken.

8.3.2 Preliminary Design

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface down to the top of medium strength rock. Table 6 outlines material and strength parameters that may be used for the preliminary design of excavation support structures, assuming a rectangular or trapezoidal distribution for walls propped/anchored at more than one elevation. Any retaining walls (separate to the basement walls) could be designed on the basis of the parameters given in Table 6 and a triangular pressure distribution. Further advice on design and specification should be sought if retaining walls are to be constructed at the site.

Table 6: Typical Material and Strength Parameters for Excavation Support Structures

Material Description	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure (kPa)
Fill Material	20	0.3	0.6	-
Residual Soil	20	0.25	0.5	-
Extremely low to low strength interbedded siltstone and sandstone	22	0.2	0.4	400
Low and medium strength interbedded siltstone and sandstone	22	0.2	0.4	2000
Low and medium strength sandstone	22	0[1]	0.1[1]	2000[1]
Medium or high strength sandstone	22	0[1]	0[1]	6000[1]

Note: (1) Provided adverse jointing is not encountered.

To estimate the passive resistance of the piles, it is suggested that an ultimate passive pressure is adopted for medium to high strength rock over any “toe-in” length developed at the base of the piles, from about 1 m below the base level of the excavation, or other excavation adjacent to the wall. The ultimate passive pressures adopted should incorporate a suitable factor of safety of at least 2.0 to limit deflection.

Lateral pressures due to surcharge loads from adjacent buildings, sloping ground surfaces, the existing road corridors, and construction machinery should be included where relevant. Hydrostatic pressures acting on the shotcrete should also be included in the design where adequate drainage is not provided behind its full height. Drainage could comprise 150 mm wide strip drains pinned diagonally to the face at 2 m centres behind shotcrete in-fill panels. It is noted that the base of the strip drains should extend out from the shoring wall to allow any seepage to flow into a perimeter toe drain connected to the stormwater drainage system.

Inspections of rock faces during excavation, following completion of each ‘drop’ in excavation level and prior to covering with shotcrete, will be required to determine whether any potentially unstable rock wedges are present requiring permanent support. Additional anchors may be required if large blocks or wedges are observed during excavation.

8.3.3 Ground Anchors

Where necessary, lateral earth pressures acting on the rear of a pile shoring wall may be resisted by a combination of declined temporary “tie-back” ground anchors and the passive resistance of the soldier piles. Anchoring of soldier piles can be accomplished by post-stressed–type strand or bar anchors. It is suggested that anchors be declined as steeply as possible, but not exceeding 30° below the horizontal, to allow anchoring in the stronger rock (i.e. medium and high strength sandstone) at depth. Further advice on design and specification should be sought if permanent anchors are to be employed at this site.

For estimating and preliminary design of temporary ground anchors, the typical average and ultimate bond stresses at the grout-rock interface are given in Table 7.

Table 7: Typical Allowable and Ultimate Bond Stresses for Anchor Design

Material Description	Allowable Bond Stress (kPa)	Ultimate Bond Stress (kPa)
Extremely low to low strength interbedded siltstone and sandstone	50	100
Low and medium strength interbedded siltstone and sandstone	150	300
Low and medium strength sandstone	150	300
Medium or high strength sandstone	500	1000

Most anchoring contracts are, however, “performance contracts” in which the anchoring contractor designs and constructs the anchors to carry the design loads. Therefore, it is the contractor’s responsibility to ensure that the correct design values specific to the anchor system, rock type and strength, and method of installation are used, and that each anchor is properly constructed and tested.

Where employed at this site, temporary ground anchors should be designed to have a free length equal to their height above the bulk excavation level (and at least 3 m) 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 80% 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.

8.4 Vibration Control

Noise and vibration will be caused by excavation work on the site, such as through the use of rock hammers. The use of rock hammers will cause vibrations which, if not controlled, could possibly result in damage to nearby structures and disturbance to occupants. It is suggested that vibrations be provisionally limited to a peak particle velocity (PPV) of 8 mm/s at the foundation level of the adjacent buildings. This level complies with AS/ISO 2631.2 – 2014 (Ref. 8) and is below the normal building damage threshold level. Consideration should also be given to consulting the owners of any in-ground utilities on and around the property to confirm construction vibration thresholds for their assets.

Vibration trials are suggested during initial excavation of rock to verify vibration levels and, if considered to be required then alternative excavation methods such as rock sawing and rock milling could be considered.

It is also recommended that a dilapidation survey be carried out on adjacent properties including structures, pathways, walls or roadways within about 30 m of the proposed excavation, prior to

commencement of the works. The dilapidation survey should document existing conditions and the presence of defects and thereby allow appropriate responses should any claims arise from construction at this site.

8.5 Groundwater

Although free groundwater was not observed during auger drilling, it was subsequently measured in all three of the installed standpipes which were screened within the underlying rock (either sandstone, interbedded siltstone and sandstone, or both).

Measurements of the groundwater chemistry indicate that the water has similar properties in Boreholes BH1 and BH14A (both standpipes screened within interbedded siltstone and sandstone, and sandstone), compared with BH2 and BH3 (screened only within the sandstone), with the sandstone-sourced groundwater being acidic (i.e. a measured pH of about 4).

It is noted that the basement car parking levels lie below the measured water levels, however, the measured variable water levels across the site and the slow rate of water recharge in all standpipes indicates that the measured levels likely relate to seepage from along the top of the rock, from strata boundaries, through the rock substance and/or from rock defects (as has been observed elsewhere within these rock materials in Sydney). The regional groundwater table is expected to be well below the proposed lowest basement level.

At this stage it is not possible to accurately estimate the likely extent and rate of seepage, although it is anticipated that seepage volumes will be relatively low (less than 3 ML/year), given the expected low permeability of the rock mass.

The possible additional groundwater inflows from faulted zones within the rock may considerably increase the seepage volumes. Excluding the possible contribution from any faulted zones, inflow rates such as these are readily handled by sump and pump drainage measures, with the pumps required to periodically remove stored water from the sub-floor drainage system. Pumps may also be needed to remove seepage from any bored pile excavations, prior to placement of concrete.

It is suggested that monitoring of flow during the early phases of excavation be undertaken to assess long term pumping requirements. Grouting of open joints and partings may be necessary if excessive water ingress is an issue during excavation.

It will be necessary to provide under-floor drainage to safeguard against uplift pressures if the slabs are designed for drained conditions, as expected. This could comprise a minimum 100 mm thick, durable open graded crushed rock with subsurface drains and sumps.

Previous experience indicates that the groundwater within the Hawkesbury Sandstone can have moderate concentrations of dissolved solids, including iron. Once groundwater comes into contact with the atmosphere, precipitation of iron oxides is likely to occur and provision should be made for the filtering and/or cleaning of this precipitate from subsoil drains, sumps, pumps and other fittings over the medium to longer term.

Based upon the groundwater observations and ground conditions encountered during the investigation, and the existing presence of shallow basement excavations in nearby residential developments at a

lower elevation to the south, the groundwater drawdown effects on adjacent properties are likely to be negligible.

8.6 Foundations

Medium or high strength sandstone (Classes II or III) is typically expected to be encountered at the basement bulk excavation level over most of the site. Foundations for the new multi-storey buildings in the northern part of the site will need to be founded below the zone of influence of nearby excavations (such as for the basement), in the underlying rock. All footings should be founded within a uniform stratum, such as Class III sandstone. Spread footings (i.e. pad or strip footings) should be suitable for supporting the proposed building loads over most of the excavation footprint, however, foundations in the southern part of the site (as indicated by Borehole BH3) may need to be taken deeper, through the soil and weaker rock layers, to the underlying stronger sandstone.

Recommended maximum allowable (and ultimate) bearing pressures, shaft adhesions and modulus values for the range of rock encountered in boreholes at the site is presented in Table 8. These parameters apply to the design of spread footings, such as pads or strip footings, or for socketed bored piles, for the support of axial compression loadings. They can be adopted on the assumption that the excavations are clean and free of loose debris, with pile sockets free of smear and adequately roughened immediately prior to concrete placement.

Foundations proportioned on the basis of the allowable parameters would be expected to experience total settlements of less than 1% of the footing width (or pile diameter) under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value. An experienced geotechnical engineer should inspect all pile excavations and spread footings (e.g. pads) prior to the placement of concrete and steel.

Footings in consistent Class III sandstone could be designed for 3 500 kPa and potentially up to 6 000 kPa, subject to spoon testing during construction. If higher bearing pressures are used in design then significant additional testing will be required, such as additional cored boreholes and spoon testing of footings, to ensure there are no defects beneath footings. Alternatively, if an allowable bearing pressure of 3 500 kPa is used then only inspection of footing excavations will be required to confirm the founding strata is consistent with design assumptions.

Table 8: Recommended Design Parameters for Foundation Design

Foundation Stratum[1]	Allowable End Bearing (MPa)	Ultimate End Bearing (MPa)	Allowable Shaft Adhesion (kPa)[2]	Ultimate Shaft Adhesion (kPa)[2]	Field Elastic Modulus (MPa)
Sandstone – Class IV	1.0	4	100	250	100
Sandstone – Class III	3.5	20	350	800	350
Sandstone – Class II [3]	6 [3]	60 [3]	600 [3]	1500 [3]	900 [3]
Sandstone – Class I [3]	12 [3]	120 [3]	600 [3]	1500 [3]	2000 [3]

Notes: (1) Rock Classification based on Pells et. al (1998) and Bertuzzi and Pells (2002).

(2) Shaft adhesion applicable to the design of bored piles, uncased over the rock socket length, where adequate sidewall cleanliness and roughness are achieved.

(3) Requires verification boreholes and spoon testing.

Where footings are located within the zone of influence of adjacent excavations, drawn upward at 45 degrees from the toe of the excavation (such as lift shafts or tanks), the allowable bearing pressure should be reduced by 25% and the excavation floor carefully inspected for adversely oriented joints. Alternatively, the footings may be taken deeper, below the zone of influence.

The floors at basement level can be designed as slabs on ground. The final rock surface should be trimmed and scraped clean of debris.

8.7 Seismic Design

In accordance with the Earthquake Loading Standard, AS 1170.4 – 2007 (Ref. 9), the site has a hazard factor (z) of 0.08. A site sub-soil class of rock (B_e) is considered appropriate.

9. References

1. Herbert C., 1983, Sydney 1:100 000 Geological Sheet 9130, 1st edition. Geological Survey of New South Wales, Sydney.
2. The Department of Land and Water Conservation, 1995. 1:25 000 Acid Sulphate Soil Risk map for Parramatta-Prospect.
3. Australian Standard AS2159-2009, “Piling – Design and Installation”, Third edition, 2009, Standards Australia.
4. Pells, PJN., Mostyn, G., and Walker, BF, 1998, “Foundations on Sandstone and Shale in the Sydney region”, Australian Geomechanics Journal, Vol. 33, No. 3.
5. Bertuzzi, R. and Pells, PJN, 2002, “Geotechnical parameters of Sydney Sandstone and Shale”, Australian Geomechanics Journal, Vol. 37, No. 5.
6. Douglas Partners Pty Ltd, “Report on Detailed Site Investigation for Contamination, 469-483 Balmain Road, Lilyfield”, Report number 72046.02.R.001.Rev1, dated 6 April 2023.
7. NSW Environment Protection Authority (EPA), 2014. “Waste Classification Guidelines”.
8. Australian / International Standard AS/ISO 2631.2 – 2014, “Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Vibration in buildings (1 Hz to 80 Hz)”.
9. Australian Standard AS 1170.4 – 2007, “Structural design actions, Part 4: Earthquake actions in Australia”.

10. Limitations

Douglas Partners (DP) has prepared this report for this project at 469-483 Balmain Road, Lilyfield in accordance with DP’s proposal SYD181259 (Rev1) dated 22 January 2019 and acceptance received from Mr. Thomas Scarf of Roche Group Pty Ltd dated 23 January 2019. The work was carried out under DP’s Conditions of Engagement. This report is provided for the exclusive use of Roche Group Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Appendix B

Site Photographs

Photo 1 – View to east across Balmain Road towards Cecily Street.

Photo 2 – View to south across Balmain Road towards Alberto Street.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 1 REV: 0

Photo 3 – View north-west towards Alberto Street and Balmain Road. The position of Borehole BH5 is indicated as shown.

Photo 4 – View to north-east from an entrance from Alberto Street, within a storage area. The position of Borehole BH5 is indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 2 REV: 0

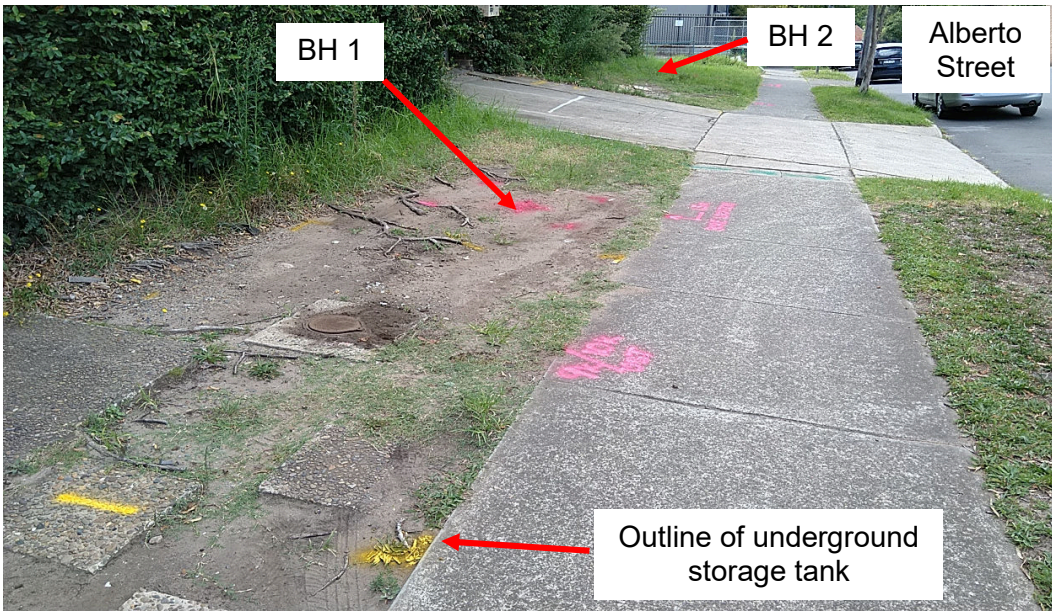


Photo 5 – View south-east along Alberto Street, towards Boreholes BH1 and BH2, which are indicated as shown.

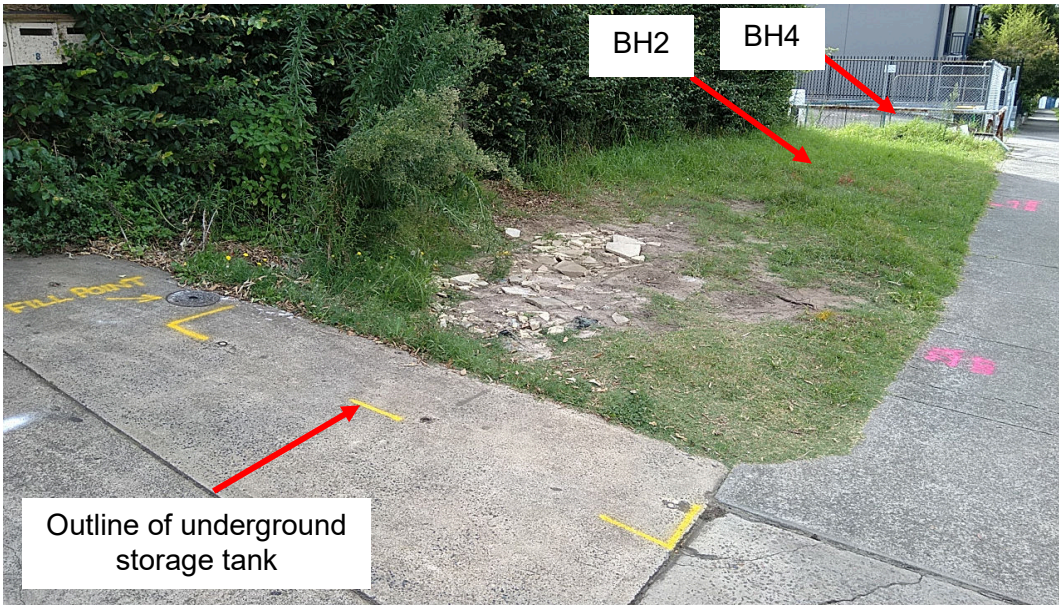


Photo 6 – View to south-east along Alberto Street, with the positions of Boreholes BH2 and BH4 (within a car park) indicated as shown. The outline of an underground storage tank is also indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 3 REV: 0

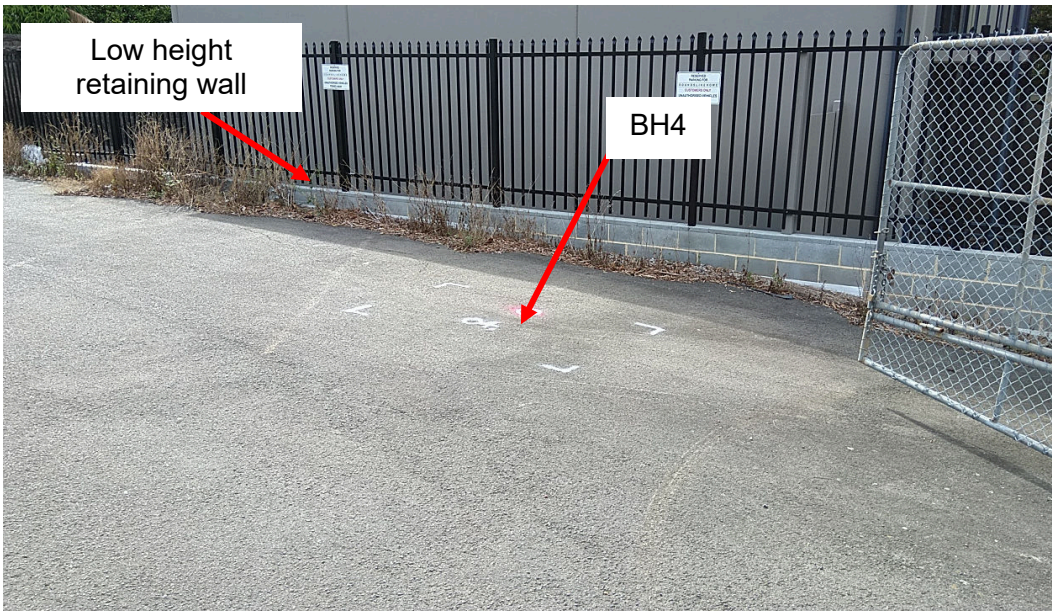


Photo 7 – View to east within an open-air car park, with the position of Borehole BH4 and a low height retaining wall indicated as shown.

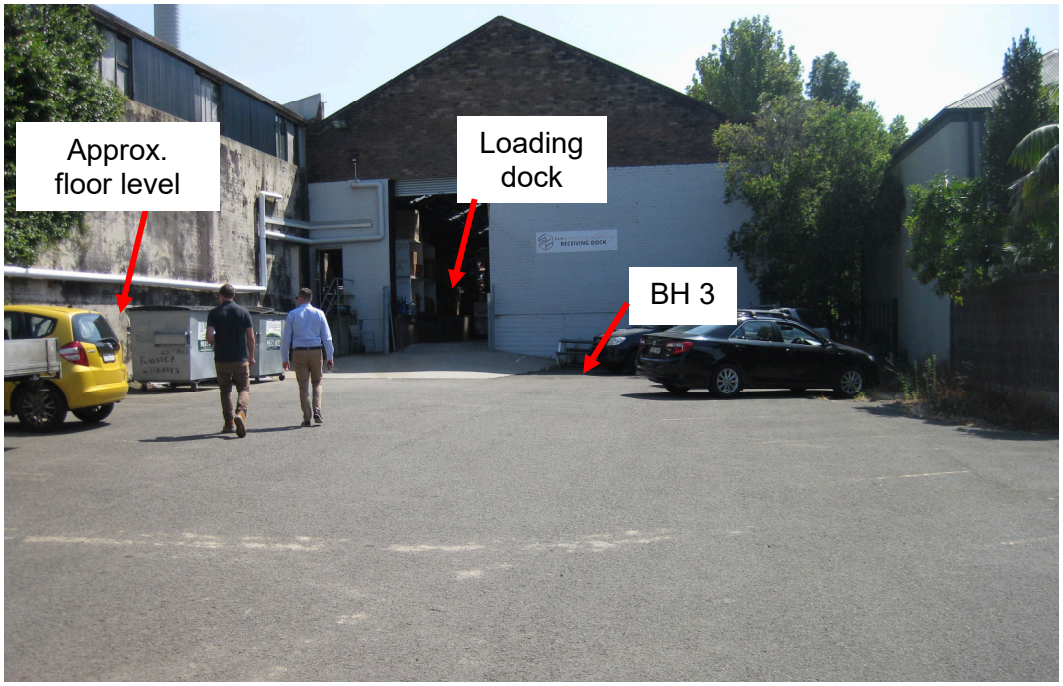


Photo 8 – View north-east from Alberto Street, towards a furniture warehouse and loading dock. The position of Borehole BH3 is indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 4 REV: 0

Photo 9 – View north-east into loading dock, with the approximate positions of Boreholes BH10 and BH11 indicated as shown.

Photo 10 – View to north-west within a factory unit, indicative of the general area near borehole BH6, which is indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 5 REV: 0

Photo 11 – View north-east along forklift passageway towards mini-workshop and the approximate position of Borehole BH8, which is indicated as shown.

Photo 12 – View south-east along forklift passageway towards loading dock, with the approximate position of Borehole BH9 indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 6 REV: 0

Photo 13 – View north-west within Fred Street loading dock, with the position of Borehole BH12 indicated as shown.

Photo 14 – View north-west within vacant warehouse towards a two-level section of the building, with the approximate positions of Boreholes BH13 and BH15 indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 7 REV: 0

Photo 15 – View south-west within factory unit and the approximate position of Borehole BH16, which is indicated as shown.

Photo 16 – View south-east within factory unit, with the approximate position of Borehole BH17 indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 8 REV: 0

Photo 17 – View south-east along Cecily Street, towards the south-eastern corner of the site.

Photo 18 – View north-west along Cecily Street, towards Balmain Road and the north-eastern corner of the site.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Mixed-Use Development** **469-483 Balmain Road, LILYFIELD**	PROJECT: 72046.03 PLATE No: 9 REV: 0

Form Information

Form Name:	**Field Report**
Submitter Name:	Nathan Ellis (nathan.ellis)
Reference Number:	20190215-1898128857

CLIENT & SITE DETAILS

Site Contact Name	Rhys
Contact Number	0437 441 231
Site Name	Drilling Works
Site Address	469 - 483 Balmain Road, Lilyfield NSW 2040
Description of Works	Clear seventeen (17) drill locations of all utilities, services and petrochemical infrastructure
Client	Douglas Partners

UTILITY LOCATING

Utility Locating Device(s)	RD8000
Start Time	7:00 AM
Finish Time	1:00 PM
Date	Feb 15, 2019
Applicable Site Fee	Utility Locating & Ground Penetrating Radar
Utility Locating Services Representative(s)	Nathan Ellis

GROUND PENETRATING RADAR (GPR)

Radar	GSSI UtilityScan
Date	Feb 15, 2019
Utility Locating Services Representative(s)	Nathan Ellis

SUPPORT DOCUMENTATION

Dial Before You Dig Job Number	15695114
Are all DBYD plans available ?	YES
Are all DBYD plans within date ?	YES
Do DBYD plans cover area of concern ?	YES
Were DBYD plans supplied by Utility Locating Services ?	NO

CHECK LIST (STANDARD)

The following utilities and services have been marked or identified	Electric Telstra Water Fire Sewer Drainage
The following methods were used to locate utilities and services	Direct Connection Transmitter Clamp 240v Live Plug Connector Electric Scan Radio Scan Inductive Sweep GPR Scan
Site Conditions	Dry
Marking Surface	Concrete Asphalt Grass

Marking System

Spot Marking Paint

.

LINE COLOUR.....UTILITY.....LEGEND
Orange.....Electricity.....-- E --
White.....Communications.....-- C --
Blue.....Water.....-- W --
Yellow.....Gas (All Pressures).....-- G --
Brown.....Petrochemical.....-- P --
Red.....Fire Service.....-- F --
Cream.....Sewer.....-- S --
Green.....Drainage.....-- D --
Purple.....Recycled Water.....-- R --
Pink.....Unidentified Service.....-- U --

In accordance with Australian Standard AS 5488 - 2013 'Classification of Subsurface Utility Information' (SUI).
The standards for locating & marking underground utilities has been divided into the following four levels.

Level A. Locate, pothole, visually verify the utility.
Level B. Electronic detection of the utility.
Level C. Approximate location of the utility obtained by surface features within an area of interest and/or concern.
Level D. Information has been sourced through utility records and/or plans.

CHECK LIST (PETROCHEMICAL)

The following fuel systems have been marked or identified

Underground Storage Tank (UST)
UST Dip Points checked to verify UST size
Remote Fills

SITE REPORT

Enter results and findings in Detail

Verify where all main services are feeding site.
Identify and locate all services in proximity to drill locations.
Check dip point on all four UST’s to verify tank size, GPR UST’s to verify tank edges, position drill locations to avoid UST’s.
Verify Electric from substation and from main meter board does not enter factory floor.
Verify Telstra is aerial in factory from property boundary.
Verify Water and Gas does not enter drill location areas.
Sewer and Drainage inaccessible to FlexiTrace so drill locations positioned to avoid these areas.
Performed full electromagnetic and GPR sweep over all seventeen (17) drill locations.
All seventeen (17) drill locations marked in white box area are clear of all utilities, services and petrochemical infrastructure.

Add photo(s) maximum 10

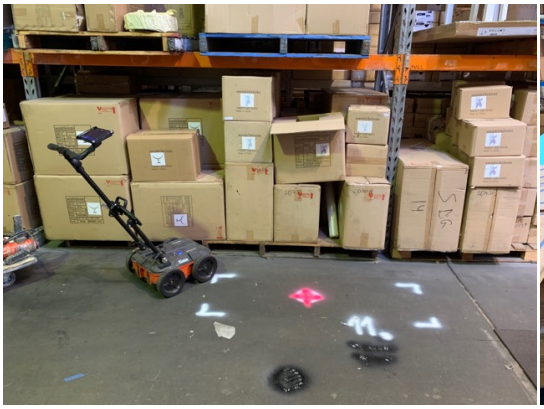

TOYOTA
DYNA
VQV 695
06.


UST 1
UST 11


13.


15.


12.



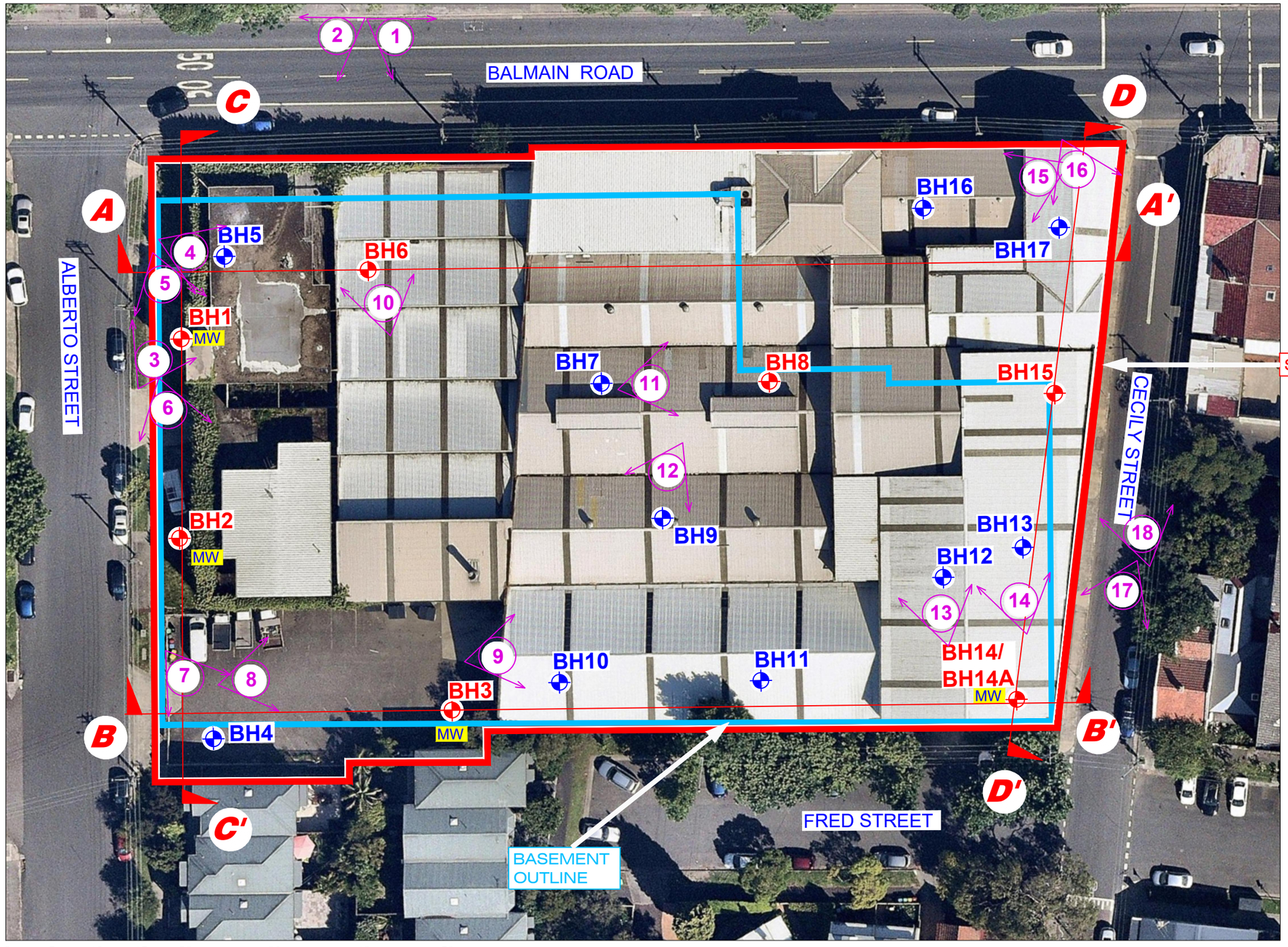

Add photo(s) maximum 10

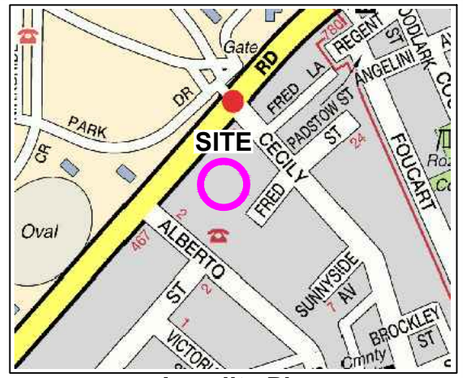
Record GEO Location

483 Balmain Rd, Lilyfield NSW 2040, Australia
Feb 15, 2019 12:49 PM [View Map]

Appendix C

Drawings





Locality Plan

0 5 10 15 20 30 40 50m

1:500 @ A3

NOTE:
1: Base image from Nearmap.com (Dated 27 December 2018)
2: Test locations are approximate only and are shown with reference to existing features
3: Basement outline as per drawing prepared by CHROFI Architects, Project 21049, drawing A-DA101 (Rev2), dated 8 March 2023.

LEGEND

- Borehole (cored)
- Borehole (auger only)
- MW Monitoring well
- A A' Geotechnical Cross Section A-A'
- 2 Site Photo number with direction of view

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Geotechnics / Environment / Groundwater

CLIENT: Roche Group Pty Ltd		TITLE: **Site and Test Location Plan**	PROJECT No: 72046.03
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Mixed-Use Development**	DRAWING No: 1
SCALE: 1:500 @ A3	DATE: 6.04.2023	**469-483 Balmain Road, LILYFIELD**	REVISION: 1

A

A'

Intersection Section C-C'

Intersection Section D-D'

Property Boundary

BUILDING

FACTORY BUILDING

WAREHOUSE

WAREHOUSE

FACTORY BUILDING

Property Boundary

ALBERTO STREET

CECILY STREET

CONCRETE

BH5
Offset 2.0m
Rock Strength
EL VL L M H VH EH
Bottom Depth 0.9 m

BH6
Offset 0.0m
Rock Strength
EL VL L M H VH EH
Bottom Depth 9.84 m

BH16
Offset 5.2m
Bottom Depth 0.9 m

BH17
Offset 2.6m
Bottom Depth 0.4 m

FILLING

FILLING
RESIDUAL CLAY

INTERBEDDED SILTSTONE AND SANDSTONE

INTERBEDDED SILTSTONE AND SANDSTONE
Extremely low to low strength with high strength bands

INTERBEDDED SILTSTONE AND SANDSTONE
Low to medium strength

SANDSTONE low and medium strength

SANDSTONE
Medium and high strength

BASEMENT PROFILE
RL 26.2m

ELEVATION (m AHD)

40 38 36 34 32 30 28 26 24 22 20

0 20 40 60 80 100 120

DISTANCE ALONG PROFILE (m)

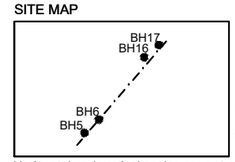
NOTE:
1. Subsurface conditions are accurate at the test locations only and variations may occur away from the test locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.
4. Ground surface level indicative only.
5. Horizontal and vertical scales are not equal.

LEGEND

- Core Loss
- Concrete
- Filling
- Sandstone
- Silty Clay
- Inferred Stratigraphic Boundary
- Inferred Geotechnical Boundary

TESTS / OTHER
- Water level

SITE MAP



0 8
Horizontal Scale (metres)
Vertical Exaggeration = 4.0
Horizontal and vertical scales are not equal

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Roche Group Pty Ltd		TITLE: **Inferred Geotechnical Cross-Section A-A'**	PROJECT No: 72046.03
OFFICE: Sydney	DRAWN BY: HDS	**Proposed Mixed-Use Development**	DRAWING No: 2
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 6.04.2023	**469-483 Balmain Road, LILYFIELD**	REVISION: 1

B

B'

WAREHOUSE BUILDING

WAREHOUSE BUILDING

Property Boundary

Intersection Section C-C'

Intersection Section D-D'

Property Boundary

CONCRETE SLAB

CONCRETE SLAB

BH10
Offset 3.2m

BH11
Offset 2.8m

BH14A
Offset- 0.2m
Rock Strength

BH3
Offset 0.6m
Rock Strength

BH4
Offset - 1.6m

ASPHALT AND ROADBASE

FILLING WITH ANTHROPOGENIC INCLUSIONS

Bottom Depth 0.7 m

CECILY STREET

ALBERTO STREET

FILLING

RESIDUAL SANDY CLAY

RESIDUAL CLAY

INTERBEDDED SILTSTONE AND SANDSTONE
Extremely low to low strength with high strength bands

Low to Medium strength

Bottom Depth 1.9 m

SANDSTONE
Low and medium strength

SANDSTONE
Low and medium strength

BASEMENT PROFILE
RL 26.2m

SANDSTONE
Medium and high strength

Bottom Depth 10 m

Bottom Depth 2.6 m

Bottom Depth 9.88 m

ELEVATION (m AHD)

40
38
36
34
32
30
28
26
24
22
20

0
20
40
60
80
100
120

DISTANCE ALONG PROFILE (m)

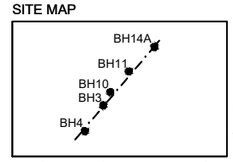
NOTE:
1. Subsurface conditions are accurate at the test locations only and variations may occur away from the test locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.
4. Ground surface level indicative only.
5. Horizontal and vertical scales are not equal.

LEGEND

- Core Loss
- Asphaltic Concrete
- Concrete
- Filling
- Roadbase
- Sandstone
- Sandy Clay
- Siltstone
- Silty Clay
- Inferred Stratigraphic Boundary
- Inferred Geotechnical Boundary

TESTS / OTHER
- Water level

SITE MAP



0 8
Horizontal Scale (metres)

Vertical Exaggeration = 4.0

Horizontal and vertical scales are not equal

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Roche Group Pty Ltd		TITLE: **Inferred Geotechnical Cross-Section B-B'**	PROJECT No: 72046.03
OFFICE: Sydney	DRAWN BY: HDS	**Proposed Mixed-Use Development**	DRAWING No: 3
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 6.04.2023	**469-483 Balmain Road, LILYFIELD**	REVISION: 1

C

C'

Property Boundary

Intersection Section A-A'

Intersection Section B-B'

Property Boundary

UNDERGROUND TANK ≃ 9-10kL

UNDERGROUND TANK ≃ 22kL

BALMAIN ROAD

BH5 Offset 4.2m

BH1 Offset - 0.6m

BH2 Offset - 1.2m

BH4 Offset 3.9m

Rock Strength EL VL L M H VH EH

FILLING

RESIDUAL CLAY

Bottom Depth 0.9 m

INTERBEDDED SILTSTONE AND SANDSTONE

Extremely low to low strength with high strength bands

Low and medium strength

SANDSTONE

Low and medium strength

SANDSTONE

Medium and high strength

ASPHALT AND ROADBASE

FILLING

RESIDUAL SANDY CLAY

Block retaining wall

(NEIGHBOUR)

Bottom Depth 1.9m

BASEMENT PROFILE

RL 26.2m

Bottom Depth 9.56 m

Bottom Depth 9.05 m

ELEVATION (m AHD)

40 38 36 34 32 30 28 26 24 22 20

-20 0 20 40 60 80 100

DISTANCE ALONG PROFILE (m)

NOTE:

1. Subsurface conditions are accurate at the test locations only and variations may occur away from the test locations.
2. Strata layers and rock classification shown are 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.
4. Ground surface level indicative only.
5. Horizontal and vertical scales are not equal.

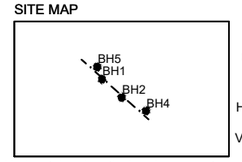
LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Concrete
- Filling
- Roadbase
- Sandstone
- Sandy Clay
- Siltstone
- Silty Clay
- Inferred Stratigraphic Boundary
- Inferred Geotechnical Boundary

TESTS / OTHER

- Water level

SITE MAP



0 8

Horizontal Scale (metres)

Vertical Exaggeration = 4.0

Horizontal and vertical scales are not equal

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Roche Group Pty Ltd		TITLE: **Inferred Geotechnical Cross-Section C-C'**	PROJECT No: 72046.03
OFFICE: Sydney	DRAWN BY: HDS	**Proposed Mixed-Use Development**	DRAWING No: 4
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 6.04.2023	**469-483 Balmain Road, LILYFIELD**	REVISION: 1

D

D'

FACTORY BUILDING

WAREHOUSE BUILDING

Property Boundary

Intersection Section A-A'

UNDERGROUND STORAGE TANK

Intersection Section B-B'

Property Boundary

CONCRETE SLAB

Filling with anthropogenic inclusions

CONCRETE SLAB

BH17
Offset - 1.7m

BH15
Offset - 0.1m

BH13
Offset - 0.6m

BH14A
Offset 0.9m

Rock Strength

BALMAIN ROAD

FILLING

Bottom Depth 0.4 m

FILLING

RESIDUAL CLAY

FILLING

SAND SLAB

FRED STREET

Bottom Depth 1.8 m

INTERBEDDED SANDSTONE AND SILTSTONE
Extremely low to low strength with high strength bands

INTERBEDDED SANDSTONE AND SILTSTONE
Low and medium strength

SANDSTONE
Low and medium strength

SANDSTONE
Medium and high strength

BASEMENT PROFILE
RL 26.2m

Bottom Depth 9.88 m

Bottom Depth 9.88 m

ELEVATION (m AHD)

40 38 36 34 32 30 28 26 24 22 20

-20 0 20 40 60 80 100

DISTANCE ALONG PROFILE (m)

NOTE:
1. Subsurface conditions are accurate at the test locations only and variations may occur away from the test locations.
2. Strata layers and rock classification shown are 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.
4. Ground surface level indicative only.
5. Horizontal and vertical scales are not equal.

LEGEND

- Core Loss
- Concrete
- Filling
- Sandstone
- Siltstone
- Silty Clay
- Inferred Stratigraphic Boundary
- Inferred Geotechnical Boundary

TESTS / OTHER
- Water level

SITE MAP

BH17
BH15
BH13
BH14A

0 8
Horizontal Scale (metres)

Vertical Exaggeration = 4.0

Horizontal and vertical scales are not equal

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Roche Group Pty Ltd		TITLE: **Inferred Geotechnical Cross-Section D-D'**	PROJECT No: 72046.03
OFFICE: Sydney	DRAWN BY: HDS	**Proposed Mixed-Use Development**	DRAWING No: 5
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 6.04.2023	**469-483 Balmain Road, LILYFIELD**	REVISION: 1

Appendix D

Field Work Results

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

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

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

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

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

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

Definitions of grading terms used are:

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

Cohesive Soils

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

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

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

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

Soil Descriptions

Soil Origin

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

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

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

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Degree of Fracturing

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

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

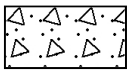
Symbols & Abbreviations

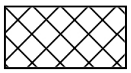
Graphic Symbols for Soil and Rock

General

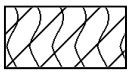

Asphalt

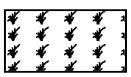

Road base

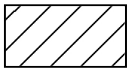

Concrete

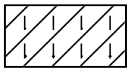

Filling

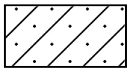
Soils


Topsoil

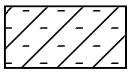

Peat

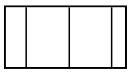

Clay

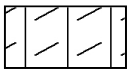

Silty clay

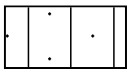

Sandy clay

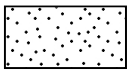

Gravelly clay

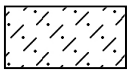

Shaly clay

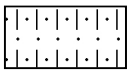

Silt


Clayey silt


Sandy silt

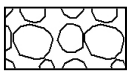

Sand

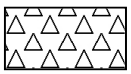

Clayey sand


Silty sand


Gravel

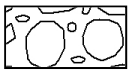

Sandy gravel


Cobbles, boulders

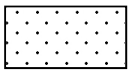

Talus

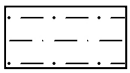
Sedimentary Rocks

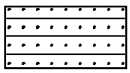

Boulder conglomerate

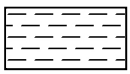

Conglomerate


Conglomeratic sandstone

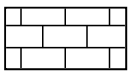

Sandstone


Siltstone

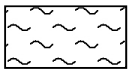

Laminite

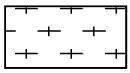

Mudstone, claystone, shale

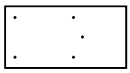

Coal


Limestone

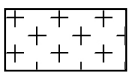
Metamorphic Rocks

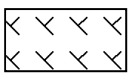

Slate, phyllite, schist

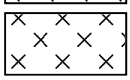

Gneiss

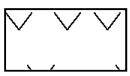

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.4 AHD
EASTING: 330280
NORTHING: 6251001
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 72046.03
DATE: 20/02/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
34	0.0	FILLING: grey-brown, fine to medium sand filling, with some gravel and earthenware fragments, trace ash, damp							A/E			PID <1
									A/E			PID <1
	0.5	SANDY CLAY: apparently stiff, red-brown to orange-brown sandy clay with some iron cemented bands, damp										
	0.6	INTERBEDDED SILTSTONE and SANDSTONE (80:20): extremely low strength, extremely weathered, fragmented, interbedded pale grey and red-brown, grey and red-brown siltstone and fine to medium grained sandstone, with some medium and high strength iron cemented bands							A/E			PID <1
33	1							1.44m: B, 0°, ro, pl, fe stn	C	96	0	
	1.8							1.77m: CORE LOSS: 30mm 1.86m: B, 0°, ro, pl	C	81	0	
32	2							2.49m: CORE LOSS: 210mm				
	2.7							2.71-3.09: B(x8), 0-10°, ro, un, fe stn				PL(A) = 1.5
31	3							3.12m: B, 0-10°, cu, cly 5mm 3.16m: B, 0°, un, cly 5mm 3.21m: Ds, 120mm 3.3m: J, sv, ro, ir and st, fe stn 3.45m: B, 0-5°, un	C	100	32	PL(A) = 0.26
	3.33	SANDSTONE: low to medium strength, highly weathered, fractured, pale grey and red-brown, fine to medium grained sandstone						3.67m: B, 5°, ro, un, fe stn 3.73m: B, 0-5°, ro, un, fe stn 3.76m: B, 0-5°, un, fe stn, ti 3.81m: B, 0-5°, ro, un, fe stn 4.06-4.09: B, 0-5°, ro, un to ir, fe stn 4.12m: Ds, 30mm	C	100	69	
30	4											PL(A) = 1.4
	4.16	SANDSTONE: medium and high strength, highly weathered to slightly weathered, slightly fractured, pale grey and red-brown, medium to coarse grained sandstone						4.7m: B, 0-5°, un, he, fe stn	C	100	95	

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM/SK **CASING:** HQ to 1.1m

TYPE OF BORING: SFA (TC bit) to 1.1m; rotary to 1.3m; NMLC coring to 9.56m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Groundwater monitoring well installed: 0-2m blank PVC, 2.0-9.56m slotted PVC, 0-0.9m bentonite plug, 0.9-9.56m gravel, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.4 AHD
EASTING: 330280
NORTHING: 6251001
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 72046.03
DATE: 20/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
29		SANDSTONE: medium and high strength, highly weathered to slightly weathered, slightly fractured, pale grey and red-brown, medium to coarse grained sandstone *(continued)*						5.36m: B, 0-10°, ro, pl, cly co 5.57m: Ds, 60mm	C	100	95	PL(A) = 0.38
28	6							5.8m: B, 0°, ro, pl, cly 5mm 5.9m: B, 10°, ro, pl, cly 3mm 6.27-6.56: B(x6), 0-30°, ro, pl and cu	C	100	87	
27	7							6.65-6.76: B(x5), 0-20°, ro, pl and cu, fe stn 6.70-6.76: J, 60-80°, pl and cu, cln 7.05m: B, 10°, ro, pl, cly 10-20mm	C	100	76	PL(A) = 0.42
26	8							7.57m: J, 45-60°, ro, pl, cln 7.83m: Ds, 10mm	C	100	88	PL(A) = 0.48
25	9							8.57m: fg, 30mm 8.61-8.74: B(x4), 0-10°, ro, pl 9.07m: B, 0-10°, ro, pl, cly 10mm 9.10-9.12: B(x2), 0-20°, pl, cly 10mm	C	100	42	PL(A) = 1.3 PL(A) = 1.6
	9.56	Bore discontinued at 9.56m - Target Depth Reached										

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM/SK **CASING:** HQ to 1.1m

TYPE OF BORING: SFA (TC bit) to 1.1m; rotary to 1.3m; NMLC coring to 9.56m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Groundwater monitoring well installed: 0-2m blank PVC, 2.0-9.56m slotted PVC, 0-0.9m bentonite plug, 0.9-9.56m gravel, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 1 PROJECT: LILYFIELD FEBRUARY 2019

1.3m – 5.0m

BORE: 1 PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 9.56m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 33.6 AHD
EASTING: 330296
NORTHING: 6250986
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 72046.03
DATE: 18/02/2019
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
33	0.2	FILLING: dark brown silty sand filling, fine sand, trace glass, concrete and rootlets, damp to humid (topsoil)							A/E			PID < 1
	0.6	FILLING: brown sand filling, slightly clayey, fine to medium sand, with anthropogenic inclusions (glass, concrete, black coal tar), trace of ash, hydrocarbon odour, humid to damp							A/E			PID < 1
	0.8	SILTY CLAY: brown, humid to damp										
32	1	SANDSTONE: extremely low strength, extremely weathered to highly weathered, orange-brown and grey sandstone, with high strength iron cemented bands							A/E			PID < 1
	1.6	SANDSTONE: low to medium strength, highly weathered, red-brown sandstone, fine to medium grained, with extremely low strength and high strength bands						1.63m: B, 0-5°, ro, ir, cly 10mm, fe stn 1.72m: Cs, 50mm 1.77m: CORE LOSS: 260mm	C	100	0	PL(A) = 2.9
	2							2.04-2.25m: B(x4), 0-10°, ro, un, fe stn 2.09m: Ds, 60mm 2.21-2.32m: J(x4), 0-30°, un-cu, fe stn, ti	C	72	16	
31	2.46	SANDSTONE: low then medium strength, highly and moderately weathered, slightly fractured to fractured, light grey and orange-brown, medium grained sandstone						2.40-2.66m: B(x3), 0-10°, ro, pl , fe stn, ti 2.51m: B, 0-5°, ro, un, cly 5mm				PL(A) = 1.3 PL(A) = 0.12
	3											PL(A) = 0.66
								3.20 and 3.47m: Ds, 20-40mm	C	100	87	
30								3.47m: J, sv, ro, un, cly co 3.58m: B, 0-5°, ro, pl, cly 5-10mm				PL(A) = 0.39
	4							3.79-3.91m: J, sv, un, fe stn, ti 3.86-4.21m: B(x6), 0-5°, ro, un, fe stn 4.0-4.2m: J, 85°, ro, un-cu, fe stn 4.21m: B, 0-5°, ro, un, fe stn	C	100	53	
												PL(A) = 0.43
29	4.55	SANDSTONE: medium strength, slightly weathered, slightly fractured to fractured, light grey and orange-brown, medium grained sandstone, thinly bedded with occasional cross-beds						4.53 and 4.70m: Ds, 20-30mm 4.81m: J, 15°, ro, pl, fe stn	C	100	76	

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.5m

TYPE OF BORING: SFA (TC bit) to 1.6m; rotary to 1.63m; NMLC coring to 9.05m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: 100% water loss from 8m depth; groundwater monitoring well installed: 0-2m blank PVC, 2-9.05m slotted PVC, 0-1m bentonite plug, 1-9.05m gravel, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 33.6 AHD
EASTING: 330296
NORTHING: 6250986
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 72046.03
DATE: 18/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
28		SANDSTONE: medium strength, slightly weathered, slightly fractured to fractured, light grey and orange-brown, medium grained sandstone, thinly bedded with occasional cross-beds *(continued)*						4.95m: B, 5°, ro, pl, cly 5mm 5.39m: B, 5°, he, ro, pl, fe stn 5.56m: B, 0°, ro, un, fe stn	C	100	76	PL(A) = 0.89
27	6							5.79m: B, 0-5°, ro, un, cly vn 6.51m: Ds, 80mm	C	100	84	PL(A) = 0.64
26	7	6.86m: highly weathered with iron-cemented bands, very thinly bedded						6.86-7.42m: B(x16), 0-10°, ro, un, fe stn 7m: J(x2), 60-70°, ro, ir, fe stn 7.04m: Ds, 50mm 7.29m: Ds, 50mm	C	100	55	
	7.4	SANDSTONE: high strength, highly weathered, slightly fractured, red-brown, medium to coarse grained sandstone with iron cemented bands						7.87-7.99: J, 70°, ro, pl-un, fe stn	C	100	100	PL(A) = 3
25	8							8.61-8.69m: B(x2), 5°, ro, un, fe stn 8.77m: J, 60°, ro, pl, fe stn 8.87m: Ds, 30mm 8.95m: B, 10°, ro, pl, cn	C	100	68	PL(A) = 1.2
24	9											
	9.05	Bore discontinued at 9.05m - Target Depth Reached										

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.5m

TYPE OF BORING: SFA (TC bit) to 1.6m; rotary to 1.63m; NMLC coring to 9.05m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: 100% water loss from 8m depth; groundwater monitoring well installed: 0-2m blank PVC, 2-9.05m slotted PVC, 0-1m bentonite plug, 1-9.05m gravel, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 2 PROJECT: LILYFIELD FEBRUARY 2019

1.63m – 5.0m

BORE: 2 PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 9.05m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 32.9 AHD
EASTING: 330331
NORTHING: 6250996
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 72046.03
DATE: 19/02/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	0.03	ASPHALTIC CONCRETE										
		ROADBASE: dark grey, gravel and sand roadbase, damp						0m: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0-10°	A/E			PID < 1
	0.4	FILLING: dark grey, silty clay filling with some fine to medium sand, fine to coarse gravel, trace anthropogenic inclusions (concrete and earthenware fragments), damp							A/E			PID < 1
	0.7	SANDY CLAY: orange-brown fine to medium sandy clay, damp							A/E			PID < 1
32	0.9	SANDSTONE: extremely low strength, highly weathered, fractured to slightly fractured, pale grey and red-brown sandstone with high strength bands										
	1							1.48-1.54m: B(x3), 0-10°, ro, ir, fe stn	C	100	34	PL(A) = 0.11
		Below 1.7m: low and medium strength, with extremely low strength bands						1.73m: B, 0-10°, ro, ir, fe stn				
31	2							2.3m: B, 0-10°, ro, un, cly 2-3mm	C	100	74	PL(A) = 0.38
								2.59m: Cs, 30mm				PL(A) = 0.15
30	3							3.3m: Ds, 10mm 3.41m: Ds, 30mm 3.46m: Ds, 15mm	C	100	61	
								3.74-3.87m: J(x3), sv, ro, ir, cly 0-20mm				PL(A) = 0.16
29	4							4.26m: B, 0°, ro, pl, cly vn 4.34m: Cs, 100mm 4.48-4.63m: B(x7), 0-10°, ro, pl-cu, fe stn 4.51-4.63m: J(x2), 40-45°, ir, fe stn, cly vn 4.7m: Ds, 40mm 4.74-4.77m: J(x2), 20-40°, ro, cu, fe stn	C	100	22	PL(A) = 0.39 PL(A) = 0.19
	4.8	SANDSTONE: refer next page										
28	5.0											

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.0m

TYPE OF BORING: SFA (TC bit) to 1.0m; rotary to 1.35m; NMLC coring to 10m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Groundwater monitoring well installed: 0-2m blank PVC, 2-10m slotted PVC, 0.6-10m gravel, 0-0.6m bentonite plug, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 32.9 AHD
EASTING: 330331
NORTHING: 6250996
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 72046.03
DATE: 19/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
27	6	SANDSTONE: low and medium strength, highly then moderately weathered, fractured, pale grey and pale yellow sandstone, thinly bedded and with occasional cross-beds, closely spaced joints and clay seams up to 200mm thick	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	4.84m: J(x2), 30°-sv, ro, st, fe stn 4.97m: Ds, 60mm 5.16m: J, 40°, ro, pl, he 5.34m: J, 30°, ro, pl, cly 10mm 5.34 to 5.66m: Ds(x3), 90-180mm 5.43m: J, 40-60°, ro, pl, cly 5-10mm	C	100	24	PL(A) = 0.44 PL(A) = 0.59
26	7							6.00-6.18m: B(x7), 0-15°, he, pl-un, fe stn 6.31m: J, 30-40°, ro, cu 6.39 & 6.67m: Ds, 10-60mm 6.48m: J, 30-40°, ro, pl, cly vn 6.78m: J, sv, ro, ir, fe stn	C	100	14	PL(A) = 0.37
25	8							7.14m: Ds, 80mm 7.24-7.44m: B(x2), 0°, ro, pl, cly 1-10mm 7.51m: Ds, 40mm 7.65m: B, 10-20°, ro, un, cly 5mm 7.85-8.57m: Ds(x4), 50-150mm 8m: CORE LOSS: 170mm	C	100	50	PL(A) = 0.35
24	9							8.62-8.67m: J, 40-60°, ro, pln, cly 40mm 8.67 & 8.72m: Ds, 30-110mm 8.86m: J, 30-40°, un, ro, fe stn 8.91 & 8.99m: Ds, 30-140mm	C	85	0	
23	10.0	8.17 SANDSTONE: very high strength, highly weathered, fractured to highly fractured, red-brown sandstone, medium to coarse grained, iron cemented Bore discontinued at 10.0m - Target Depth Reached						9.23-9.34m: B(x8), 10°, ro, pl 9.38-9.43m: J(x4), 20-45°, ro, pl-cu, fe stn, partially he 9.53-9.77m: B(x6), 0-20°, ro, pl, fe stn 9.77m: Cz, 30mm	C	100	45	PL(A) = 4.6

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.0m

TYPE OF BORING: SFA (TC bit) to 1.0m; rotary to 1.35m; NMLC coring to 10m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Groundwater monitoring well installed: 0-2m blank PVC, 2-10m slotted PVC, 0.6-10m gravel, 0-0.6m bentonite plug, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

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BORE: 3 PROJECT: LILYFIELD FEBRUARY 2019

1.35m – 5.0m

BORE: 3 PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 10.0m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 32.3 AHD
EASTING: 330316
NORTHING: 6250975
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 72046.03
DATE: 21/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 60mm)
32	0.08	ASPHALTIC CONCRETE							
	0.2	ROADBASE: dark grey, gravel and sand roadbase, damp							
		FILLING: dark grey, silty clay filling, with fine to medium sand and fine to coarse gravel, trace anthropogenic inclusions (concrete and earthenware fragments), damp		A/E	0.5		PID < 1		
	1			A/E	1.0		PID < 1		1
31	1.3	SANDY CLAY: orange-brown fine to medium sandy clay, with ironstone bands, damp		A/E*	1.5		PID < 1		
	1.9	Bore discontinued at 1.9m - Target Depth Reached							
	2								2
30									
	3								3
29									
	4								4
28									

Dynamic Penetrometer Test (blows per 60mm): 5, 10, 15, 20

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: SFA (TC bit) to 1.9m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: *BD2 taken at 1.5m

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330276
NORTHING: 6251011
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 72046.03
DATE: 21/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
34	0.13	CONCRETE SLAB			0.1				
	0.3	FILLING: dark brown silt and sand filling, with clay, trace roots, damp		A/E	0.2		PID < 1		
	0.6	SILTY CLAY: brown to orange-brown silty clay with sand, damp			0.5				
	0.9	INTERBEDDED SANDSTONE AND SILTSTONE: extremely low strength, extremely weathered, brown and red-brown, interbedded sandstone and siltstone, with iron cemented bands		A/E			PID < 1		
				*A/E	0.8		PID < 1		
	1	Bore discontinued at 0.9m - Target Depth Reached							
33	2								
32	3								
31	4								
30									

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.13m; SFA (TC bit) to 0.9m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: *BD1 taken at 0.8m

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: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330288
NORTHING: 6251022
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 72046.03
DATE: 21/02/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	0.1	CONCRETE SLAB							A/E			PID<1
	0.16	FILLING: brown, medium sand filling, with some clay, trace rootlets, gravel and ash, damp							A/E			PID<1
	0.42	SANDSTONE BOULDER (filling)										
		SILTY CLAY: brown and red-brown silty clay with some sand, trace rootlets and ironstone gravel										
34	0.67	INTERBEDDED SILTSTONE and SANDSTONE (80:20): extremely low strength, extremely to highly weathered, slightly fractured to fractured, interbedded grey and red-brown siltstone and pale-grey to red-brown sandstone, with some medium and high strength iron cemented bands						0.67-0.79m: J, 40-60°, ro, pl, cly 30mm 0.91m: CORE LOSS: 170mm	C	78	0	
	1							1.08-2.05m: B(x11), 0-10°,ro, pl, cln	C	100	0	PL(A) = 1.8
33	2							2.21-3.01: B(x17), 0-5°, ro, pl, cly co	C	100	0	PL(A) = 1.2
32	3	Below 3m: medium strength, highly weathered, iron cemented with closely spaced clay seams						3.08m: J, 20-30°, ro, pl 3.15m: B, 0°, ro, pl, cly 20mm 3.2m: Ds, 40mm 3.29-3.32m: B(x4), 0°, ro, ir and pl, fe stn 3.32, 3.39m, 3.49m, 3.52m, 3.57m, 3.66m: Cs(x6), 10-60mm 3.72-3.77m: J, 40°, ro, pl, sand 3.82m: Cs, 30mm 3.95m: Ds, 50mm	C	100	0	PL(A) = 0.4 PL(A) = 1.6
31	4											PL(A) = 0.55
	4.0	SANDSTONE: medium strength, moderately weathered, slightly fractured, orange-brown medium grained sandstone						4.47-4.54m: B(x2), 0-5°, ro, ir, fe stn 4.63m: J, 40-60°, ro, pl to un, he 4.64-4.82m: B(x2), 0-10°, ro, pl	C	100	77	PL(A) = 0.17 PL(A) = 2.3
30	4.85	SANDSTONE: refer next page										
	5.0											

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 0.3m

TYPE OF BORING: SFA (TC-bit) to 0.25m; rotary to 0.3m, NMLC coring to 9.83m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330288
NORTHING: 6251022
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 72046.03
DATE: 21/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
29	6	SANDSTONE: medium strength, slightly weathered, slightly fractured, orange-brown and pale grey, medium to coarse grained sandstone, thickly bedded with occasional cross-beds						5.15-5.21m: B(x2), 0°, ro, pl, cly 1-5mm	C	100	62	
									C	100	62	
								5.69m: J, 20-30°, ro, un, fe stn				
								5.79-6.30: B(x4), 0-10°, ro, pl / ir, fe stn / he				PL(A) = 0.61
								5.85m: B, 0°, ro, pl, he				
28	7							6.40m & 6.45m & 6.51m: Ds, 10-20mm	C	100	80	
								6.45-6.51m: J, 30°, ro, pl, he				
								6.6m: B, 0-10°, pl, ro, cly 5mm				PL(A) = 0.61
								6.96m: B, 0°, ro, pl, fe stn				
								7.1m: B, 0-10°, ro, pl, fe stn				
									C	100	76	
27	8							7.61m: Ds, 20mm				PL(A) = 0.76
									C	100	100	
								8.43m: B, 0-10°, ro, pl, cly vn				PL(A) = 0.59
26	9											
									C	100	89	
								9.37m: Ds, 20mm				
								9.4m: J, 30-40°, ro, cu, fe stn				
								9.43-9.46m: J, sv, ro, pl				
	9.5	SANDSTONE: high strength, highly weathered, slightly fractured, red-brown, medium and coarse grained sandstone						9.46m: Ds, 20mm				PL(A) = 1.1
25	9.84	Bore discontinued at 9.84m - Target Depth Reached										

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 0.3m

TYPE OF BORING: SFA (TC-bit) to 0.25m; rotary to 0.3m, NMLC coring to 9.83m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BORE: 6 PROJECT: LILYFIELD FEBRUARY 2019

0.3m – 5.0m

BORE: 6 PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 9.84m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330315
NORTHING: 6251033
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.1	CONCRETE SLAB							
		FILLING: dark grey gravelly sand filling, with anthropogenic inclusions (concrete, building rubble, slag, glass, and fibre cement fragments), damp		A/E	0.5		PID<1		
	0.8	SILTY CLAY: red-brown to pale grey silty clay, with some ironstone bands		A/E	1.0		PID <1.0		
	1.5	Bore discontinued at 1.5m - Target Depth Reached		A/E	1.5		PID<1.0		

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

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.1m; SFA (TC bit) taken to 1.5m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330327
NORTHING: 6251047
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE SLAB										
	0.2	FILLING: brown to grey gravelly sand and clay filling, with anthropogenic inclusions (concrete, building rubble), damp							A/E			PID<1
34	0.6	SILTY CLAY: red-brown silty clay, with some sand, damp							A/E			PID<1
1									A/E			PID<1
	1.4	INTERBEDDED SILTSTONE and SANDSTONE (80:20): extremely low and medium strength, extremely to highly weathered, highly fractured, interbedded grey siltstone and red-brown sandstone, with medium strength iron cemented bands						1.55m: B, 0°, ro, pl, cly 1.58-1.74m: B(x4), 0°, ro, pl, cly 2-3mm 1.93-1.95m: J, 30-40°, ro, pl, cly 1.99-2.09m: B(x3), 0-10°, ro, pl, fe stn 2.11m: CORE LOSS: 260mm	C	65	0	PL(A) = 0.08
33												
2	2.37	SANDSTONE: low to medium strength and low strength, moderately weathered, fractured, pale grey and red-brown, medium grained sandstone.						2.43-2.64m: B, (x5), 0°, ro, pl, fe stn 2.65m: Ds, 40mm 2.74m: B, 0°, ro, pl, fe stn 2.84m: Ds, 20mm 2.98-3.04m: J, 30°, ro, pl, cly 40mm 3.1m: Ds, 90mm 3.21m: J, 20-30°, ro, un, ti	C	100	44	PL(A) = 0.51 PL(A) = 0.11 PL(A) = 0.2
32												
3												
31								3.57-3.64m: B(x3), 0-10°, ro, pl, fe stn 3.66m: B, 10°, ro, pl, cly 10mm 3.70-3.72m: J, 20-30°, ro, ir 3.82m: B, 0°, ro, un, cln 3.84-3.87: J, 30°, ro, pl, cly 10mm 3.87-3.92m: B(4x), 0°, ro, pl, cly 20-30mm 3.95-4.12m: B(x3), 0-20°, ro, pl, cly vn 4.06m: Ds, 20mm 4.19m: Ds, 100mm	C	100	36	PL(A) = 0.41 PL(A) = 0.24 PL(A) = 1.2 PL(A) = 0.13 PL(A) = 0.16
4												
	4.33	Bore discontinued at 4.33m - Limit of Investigation										
30												

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.4m

TYPE OF BORING: SFA (TC bit) to 1.2; rotary to 1.4m, NMLC coring to 4.33m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Bore discontinued due to time constraints in warehouse

SAMPLING & IN SITU TESTING LEGEND

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

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BORE: 8 PROJECT: LILYFIELD FEBRUARY 2019

1.4m – 4.33m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330331
NORTHING: 6251028
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.1	CONCRETE SLAB							
		FILLING: dark grey gravelly sand filling, with anthropogenic inclusions (concrete, building rubble, slag, glass, and fibre cement fragments), damp		A/E	0.5		PID <1		
	1			A/E	1.0		PID <1		1
33	1.3	SILTY CLAY: brown to red-brown silty clay, with some sand, damp		A/E	1.5		PID < 1		
				A/E	1.7		PID < 1		
	1.8	Bore discontinued at 1.8m - Refusal on inferred top of rock							
32	2								2
	3								3
31	4								4
30									

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

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.1m; SFA (TC bit) taken to 1.8m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.6 AHD
EASTING: 330337
NORTHING: 6251007
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.2	CONCRETE SLAB							
		FILLING: dark grey gravelly sand filling, with anthropogenic inclusions (concrete, building rubble, slag, glass and fibre cement fragments), damp		A/E	0.5		PID<1		
	1			A/E	1.0		PID<1		1
33				A/E	1.5		PID<1		
	2								2
	2.1	SILTY CLAY: brown to red-brown silty clay, with some sand, damp		A/E	2.5		PID<1		
32	2.6	Bore discontinued at 2.6m - Target Depth Reached							
	3								3
31									
	4								4
30									

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.2m; SFA (TC bit) taken to 2.6m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

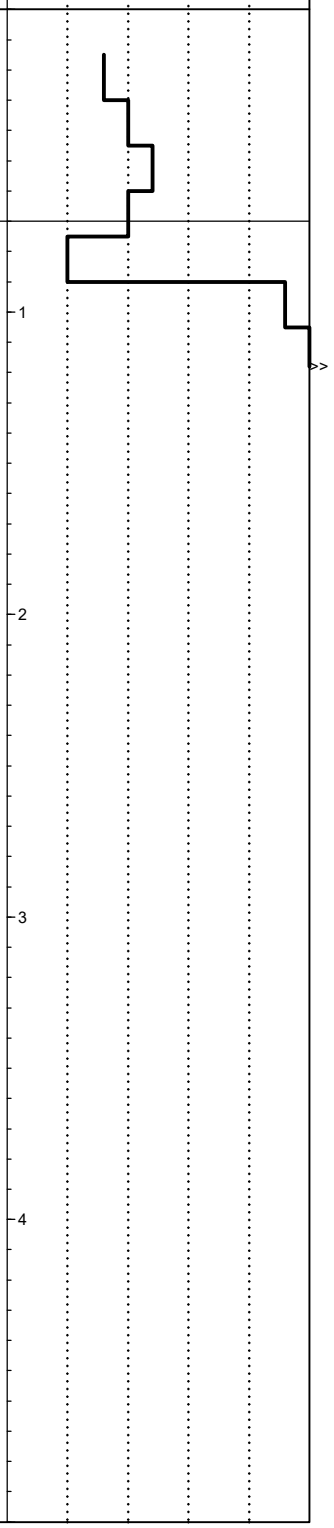
BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.6 AHD
EASTING: 330352
NORTHING: 6251024
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 72046.03
DATE: 25/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.15	CONCRETE SLAB							
	0.3	FILLING: brown gravelly medium sand filling, fine to coarse gravel-size anthropogenic inclusions (sandstone and brick), damp		A/E	0.2		PID <1		
	0.5	FILLING: orange-brown and brown silty clay filling, damp		A/E	0.4		PID <1		
	0.7	FILLING: dark-grey sandy gravel filling, with some silt, anthropogenic inclusions (brick, sandstone, possible slag, fibre cement fragments), damp, unidentified odour		A/E	0.6		PID <1, grab sample		
		Bore discontinued at 0.7m - Refusal on Obstruction in Filling							



RIG: Hand Tools **DRILLER:** RMM **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.15m; Hand Auger to 0.7m

WATER OBSERVATIONS: No Free Groundwater Observed to 0.5m

REMARKS: Water added while augering from 0.5m for dust suppression

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330357
NORTHING: 6251047
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 72046.03
DATE: 26/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 80mm)
34	0.13	CONCRETE SLAB							
		FILLING: pale brown sand filling, medium sand, damp		A/E	0.2		PID <1		
	0.3								
	0.35	CONCRETE SLAB							
		FILLING: dark grey gravel filling, with some sand and cobbles, anthropogenic inclusions (building rubble, asbestos fibre cement, concrete, tiles, brick), damp		A/E	0.5		PID = 4, grab sample		
	1								1
	1.1	SILTY CLAY: brown and orange-brown silty clay							
				A/E	1.5		PID = 3		
	1.6	Bore discontinued at 1.6m - Target Depth Reached							
33	2								2
32	3								3
31	4								4
30									

Dynamic Penetrometer Test (blows per 80mm): 5, 10, 15, 20

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.13m; SFA (TC bit) to 0.3m; Diatube to 0.35m; SFA (TC bit) to 1.6m

WATER OBSERVATIONS: No Free Groundwater Observed to 0.3m

REMARKS: Water added while augering from 0.5m for dust suppression

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330361
NORTHING: 6251056
DIP/AZIMUTH: 90°/--

BORE No: 13
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.1	CONCRETE SLAB			0.1				
		FILLING: light brown medium sand filling, damp Below 0.2m: slightly gravelly sand filling, with anthropogenic inclusions (concrete and brick fragments)		A/E	0.2		PID <1		
				A/E	0.4		PID <1		
				A/E	0.9		PID <1		
33	1.0	SILTY CLAY: red-brown and pale grey silty clay, with some sand and ironstone bands, damp		A/E	1.5		PID <1		
	1.8	Bore discontinued at 1.8m - Target Depth Reached							
32									
31									
30									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3, 4

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.1m; SFA (TC bit) taken to 1.8m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330373
NORTHING: 6251044
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 72046.03
DATE: 25/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.1	CONCRETE SLAB							
		FILLING: yellow-brown fine to medium sand filling		A/E	0.5		PID <1		
				A/E	0.8		PID <1		
	0.9	Bore discontinued at 0.9m Terminated on buried concrete slab							
33	1								
32	2								
31	3								
30	4								

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

RIG: Hand Tools **DRILLER:** SS/RMM **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.1m; Hand Auger to 0.9m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Hole drilled adjacent to buried underground storage tank

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330373
NORTHING: 6251044
DIP/AZIMUTH: 90°/--

BORE No: 14A
PROJECT No: 72046.03
DATE: 26/02/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.1	CONCRETE SLAB										
34	1	FILLING: light brown fine to medium sand filling, with some anthropogenic inclusions (concrete, timber) and ironstone gravel, trace roots, damp							A/E			PID = 3
	1.1	SILTY CLAY: orange-brown and brown silty clay with some ironstone bands, damp							A/E			PID = 4.5
33	1.65	SILTSTONE: extremely low strength, extremely weathered, highly fractured, orange-brown and pale grey siltstone, with iron cemented bands							C	100	0	
	2							2.1m: CORE LOSS: 100mm				
	2.2								C	89	0	
32	3							2.6-2.69m: B(x13), 0-10°, ro, ir-un, cly 0-10mm, fe stn 2.78-2.84m: J(x3), 45°-sv, ro, ir-un, cly 20-30mm				
	3.03	SANDSTONE: extremely low to medium strength, highly weathered, highly fractured, brown and pale grey, fine grained sandstone, with iron cemented bands						3.03-3.21m: B(x6), 0-20°, ro, un, cly 0-10mm, fe stn 3.21-3.25m: J, 70°, ro, pl, cly 20mm 3.31m: Ds, 300mm	C	89	0	PL(A) = 0.62
31	3.93							3.59-3.68m: J(x2), sv, ro, ir-st, cly 20mm 3.68m: Cs, 20mm 3.79m: Ds, 40mm 3.83m: CORE LOSS: 100mm 3.98m: Ds, 20mm				
	4											
	4.13							4.04m: CORE LOSS: 90mm 4.13m: Ds, 80mm				
	4.2	SANDSTONE: medium to high strength, highly then moderately weathered, fractured then slightly fractured, pale grey and red-brown, medium grained sandstone, thinly bedded with laminations dipping 20-30°						4.29-4.32m: B(x2), 0-10°, ro, un, cly 5mm 4.43m: B, 0°, ro, un, cly vn 4.46-4.48m: B(x3), 0-15°, ro, pl-ir, fe stn	C	92	69	PL(A) = 1.6
30												

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.5m

TYPE OF BORING: Diatube to 0.1m; SFA (TC bit) to 1.5m; NMLC coring to 9.89m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Hole drilled 0.4m east of BH14 (towards wall), 100% water loss from 4.5m depth; groundwater monitoring well installed: 0-2.2m blank PVC, 2.2-9.89m slotted PVC, 0-0.5m bentonite plug, 0.5-9.89m gravel and hole collapse, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330373
NORTHING: 6251044
DIP/AZIMUTH: 90°/--

BORE No: 14A
PROJECT No: 72046.03
DATE: 26/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
29	6	SANDSTONE: medium to high strength, highly then moderately weathered, fractured then slightly fractured, pale grey and red-brown, medium grained sandstone, thinly bedded with laminations dipping 20-30° *(continued)*						5.64-5.77m: J(x4), 0-20°, ro, ir, fe stn 5.85m: Ds, 180mm	C	100	53	PL(A) = 0.83
		6.07m: slightly weathered, cross-bedded at 0-20°						6m: Ds, 30mm 6.03m: J, 40-60°, ro, ir, fe stn 6.04m: B, 0°, ro, pl, cly 3mm 6.18m: B, 0°, ro, pl, fe stn	C	100	94	PL(A) = 0.34
28	6.3	SANDSTONE: medium then high strength, fresh, mostly unbroken, grey, medium grained sandstone, medium bedded, with some occasional carbonaceous or cross-bedded laminations						6.65m: B, 0°, ro, pl-un, cn				PL(A) = 1.8
	7								C	100	100	
27	8							8.05m: B, 0°, ro, ir, cly vn	C	100	100	PL(A) = 1
26	9											PL(A) = 1.1
									C	100	100	
25	9.89	Bore discontinued at 9.89m - Target Depth Reached										

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.5m

TYPE OF BORING: Diatube to 0.1m; SFA (TC bit) to 1.5m; NMLC coring to 9.89m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS: Hole drilled 0.4m east of BH14 (towards wall), 100% water loss from 4.5m depth; groundwater monitoring well installed: 0-2.2m blank PVC, 2.2-9.89m slotted PVC, 0-0.5m bentonite plug, 0.5-9.89m gravel and hole collapse, gatic concreted at surface

SAMPLING & IN SITU TESTING LEGEND

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

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BORE: 14A PROJECT: LILYFIELD FEBRUARY 2019

1.5m – 5.0m

BORE: 14A PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 9.89m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330350
NORTHING: 6251070
DIP/AZIMUTH: 90°/--

BORE No: 15
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	0.0	CONCRETE SLAB						
	0.1	FILLING: brown sand filling, with some clay and ash, and anthropogenic inclusions (including concrete, brick fragments, asbestos fibre cement and clinker), damp			E			Grab sample
34	0.6	SILTY CLAY: brown to grey silty clay (possible filling)						
	1.0	SILTSTONE: extremely low strength, extremely weathered, pale grey and red brown siltstone, with iron cemented bands			A/E			PID <1
				1.1-2.16m: B(x8), 0°, ro, pl, cly vn	C	100	0	
33	2			2.16m: Cs, 50mm 2.23-2.27m: J, 40-60°, ro, pl, cly vn 2.28m: Cs, 30mm 2.31-2.49m: J, SV, ro, pl, cly co	C	100	12	PL(A) = 1.6
	2.55	INTERBEDDED SANDSTONE and SILTSTONE (60:40): low to high strength, highly fractured, orange-brown sandstone and dark grey and brown siltstone, fine to medium grained sandstone		2.54m: B, 0°, ro, pl, cly 10mm 2.56m: B, 0-20°, ro, cu 2.63m: Cs, 20mm 2.67m: Cs, 10mm 2.7m: Cs, 20mm 2.73m: B, 0°, ro, pl, cly 2mm 2.92m: B, ro, pl, fe stn, cly 5mm 2.94m: Cs, 20mm 2.98m: Cs, 50mm 3.09-3.17m: J, 40°, ro, pl 3.17-3.26m: B(x4), ro, pl, cly 5mm 3.26m: Ds, 20mm 3.37m: J, sv, ro, pl, cly 20mm 3.6m: Cs, 10mm 3.61-3.64m: J(x3), sv, ro, pl 3.68m: Cs, 40mm 3.95m: B, 0-20°, ro, pl, fe stn 4.01-4.03m: J, sv, ro, ir, fe stn 4.35-4.38m: J, 40°, ro, un, fe stn 4.47-4.56m: B(x3), 0°, ro, pl, fe stn, cly 2-3mm 4.65m: Ds, 30mm	C	100	23	PL(A) = 0.38 PL(A) = 0.54 PL(A) = 0.14 PL(A) = 1.9 PL(A) = 1.1 PL(A) = 0.56
32	3							
	3.71	SANDSTONE: medium strength, highly to moderately weathered, slightly fractured, red-brown medium to coarse grained sandstone, thinly bedded with laminations dipping 20-30°			C	100	63	PL(A) = 0.51
31	4							
30	5.0							

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

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.1m

TYPE OF BORING: SFA (TC bit) to 1.0m; rotary to 1.1m; NMLC coring to 9.88m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.8 AHD
EASTING: 330350
NORTHING: 6251070
DIP/AZIMUTH: 90°/--

BORE No: 15
PROJECT No: 72046.03
DATE: 22/02/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
29		SANDSTONE: high strength, slightly weathered then fresh, slightly fractured to unbroken, grey, medium to coarse grained sandstone						5.17-5.19m: B(x2), 0°, ro, pl, fe stn	C	100	92	PL(A) = 1.3
									C	100	92	
	6							5.83m: J, 0-30°, ro, cu, fe stn 5.97-6.00m: J, 60-90°, ro, pl, cln				
								6.27m: B, 0-10°, ro, un, cly 1mm	C	100	77	
28								6.78m: B, 0°, ro, pl, fe stn				PL(A) = 0.96
	7											
									C	100	67	
								7.65m: B, 0°, ro, pl, cly 5mm				PL(A) = 1.6
27	8											
									C	100	100	
26												PL(A) = 1.2
	9											
									C	100	100	
25												PL(A) = 1.3
	9.88	Bore discontinued at 9.88m										

RIG: Geo-205 **DRILLER:** SS **LOGGED:** RMM **CASING:** HQ to 1.1m

TYPE OF BORING: SFA (TC bit) to 1.0m; rotary to 1.1m; NMLC coring to 9.88m

WATER OBSERVATIONS: No Free Groundwater Observed Whilst Augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BORE: 15 PROJECT: LILYFIELD FEBRUARY 2019

1.11m – 5.0m

BORE: 15 PROJECT: LILYFIELD FEBRUARY 2019

5.0m – 9.88m

BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.7 AHD
EASTING: 330325
NORTHING: 6251073
DIP/AZIMUTH: 90°/--

BORE No: 16
PROJECT No: 72046.03
DATE: 25/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
34	0.1	CONCRETE SLAB							
	0.3	FILLING: brown gravelly sand filling, fine and medium ironstone gravel, with some clay, trace ash, damp		A/E	0.2		PID <1		
		SILTY CLAY: stiff, orange-brown and brown silty clay 0.6m: grading to orange-brown and red brown 0.8m: grading to pale grey and red-brown, with some ironstone bands		A/E	0.5		PID <1		
				*A/E	0.7		PID <1		
	0.9	Bore discontinued at 0.9m - Target Depth Reached							

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

RIG: Hand Tools **DRILLER:** RMM **LOGGED:** RMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.15m; Hand Auger to 0.9m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: *BD3 taken at 0.7m

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Roche Group Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 469-483 Balmain Road, Lilyfield

SURFACE LEVEL: 34.5 AHD
EASTING: 330337
NORTHING: 6251083
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 72046.03
DATE: 25/02/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	CONCRETE SLAB							
		FILLING: brown sand and gravel filling, with some clay and ironstone gravel, trace ash, damp		A/E	0.2		PID <1		
	0.3	FILLING: brown and red-brown cobble or boulder filling, with iron cemented bands		A/E	0.35		PID <1		
	0.4	Bore discontinued at 0.4m - Practical refusal in filling							

RIG: Hand Tools **DRILLER:** RMM **LOGGED:** SMM **CASING:** Uncased

TYPE OF BORING: Diatube to 0.1m; Hand Auger to 0.4m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Results of Dynamic Penetrometer Tests

Client Roche Group Pty Ltd
Project Proposed Mixed-Use Development
Location 469-483 Balmain Road, Lilyfield

Project No. 72046.03
Date 11/03/2019
Page No. 1 of 2

Test Locations	BH1	BH2	BH4	BH6	BH7	BH8	BH9	BH10	BH11	BH12
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 – 0.15	12	10	E	E	E	E	E	E	E	E
0.15 – 0.30	13	28	35/60	15/10	9	E	9	*4/30	8	4/80
0.30 – 0.45	9	19	HB	HB	14	5	11	9	10	HB
0.45 – 0.60	6	16			10	3	5	18	12	
0.60 – 0.75	10	13			15	4	13	18	10	
0.75 – 0.90	7	18			6	4	9	5	5	
0.90 – 1.05	8	20/60			7	6	8	3	23	
1.05 – 1.20	10	HB			6	10	16	5	25/130	
1.20 – 1.35	End				End	End	End	End	HB	
1.35 – 1.50										
1.50 – 1.65										
1.65 – 1.80										
1.80 – 1.95										
1.95 – 2.10										
2.10 – 2.25										
2.25 – 2.40										
2.40 – 2.55										
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑
AS 1289.6.3.3, Sand Penetrometer ☐

Tested By **RMM**
Checked By **HDS**

Remarks
END = TEST TERMINATED
20/60 = 20 BLOWS FOR 60 MM OF PENETRATION
HB = HAMMER BOUNCING, REFUSAL
E = EXCAVATED
REF = REFUSAL
*TEST COMMENCED BELOW SLAB, START DEPTH 0.2M

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Results of Dynamic Penetrometer Tests

Client	Roche Group Pty Ltd	**Project No.**	72046.03
Project	Proposed Mixed-Use Development	**Date**	11/03/2019
Location	469-483 Balmain Road, Lilyfield	**Page No.**	2 of 2

Test Locations	BH13	BH14	BH15	BH16	BH17					
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 – 0.15	E	E	E	E	E					
0.15 – 0.30	9	1	8	5	3					
0.30 – 0.45	22	0	7	6	19					
0.45 – 0.60	27/110	0	5/20	5	20					
0.60 – 0.75	Ref	0	HB	16	25/30					
0.75 – 0.90		0		5	Ref					
0.90 – 1.05		10/0		20						
1.05 – 1.20		HB		Ref						
1.20 – 1.35										
1.35 – 1.50										
1.50 – 1.65										
1.65 – 1.80										
1.80 – 1.95										
1.95 – 2.10										
2.10 – 2.25										
2.25 – 2.40										
2.40 – 2.55										
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑ **Tested By** **RMM**
AS 1289.6.3.3, Sand Penetrometer ☐ **Checked By** **HDS**

Remarks
END = TEST TERMINATED
20/60 = 20 BLOWS FOR 60 MM OF PENETRATION
HB = HAMMER BOUNCING, REFUSAL
E = EXCAVATED
REF = REFUSAL

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_1 d_1^2/4 - n(\pi h_1 d_1^2/4 - \pi h_2 d_2^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH1
Project Name:	
Project Number:	120646.02
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-
Bore Development Details	
Date/Time:	22.2.19
Purged By:	TC
GW Level (pre-purge):	3.06 m bgl
GW Level (post-purge):	9.01 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	9.29 m bgl
Estimated Bore Volume:	45 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) 27, dry
Equipment:	Twister
Micropurge and Sampling Details	
Date/Time:	6.3.19
Sampled By:	12:45
Weather Conditions:	Overcast, Warm
GW Level (pre-purge):	3.47 m bgl
GW Level (post sample):	4.32 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	9.43 m bgl
Estimated Bore Volume:	43 L
Total Volume Purged:	8 L
Equipment:	Peristaltic pump. ¼" LDPE tubing. TPS meter

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1°C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1 / 1	24.9	3.73	607	6.27	192	57
3 / 2	22.8	3.00	609	6.38	111	50
5 / 3	22.1	2.74	610	6.36	79	47
7 / 4	22.1	2.63	605	6.34	82	44
9 / 5	22.0	2.71	602	6.30	73	42
11 / 6	22.2	2.60	598	6.24	69	41
13 / 7	22.2	2.59	594	6.21	67	41
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	7 m bgl, Middle of water column
Sample Appearance (e.g. colour, siltiness, odour):	Clear, very slightly turbid. No odour
Sample ID:	BH1
QA/QC Samples:	BD1 / 20190306
Sampling Containers and filtration:	2x HCL vials, 2x HNO3 plastic bottles, 2x 500mL glass bottle.
Comments / Observations:	No odours.

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_1 d_1^2/4 - n(\pi h_1 d_1^2/4 - \pi h_2 d_2^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH2
Project Name:	~~207~~ 72046.02
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	20.2.19
Purged By:	TG
GW Level (pre-purge):	7.89 m bgl
GW Level (post-purge):	8.78 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	9.01 m bgl
Estimated Bore Volume:	8 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) 8L / Dry
Equipment:	Twin

Micropurge and Sampling Details	
Date/Time:	6.3.19
Sampled By:	TG
Weather Conditions:	Overcast Warm
GW Level (pre-purge):	8.00 m bgl
GW Level (post sample):	8.79 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	9.01 m bgl
Estimated Bore Volume:	7 L
Total Volume Purged:	5 L
Equipment:	Peristaltic pump, TPS, 1/4" LDPE tubing

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
0/0.5	23.6	3.51	949	4.35	417	7
2/1.5	23.1	3.20	774	4.11	326	5
4/2.5	22.2	3.53	735	3.93	282	9
6/3.5	22.1	3.72	708	3.89	191	15
8/4.5	22.0	3.80	684	3.87	175	23
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	9.00 m bgl, Low water
Sample Appearance (e.g. colour, siltiness, odour):	Slightly turbid, No odor, pale yellow
Sample ID:	BH2
QA/QC Samples:	-
Sampling Containers and filtration:	2x Vials, 2x Multi HNO_3 bottle, 2x 500mL amber, 45µm inline filter
Comments / Observations:	No odours

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_1 d_2^2/4 + n(\pi h_1 d_1^2/4 - \pi h_2 d_2^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH3
Project Name:	72647.02
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	22.2.19
Purged By:	TG
GW Level (pre-purge):	4.73 m bgl
GW Level (post-purge):	8.81 m bgl
PSH observed:	Yes / (No) interface / visual). Thickness if observed:
Observed Well Depth:	8.94 m bgl
Estimated Bore Volume:	~30 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) 20L, Dry
Equipment:	Twister

Micropurge and Sampling Details	
Date/Time:	06.03.2019 / 1320
Sampled By:	TG
Weather Conditions:	Overcast, Warm
GW Level (pre-purge):	5.22 m bgl
GW Level (post sample):	6.94 m bgl
PSH observed:	Yes / (No) interface / visual). Thickness if observed:
Observed Well Depth:	9.11 m bgl
Estimated Bore Volume:	28 L
Total Volume Purged:	10 L
Equipment:	Peripump, TPS meter, ¼" LDPE tubing

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
0 / 1	24.8	0.9	503	4.61	180	87
2 / 2	22.9	0.34	506	4.23	132	83
4 / 3	22.3	0.16	503	4.20	101	85
6 / 4	22.2	0.15	497	4.20	106	87
8 / 5	22.1	0.19	499	4.21	94	88
10 / 6	22.1	0.19	499	4.23	83	88
12 / 7	22.2	0.19	495	4.25	70	89
14 / 8	22.3	0.21	496	4.24	74	89
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	7.9 m bgl, Middle of water column
Sample Appearance (e.g. colour, siltiness, odour):	Clear, slightly turbid, No odour
Sample ID:	BH3
QA/QC Samples:	-
Sampling Containers and filtration:	2x HCl vials, 2x HNO3 plastic bottles, 2x 500mL Amber 45µm chlor filter
Comments / Observations:	No odours

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_1 d_1^2/4 + n(\pi h_1 d_1^2/4 - \pi h_2 d_2^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH 14A
Project Name:	
Project Number:	76646.02
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	27.2.19
Purged By:	TA
GW Level (pre-purge):	3.12 m bgl
GW Level (post-purge):	8.54 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	9.39 m bgl
Estimated Bore Volume:	45 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) 30L By
Equipment:	Twister

Micropurge and Sampling Details	
Date/Time:	6.3.19 – 1400
Sampled By:	TA
Weather Conditions:	Overcast, Warm
GW Level (pre-purge):	3.25 m bgl
GW Level (post sample):	5.10 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	9.61 m bgl
Estimated Bore Volume:	46 L
Total Volume Purged:	10 L
Equipment:	Peripump, TPS meter, ¼" LDPE Tubing

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1°C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
2 / 1	23.7	1.04	811	6.33	132	65
4 / 2	22.5	0.56	785	6.55	111	53
6 / 3	22.0	0.29	725	6.51	91	46
8 / 4	21.9	0.21	710	6.45	72	44
10 / 5	21.9	0.17	692	6.41	60	42
12 / 6	21.9	0.23	676	6.40	53	42
14 / 8	21.9	0.30	656	6.36	53	42
16 / 9	22.0	0.34	638	6.31	49	44
18 / 10	22.00	0.33	635	6.29	45	46

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS

Sample Details

Sampling Depth (rationale):	7.5 m bgl, Middle of wet column
Sample Appearance (e.g. colour, siltiness, odour):	2x HCl vials, 2x HNO_3 plastic bottle, 2x 500 amber bottle (Bottom Drum)
Sample ID:	BH14A
QA/QC Samples:	-
Sampling Containers and filtration:	No odour, Clear, very slightly turbid
Comments / Observations:	Nil

Appendix E

Laboratory Test Reports

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 212269-B

Client Details

Client	Douglas Partners Pty Ltd
Attention	Tom Gordon
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**72046.02, Lilyfield**
Number of Samples	15 SOIL
Date samples received	26/02/2019
Date completed instructions received	08/03/2019

Analysis Details

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

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

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

Report Details

Date results requested by	15/03/2019
Date of Issue	15/03/2019

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Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Soil Aggressivity			
Our Reference		212269-B-7	212269-B-8
Your Reference	UNITS	BH4	BH4
Depth		0.5	1.5
Date Sampled		21/02/2019	21/02/2019
Type of sample		SOIL	SOIL
pH 1:5 soil:water	pH Units	8.7	8.4
Electrical Conductivity 1:5 soil:water	µS/cm	280	180
Resistivity by calculation	ohm m	36	56
Chloride, Cl 1:5 soil:water	mg/kg	26	<10
Sulphate, SO4 1:5 soil:water	mg/kg	280	100

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Soil Aggressivity					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Resistivity by calculation	ohm m	0.1	Inorg-002	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	96	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions

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

Quality Control Definitions

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Andrew Fitzsimons

From: Andrew Fitzsimons
Sent: Friday, 8 March 2019 7:32 PM
To: Andrew Fitzsimons
Subject: FW: Further testing for Lilyfield project - 72046.02

From: Tom Graham [mailto:Tom.Graham@douglaspartners.com.au]
Sent: Friday, 8 March 2019 12:05 PM
To: Aileen Hie <AHie@envirolab.com.au>
Subject: Further testing for Lilyfield project - 72046.02

Ref: 212269-B
TAT: std
Due: 15/3/19
fitz

Hi Aileen,

Can I please schedule the following tests for samples that we have already sent you.

Soil Aggressivity:

- BH4/0.5 (212269-7)
- BH5/1.5 (212269-8)
- BH13/0.4 (212661-11)
- BH16/0.7 (212661-17)

BH4

Can I also schedule Water Aggressivity:

- BH1 (21963-1)

Let me know if there are any issues.

Cheers,

Tom Graham | Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0427 032 254 | E: Tom.Graham@douglaspartners.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 212661-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Tom Graham
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**72046.02, Lilyfield**
Number of Samples	22 Soil
Date samples received	04/03/2019
Date completed instructions received	08/03/2019

Analysis Details

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

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

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

Report Details

Date results requested by	15/03/2019
Date of Issue	15/03/2019

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Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Soil Aggressivity			
Our Reference		212661-A-11	212661-A-17
Your Reference	UNITS	BH13	BH16
Depth		0.4	0.7
Date Sampled		22/02/2019	25/02/2019
Type of sample		Soil	Soil
pH 1:5 soil:water	pH Units	9.1	6.1
Electrical Conductivity 1:5 soil:water	µS/cm	1,200	35
Resistivity by calculation	ohm m	9.0	280
Chloride, Cl 1:5 soil:water	mg/kg	24	<10
Sulphate, SO4 1:5 soil:water	mg/kg	2,900	20

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Resistivity by calculation	ohm m	0.1	Inorg-002	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	94	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	98	[NT]

Result Definitions

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

Quality Control Definitions

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Andrew Fitzsimons

From: Andrew Fitzsimons
Sent: Friday, 8 March 2019 7:32 PM
To: Andrew Fitzsimons
Subject: FW: Further testing for Lilyfield project - 72046.02

From: Tom Graham [mailto:Tom.Graham@douglaspartners.com.au]
Sent: Friday, 8 March 2019 12:05 PM
To: Aileen Hie <AHie@envirolab.com.au>
Subject: Further testing for Lilyfield project - 72046.02

Hi Aileen,

Can I please schedule the following tests for samples that we have already sent you.

Soil Aggressivity:

- BH4/0.5 (212269-7)
- BH5/1.5 (212269-8)
- BH13/0.4 (212661-11)
- BH16/0.7 (212661-17)

Ref: 212661-A
TAT: std
Due: 15/3/19

Can I also schedule Water Aggressivity:

- BH1 (21963-1)

Let me know if there are any issues.

Cheers,

Tom Graham | Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0427 032 254 | E: Tom.Graham@douglaspartners.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 212963-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Tom Graham
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**72046.02, Lilyfield**
Number of Samples	7 WATER
Date samples received	07/03/2019
Date completed instructions received	08/03/2019

Analysis Details

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

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

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

Report Details

Date results requested by	15/03/2019
Date of Issue	15/03/2019

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Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics		
Our Reference		212963-A-1
Your Reference	UNITS	BH1
Date Sampled		06/03/2019
Type of sample		WATER
Date prepared	-	14/03/2019
Date analysed	-	14/03/2019
pH	pH Units	6.9
Electrical Conductivity	µS/cm	530
Resistivity by calculation	ohm m	19
Chloride, Cl	mg/L	36
Sulphate, SO4	mg/L	48

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			14/03/2019	[NT]	[NT]	[NT]	[NT]	14/03/2019	[NT]
Date analysed	-			14/03/2019	[NT]	[NT]	[NT]	[NT]	14/03/2019	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Resistivity by calculation	ohm m	0.1	Inorg-002	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	86	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
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Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Andrew Fitzsimons

From: Andrew Fitzsimons
Sent: Friday, 8 March 2019 7:32 PM
To: Andrew Fitzsimons
Subject: FW: Further testing for Lilyfield project - 72046.02

From: Tom Graham [mailto:Tom.Graham@douglaspartners.com.au]
Sent: Friday, 8 March 2019 12:05 PM
To: Aileen Hie <AHie@envirolab.com.au>
Subject: Further testing for Lilyfield project - 72046.02

Hi Aileen,

Can I please schedule the following tests for samples that we have already sent you.

Soil Aggressivity:

- BH4/0.5 (212269-7)
- BH5/1.5 (212269-8)
- BH13/0.4 (212661-11)
- BH16/0.7 (212661-17)

Ref: 21963-A
TAT: Std
Due: 15/3/19

Fitz

Can I also schedule Water Aggressivity:

- BH1 (21963-1)

Let me know if there are any issues.

Cheers,

Tom Graham | Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0427 032 254 | E: Tom.Graham@douglaspartners.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 212965

Client Details

Client	Douglas Partners Pty Ltd
Attention	Tom Graham
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**72046.02, Lilyfield**
Number of Samples	1 Material
Date samples received	07/03/2019
Date completed instructions received	07/03/2019

Analysis Details

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

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

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

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

Report Details

Date results requested by	14/03/2019
Date of Issue	12/03/2019

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Panika Wongchanda
Authorised by Asbestos Approved Signatory: Lucy Zhu
Results Approved By
Lucy Zhu, Senior Asbestos Analyst

Authorised By

Jacinta Hurst, Laboratory Manager

Asbestos ID - materials		
Our Reference		212965-1
Your Reference	UNITS	BH15/0.5
Date Sampled		22/02/2019
Type of sample		Material
Date analysed	-	11/03/2019
Mass / Dimension of Sample	-	45x31x4mm
Sample Description	-	Grey compressed fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

Result Definitions

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

Report Comments

Samples received in good order

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	72046.02	**Suburb:**	Lilyfield	**To:**	Envirolab Services
Project Name:	Proposed Mixed-Use Development	**Order Number**			12 Ashley Street, Chatswood
Project Manager:	Tom Graham	**Sampler:**	RMM	**Attn:**	Aileen Hie
Emails:	Tom.graham@douglaspartners.com.au john.russell@douglaspartners.com.au			**Phone:**	
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☑			**Email:**	ahie@envirolab.com.au
Prior Storage:	☐ Esky ☐ Fridge ☑ Shelved	Do samples contain 'potential' HBM?	Yes ☐ No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)		

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: Asbestos									Notes/preservation
BH15/0.5	1	22/02/19	ACM	P	X									
PQL (S) mg/kg														**ANZECC PQLs req'd for all water analytes** ☐

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 212965
Date Received: 7-3-19
Time Received: 1333
Received by: KG
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container: 1 **Relinquished by:** TG **Transported to laboratory by:** Bonded Courier

Send Results to: ~~Douglas Partners~~ Pty Ltd **Address:** **Phone:** **Fax:**

Signed: **Received by:** ETS K. Gore. **Date & Time:** 7-3-19 13:33

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

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

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

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

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

Douglas Partners Pty Ltd