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Report on
Geotechnical Investigation

Botany Aquatic Centre
2 Myrtle Street, Botany

Prepared for
CO-OP Studio Pty Ltd

Project 201489.03
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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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1. Introduction

This report presents the results of a geotechnical investigation carried out for the proposed upgrades at Botany Aquatic Centre, 2 Myrtle Street, Botany. The investigation was commissioned by CO-OP Studio Pty Ltd (CO-OP) and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal 201489.01.P.004.Rev0 dated 26 May 2023.

The investigation was carried out to provide information on subsurface soil and groundwater conditions for planning, design and submission with a Development Application (DA) to Bayside Council, for the proposed upgrades. The proposed upgrades include the following:

- 50 m outdoor competition pool;
- Indoor learn to swim pool;
- 25 m indoor lap pool;
- Adventure slides/major water play/splash pad;
- A new building including entrance, amenities and change rooms and café;
- New grandstand;
- Landscaping works to the open green space;
- Health and fitness/gym space;
- Community/child minding space; and
- Review of access and car parking to comply with the DA requirements.

The field work included six cone penetration tests (CPT) to a maximum depth of 17 m (or to refusal) and twelve boreholes ranging from 3 m to 6 m in depth. Details of the field work are provided in this report together with comments relating to design and construction issues.

DP carried out a contamination investigation in conjunction with the geotechnical investigation, the results of which are reported separately (Project 201489.03).

2. Site Description

The site is bounded by Myrtle Street to the south, a playground to the west, ARTC rail corridor to the north-east, a warehouse to the north-west and covers an area of approximately 3 hectares. The site is generally on relatively level ground typically ranging from RL7 m to RL8 m Australian Height Datum (AHD), except on the mound around the swimming pool and towards the northern boundary of the site where the ground is between RL8 m to RL10 m AHD.

At the time of investigation, approximately all of the western half of the site was occupied with facilities and the eastern half was grass covered with trees scattered in the area. The western half of the site was occupied by an on-grade car park, a grandstand, single storey brick reception and amenities building and two swimming pools.

3. Regional Geology

Reference to the Sydney 1:100,000 Geological Series Sheet indicates that the site is underlain by Quaternary sediments comprising medium to fine grained marine sands. In this part of Botany, these sediments typically overlie Hawkesbury Sandstone.

4. Field Work Methods

The field work for the investigation included the following:

- six cone penetration tests (CPT1 to CPT6) to depths of 14.0 m to 17.0 m;
- a total of 40 boreholes to maximum depths of 6 m; BH1 to BH12 for combined geotechnical and contamination investigations and BH13 to BH40 primarily for contamination investigation;
- installation of groundwater monitoring wells in BH6, BH9, BH17 and BH30 to allow measurement of water levels and sampling of groundwater for the contamination investigation.

The test locations are shown on Drawing 1 in Appendix B.

CPT's use a ballasted truck-mounted test rig to push a 35 mm diameter instrumented cone tipped probe into the soil with a hydraulic ram system. Continuous measurements are made of the end-bearing pressure on the cone tip and the friction on a 135 mm long sleeve located immediately behind the cone. The cone tip resistance and friction readings are displayed during the test and stored for subsequent plotting of results and interpretation. The depth to groundwater was recorded upon extraction of the CPT rods.

The boreholes were drilled with a truck mounted drilling rig using solid flight augers and wash boring techniques were used where collapsing conditions were encountered (generally occurs when drilling below the water table). Standard penetration tests (SPT) were carried out within most of the boreholes at 1.0 m to 1.5 m depth intervals to obtain samples and to assess the in-situ strength of the soils.

Following installation of the groundwater wells, the wells were developed by removing at least 3 well volumes of water.

The surface levels and coordinates at the test locations were measured using Differential Global Positioning System (DGPS).

5. Field Work Results

5.1 CPT and Boreholes

Detailed CPT plots and borehole logs are presented in Appendix C together with notes explaining descriptive terms and classification methods used. The sequence of subsurface materials encountered within the boreholes, in increasing depth order, may be summarised as follows:

Fill: encountered at all locations to depths of 0.55 m to 2.0 m. The fill included mostly variably compacted silty sand with sandstone and igneous gravel, bitumen, concrete and brick gravel. The fill was encountered to a greater depth (2 m) at the boreholes and CPTs located on the mounded areas;

Natural Sand: generally loose to medium dense to depths of 4.8 m to 7.7 m, then medium dense to dense or dense to very dense. All boreholes were terminated on the loose to medium dense sand at maximum depths of 6 m below the existing ground surface. Medium dense sand with very stiff to hard clayey interbeds was encountered at depths of 6.6 m to 11.6 m with thicknesses ranging from 0.8 m to 4.0 m. Below the sand and clay interbeds, sand described as medium dense to very dense was encountered. CPT refusal was encountered within the very dense sand at depths of 14 m to 17 m below the ground surface.

5.2 Groundwater

Groundwater levels encountered in the boreholes and CPT were measured at depths of 1.3 m to 2.9 m below ground surface level and are summarised in Table 1 below. Groundwater levels from boreholes without groundwater wells were measured during soil sampling from 8 May 2020 to 19 May 2020. Groundwater levels from combined boreholes and monitoring wells were taken during groundwater sampling from 22 May 2020 and 28 May 2020. Groundwater levels from CPTs were measured after withdrawal of CPT rods on 12 May 2020. Groundwater measurements in the wells are considered to be more accurate as the water levels observed during drilling or in the CPT holes may not have stabilised.

Table 1: Summary of Groundwater Levels Observed in Boreholes and CPTs

Borehole/CPT	Groundwater Depth (m)	Groundwater Elevation (m AHD)
BH1	2.35	4.85
BH2	2.4	4.8
BH3	2.4	4.6
BH6/GW6	2.85	5.15
BH7	2.7	5.1
BH9/GW9	1.9	5.5
BH10	1.5	5.9
BH11	1.65	5.75
BH12	2.15	5.45

Borehole/CPT	Groundwater Depth (m)	Groundwater Elevation (m AHD)
BH14	2.2	4.9
BH17/GW17	2.1	4.7
BH18	2.0	5.5
BH19	1.3	6.1
BH24	2.3	5.4
BH30/GW30	2.0	7.7
BH33	2.9	5.9
BH36	2.9	6.1
BH38	1.9	5.8
BH39	2.9	5.9
BH40	2.4	5.8
CPT1	2.2	5.0
CPT2	1.6	5.7
CPT3	3.25	5.15
CPT4	3.25	4.25
CPT5	3.4	5.0
CPT6	2.3	5.3

6. Laboratory Testing

Selected soil samples from the boreholes were tested for the following tests:

- California Bearing Ratio (CBR) - 4 day soaked and Standard Compaction;
- Particle size distribution; and
- Soil aggressivity suite (pH, Electrical Conductivity, Chloride and Sulphate).

The laboratory test certificates are presented in Appendix D. Summaries of the test results are presented in Tables 2 and 3 below.

Table 2: Summary CBR and Particle Size Distribution Tests

Sample ID	CBR (%)	MDD* (t/m^3)	OMC* (%)	Gravel (%)	Sand (%)	Silt and Clay (%)
BH3 0.6 – 1.1 m	11	1.76	13.5	3	93	4
BH6 1.9-2.0 m	-	-	-	0	95	5
BH9 0.6-1.35 m	11	1.74	13.5	2	94	4
BH10 0.9-1.0 m	-	-	-	0	97	3
BH11 0.7-1.35 m	13	1.75	14.5	1	95	4
BH12 0.75-1.5 m	10	1.72	11.5	2	94	4

*MDD = Maximum Dry Density; OMC = Optimum Moisture Content

Table 3: Summary of Soil Aggressivity Test Results

Sample ID	pH	Electrical Conductivity (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH1 2.5-2.95 m	7.2	37	28	24
BH3 1.9-2.0 m	4.9	100	24	90
BH7 2.5-2.95 m	7.2	16	<10	<10
BH8 2.5-2.95 m	7.6	35	<10	<10
BH10 0.9-1.0 m	6.8	11	<10	<10
BH12 3.5-3.95 m	6.7	10	<10	<10

7. Geotechnical Model

The interpreted depths and levels at the top of the various interpreted soil layers are shown in Table 4.

Table 4: Summary of Material Strata Levels in Boreholes and CPTs

Unit	Description	Depth (RL) to Top of Unit (m/m AHD)	Approximate Thickness (m)
Unit 1	Fill	Surface (RL6.8 to RL9.7)	0.55 to 2.0
Unit 2a	Sand – Loose to Medium Dense	0.55 to 2.0 (RL4.8 to RL9.2)	3.2 to 6.5
Unit 2b	Sand – Medium Dense to Very Dense	4.8 to 7.7 (RL-0.1 to RL2.6)	0.6 to 5.6
Unit 3	Interbedded Medium Dense Sand and Very Stiff to Hard Clay	6.6 to 11.6 (RL-4.3 to RL0.9)	0.8 to 4.0
Unit 4a	Sand – Medium Dense to Very Dense	9.5 to 13.5 (RL-1.9 to RL-6.3)	2.3 to 5.3 absent in CPT2, CPT3 and CP5
Unit 4b	Sand – Dense to Very Dense	10.5 to 15.9 (RL-2.1 to RL-8.7)	Not penetrated to base of unit

Notes: - Bracketed numbers are the Reduced Level (m AHD) for the top of the unit.

Groundwater was observed at depths of between 1.9 m to 2.8 m (RL 4.7 m to RL 7.7 m AHD) in the groundwater wells installed at the site. Groundwater flows in a generally south-westerly direction towards Mill Stream, presumably converging with Mill Pond and draining to Botany Bay.

It should be noted that groundwater will fluctuate with climatic conditions and is likely to rise following periods of extended wet weather.

8. Comments

8.1 Proposed Development

Based on the information provided by the client, the proposed new structures for the new aquatic centre are to be located on the western half of the site where existing structures are currently located. The new aquatic centre will include an indoor (25 m pool, learn to swim pool and indoor aqua play pool) and outdoor aquatic facilities (50 m pool, slides and pool leisure). All proposed facilities and amenities (except for pools) will be on the ground level and no basement levels are proposed. The drainage design drawings indicate a proposed onsite stormwater detention (OSD) tank beneath the carpark, understood to be up to 1.8 m depth, which will discharge to the council stormwater system.

8.2 Excavation Conditions and Batter Slopes

It is understood that excavations for the 50 m swimming pool will be about 2.5 m deep at the deep end (including depth of pool and thickness of floor slab) reducing to probably less than 1.5 m deep at the

shallow end. Excavation for the 25 m pool are expected to be at similar depths. Excavations for the OSD tank are expected to be less than 2.5 m depth.

Excavations are expected to penetrate through fill and natural sands which should be readily achieved using conventional earthmoving equipment such as tracked excavators.

Based on the measured groundwater levels in the installed groundwater wells on site, groundwater may be about 0.5 m above the deeper excavation for the 50 m pool and close to or slightly above the excavation for the 25 m pool. Groundwater levels may vary and fluctuate and could be different at the time of construction. Further long term groundwater monitoring (preferably using data loggers) will be required to assess fluctuations in groundwater level with response to rainfall, together with review of the groundwater data and proposed excavation depths and RL once the pool locations are confirmed.

Where excavations extend below the groundwater table, temporary dewatering will be required for construction of the swimming pools. Alternatively, the requirement for dewatering could be eliminated if the swimming pools are raised so that excavations are above the measured groundwater level. Other areas/structures for the development will not require dewatering as above-ground structures are proposed for the site.

Trafficability on the sandy soils during bulk earthworks will generally require the use of tracked plant and machinery. Trafficability after bulk excavation could be improved by placement of a layer of compacted crushed concrete or similar, which may subsequently be used as sub-base for the floor slabs.

During the bulk excavation phase, it is recommended that temporary batter slopes above the groundwater table do not exceed 2H:1V (Horizontal:Vertical) in both fill and sandy soils. Below groundwater level the sands will not be stable unless battered at 5H:1V, or full depth retention systems will need to be installed prior to the start of the excavations.

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the Waste Classification Guidelines (NSW EPA 2014) and in accordance with any recommendations provided in the DP Contamination Investigation report.

8.3 Dilapidation Surveys

Dilapidation surveys should be undertaken on surrounding structures and pavements prior to commencing work on the site to document any existing defects so that any claims for damage due to construction related activities can be accurately assessed. The appropriate extent of dilapidation surveys may be better assessed once details of the proposed development and construction methods have been confirmed.

8.4 Dewatering and Tanking

The sandy soils are expected to be highly permeable and therefore a relatively impermeable shoring wall and associated dewatering system will be required during construction. A ‘tanked’ structure (permanent structure) with walls and floor slabs designed to resist hydrostatic pressures will also be required for the swimming pools on this site.

The standing groundwater table is likely to fluctuate between a range of about 1 m and 2 m below existing ground surface. However, during heavy rainfall events and prolonged wet periods groundwater may rise to the ground surface. In the absence of 'long term' groundwater monitoring, it is recommended that the existing ground surface be considered for the design groundwater level, and consideration be made for any surcharge loads due to flooding.

It is assumed that bulk excavations for the swimming pools will be carried out to maximum depths of about 2.6 m but shallower for the shallow end and smaller pools.. Generally, the groundwater level should be lowered to at least 1 m below the bulk excavation to allow machinery to operate and traverse the site. On this basis, the normal groundwater level (measured at the time of the investigation) may need to be temporarily lowered by up to approximately 1.5 m depth in some areas (to be confirmed with excavation levels and long term groundwater monitoring data).

Temporary dewatering will need to be continued until sufficient overburden pressure is applied to the swimming pool floor slab. This pressure may be able to be applied by the weight of the swimming pool, hold-down piles or ground anchors, or a combination of these (this will presumably only be required where the pool is empty and even then, the maximum water level would only be expected for a temporary period following prolonged and heavy rainfall).

8.4.1 Piping Failure

Erosion of the sandy soils may occur in the form of piping failures of the material at the base of the excavation if the excavation is not adequately dewatered. Piping failure occurs when excess hydrostatic pressure acting on the soils within the excavation become equal to the effective weight of the overlying soil. The risk of piping failure will generally be greatest in the event that the dewatering pumps fail when bulk excavation is below the water level beyond the shoring support. It is recommended that the shoring wall should have a minimum embedment of about 2-3 m below the deepest bulk excavation level to reduce the risk of piping failure (but this will depend on the depth of excavation below the water table and deeper embedment may be required for stability and to reduce inflows).

8.4.2 Method of Dewatering

Dewatering on sites underlain by sandy soils is usually undertaken with wells installed at a regular spacing within the confines of the excavation. Wells (slotted PVC pipes) are installed below the groundwater table and generally spaced at about 1 m to 2 m centres around the perimeter of the excavation. Alternatively larger diameter wells can be used and positioned closer towards the centre of the site. The wells are connected by a series of pumps and hoses which collect groundwater, usually in a sedimentation tank, prior to discharge off-site.

Based on previous experience in the area, the relatively clean sands underlying the site are likely to have a bulk permeability (k) of between 2.5 x 10^{-4} m/sec to 5 x 10^{-4} m/sec. This value is typical for clean sands and may be used as a basis for preliminary design of the temporary well-point dewatering system for this site. Sump and pump dewatering methods will not be practical or effective for the high permeability sandy soils.

Design of the dewatering system should give due consideration to drawdown effects on adjacent properties and the dewatering of the site should be carried out by a contractor with demonstrated

experience in similar conditions. The use of recharge wells or infiltration trenches may be considered to limit drawdown of groundwater levels outside the site. Reinjection would generally be subject to approval from relevant authorities (i.e. WaterNSW).

Numerical modelling could be carried out to assess the effectiveness of the proposed dewatering system and predict drawdown levels and associated settlements on adjacent properties. Groundwater modelling is generally carried out once details of the proposed shoring and dewatering system are available.

8.4.3 Drawdown and Settlement

It is anticipated that the dewatering system will require lowering of the normal groundwater table by approximately 1.5 m and that the drawdown within the permeable sands outside of the perimeter shoring wall will reduce rapidly away from the dewatering system. It is expected that a drawdown of less than 1.5 m would be within the range of historic low groundwater levels and therefore settlements due to drawdown with loose to medium dense sand should be relatively minor (less than 5 mm).

It is recommended that drawdown outside the excavation in the vicinity of the adjacent properties should be monitored and kept to less than 1.5 m below normal groundwater levels. The following general procedure is recommended to monitor groundwater drawdown levels:

- Install standpipes in accessible areas on adjacent properties to monitor groundwater drawdown levels during dewatering;
- Measure groundwater levels on a weekly basis for three weeks prior to operation of the dewatering system to establish pre-developed levels;
- Measure groundwater levels twice per day during the first two days of dewatering, and then daily during the first week of dewatering and weekly until decommissioning of the dewatering pumps, or until a lesser frequency is advised by the geotechnical engineer;
- The measured values are to be provided to the geotechnical engineer on the day of measurement for review;
- Where drawdown levels exceed 1.5 m (trigger level) below pre-developed groundwater levels, the reason for the change in groundwater level should be investigated and measures put in place to rectify the exceedance. These measures could include reduction of pumping rates or suspension of dewatering;

8.4.4 Groundwater Disposal

The groundwater removed from the site will require disposal. Generally, water resulting from dewatering operations should be suitable for disposal by pumping to stormwater drains, subject to confirmation testing and approval from relevant authorities. The DP Contamination Investigation report provides guidance on this matter which indicated that there is no broad or significant contamination of the groundwater within the site.

8.5 Excavation Support

8.5.1 Shoring Wall Systems

Where batter slopes cannot be used, the sides of the swimming pool excavation will need to be supported by shoring walls until such time as the permanent walls support the pool excavation. Possible shoring wall options for the site include:

- Secant pile wall
- Sheet pile wall
- Cutter soil mix wall

The selected retention would require installation prior to excavation. Progressive excavation and wall construction methods are not considered viable.

For a secant pile wall option, given the subsurface soils are primarily sands it is considered that Continuous Flight Auger (CFA) piles or CFA piles with jet grouted columns between the piles will be required. This shoring system can generally provide an effective seal to minimise sand loss and water inflow from behind the wall, and if adequately supported, minimise lateral deflections. The 'hard' (reinforced concrete) piles can be incorporated into the vertical load carrying footing system and can generally form part of the structure.

For the sheet pile wall option (overlapping or interlocking sheets) consideration will need to be given to noise and vibrations caused by installation of the sheet piles and the subsequent impact on nearby or adjacent properties. Furthermore, consideration will need to be given to the driveability of sheet piles through the dense and very dense sands as it is possible that the sheet piles may not be able to penetrate these materials; predrilling could be considered to reduce vibration and aid penetration. Sheet piles may be suitable for the relatively shallow excavations that are set back from adjacent properties and provided that vibrations can be managed.

Cutter soil mixed wall systems also sometimes provide a suitable alternative to the more conventional secant pile wall. These walls are constructed using specialised equipment to blend cement with the in-situ soils to create a soil-cement mix. There are several different systems available and further advice should be obtained from the specialist piling contractor regarding the suitability of the wall system to this site. In particular, confirmation should be sought in relation to the consistency/strength of the soil mixed wall, the long term durability, permeability, potential issues with blending cement and joining the soil mixed wall with the tanked base slab.

For the above retention options, the toe of the walls would need to be embedded to a suitable depth below bulk excavation level to provide adequate cut off to groundwater and to reduce drawdown and also for wall stability.

8.5.2 Earth Pressures

Table 5 outlines material and strength parameters that could be used for the design of retaining walls/pool walls.

Table 5: Recommended Design Parameters for Retaining Wall

Unit	Bulk Weight (kN/m^3)	Earth Pressure Coefficient			Effective Cohesion c' (kPa)	Effective Friction Angle (Degrees)
		Active (K_a)	At Rest (K_o)*	Passive (K_p)		
1 – Fill (compacted)	20	0.3	0.5	3.3	0	32
2a – Sand L to MD	18	0.35	0.5	2.8	0	30
2b – Sand MD to VD	20	0.3	0.5	3.3	0	33
3 – Interbedded Sand and Clay	20	0.4	0.6	2.5	5	30
4a and 4b – Sand MD to VD	20	0.25	0.5	4.5	0	36

Notes: *These are modified rather than in-situ K_0 values, assuming that at least a small amount of wall movement (say about 0.1 to 0.3% of the wall height) could occur.

Retaining walls/pile elements will have to be specifically sized and designed to support any adjacent structures or surcharge loads that lie within the excavation zone of influence. Structures within a line drawn at approximately 2H:1V from the base of the excavation to the ground surface behind the excavated face may influence, or be influenced by the excavation and shoring system. Shoring wall design will also need to consider hydrostatic pressures where the groundwater table lies near the surface to account for increases in groundwater levels caused by significant rainfall events and flooding. A cantilevered retaining wall, or a wall restrained by only a single row of anchors could be designed assuming that a triangular earth pressure distribution applies to the wall.

8.5.3 Temporary Ground Anchors

If required for deeper excavations, the design of temporary and permanent ground anchors for the support of excavations and/or shoring systems may be carried out on the basis of the ultimate bond stresses given in Table 6.

Table 6: Ultimate Bond Stress

Unit	Ultimate Bond Stress (kPa)
2a – Sand L to MD (above water table)	11D
2a – Sand L to MD (below water table)	5.5D
2b – Sand MD to VD	6.5D

Notes: D = depth to centre of bond length below the surface.

The parameters given in Table 6 assume that the drilled holes are clean and adequately flushed. Anchor designs should be based on bonding to be developed behind an 'active zone' determined by drawing a line upwards from the base of the retained height at 45° from horizontal. Anchor bond lengths should be at least 3 m and not more than 7 m long, to reduce the risk of progressive debonding failures.

Anchors should be proof loaded as follows:

- 1.5 times working load for permanent anchors;
- 1.3 times working load for temporary anchors.

It is anticipated that the permanent walls will support the swimming pool excavation over the long term and therefore the ground anchors are expected to be temporary only.

The permission of adjacent landowners and authorities would be required if it is necessary to install anchors outside the site boundaries (e.g. into roadway corridors and beneath adjacent buildings).

8.6 Subgrade Preparation and Earthworks

The following site preparation and earthworks are recommended for the site:

- Prepare the area by stripping all vegetation, topsoil and any unsuitable materials such as putrescible waste, foreign materials, and building rubble.
- Proof roll the stripped surface with an appropriate roller with the final pass observed by a geotechnical engineer.
- Any soft or heaving areas identified must be treated with engineered fill.
- Engineered fill should be a good quality or 'select' material such as ripped sandstone or shale. Alternatively, site won materials can be used as engineered fill subject to environmental requirements.
- Place engineered fill in 300 mm thick horizontal layers and compact to a minimum 98% Standard Maximum Dry Density (SMDD) at moisture contents within 2% of Standard Optimum Moisture Content (SOMC).
- Fill within 0.3 m depth of pavement subgrades should be compacted to at least 100% SMDD.
- A maximum temporary safe batter slope of 2.5H:1V (subject to assessment of surcharge loads) could be used for the fill platform and allowance should be made for protection against erosion. Good practice involves overfilling and then trimming back to form well compacted material in batters.
- All earthworks should be carried out in accordance with the requirements of AS3798 – Guidelines on Earthworks for Commercial and Residential Developments.

Site landscaping should be designed to prevent ponding of water on the finished surface. Subsurface drainage should also be provided.

Heavy plant (e.g. piling rigs) may be required to operate on the site for which it is recommended that a working platform be constructed atop the prepared subgrade. The platform should be constructed from good quality granular material with low fines, such as recycled concrete or high strength crushed rock. The thickness of the platform should be assessed once specific details of the heavy plant operating within the site are known.

8.7 Foundations

8.7.1 Shallow Foundations

Shallow footings such as strip or pad footings founded on natural sands Unit 2a could be used depending on the footing size, depth of embedment and depth to groundwater. As a guide, footings 1 m by 1 m in area and 0.5 m deep founded on Unit 2a sand could be designed for an allowable bearing 100 kPa. Higher allowable bearing capacities may be used for larger and/or more deeply embedded footings. Design of footings will also need to consider total and differential settlements. Further geotechnical review and analysis can be provided once details of applied loads are confirmed.

If higher loads or stringent settlement criteria are required, the following sections present foundation options that may be considered.

8.7.2 Raft Slabs and Piled Raft

Consideration may be given to the use of a raft slab foundation. However, this will be subject to detailed review and analysis of bearing pressures and settlements once more specific details of the founding level, column layout and slab loadings have been confirmed.

Details of structural loads were not available at the time of preparing this report. As a guide, for raft slab foundations, preliminary settlement analyses have been carried out assuming a distributed slab load of 20 kPa, with a loaded area of 20 m by 20 m. Based on the results of the analyses, preliminary design of raft slabs to support column and floor loadings may be based on a modulus of subgrade reaction (k) value of the order of 2 kPa/mm for the broadly loaded area. Settlements of between 6-10 mm could therefore be expected under the assumed loads. It is noted that the k value (which is not strictly a soil parameter) is very dependent on the size of the loaded area and the rigidity of the raft system.

Construction of the raft slabs should incorporate subgrade preparation as outlined in Section 8.6. It is also suggested that a 150 mm thick layer of good quality granular material such as recycled concrete or crushed rock should be placed and compacted over the prepared surface, particularly at the more heavily loaded areas. The granular layer will help to confine the sandy soils and improve the compaction and density of the surface soils.

A piled raft foundation may also be considered to reduce differential settlements, if required.

Further geotechnical analysis and advice will be required in relation to the design and construction of both raft slabs and piled raft slabs, if these are to be considered.

8.7.3 Piled Foundations

The alternative to shallow foundations is to support the structural loads on piles founded within the dense sands in Unit 4a or 4b which is typically at depths of approximately 13 m to 14 m below the existing ground surface level. Piles founded above Unit 4a and 4b will achieve lower capacities and will need to consider the proximity to clay layers and the impact to capacity and settlement.

Driven piles are technically suitable for the site and would minimise the volumes of waste material to be removed off-site. However, the noise and vibration constraints due to nearby residential properties and buried services at this site may preclude the use of driven pile types. Confirmation of the sensitivity of the buried services and structures to vibrations will be required to assess this option.

Continuous Flight Auger (CFA), concrete injected piles could be considered for this site, as could cast-in-situ screwed pile types such as Atlas or Omega piles. These types of piles are all associated with relatively low levels of noise and vibration. Screwed cast in-situ piles leave a reinforced concrete screw shaped pile and involve lateral displacement of the soil during installation, more efficiently using the in-situ capacity of the soil.

It is noted that CFA piles are a proprietary product and pile construction is considered to be a “blind” drilling technique. Soil decompression can occur during CFA piling when a strong stratum is encountered. This occurs when the augers continue to rotate but the rate of auger progression decreases, displacing soil from around the auger upwards towards the surface. Decompression can cause weakening and settlement of the soils adjacent to the pile and should be avoided by monitoring auger speed and progression closely. Construction of CFA piles should be witnessed and certified by the piling contractor. A geotechnical engineer should regularly attend site during piling works, to observe the CFA drilling techniques and to confirm the founding depths of the piles with the pile design.

Conventional open bored piles will not be appropriate due to the potential for soil collapse and groundwater inflow.

Steel screw piles may be considered subject to confirmation of their load carrying capacity and durability but are unlikely to be suitable for relatively high column loads. Steel screw piles are a proprietary product, and as such information on their installation and load carrying capacity must be obtained from the specialist contractor. Based on previous experience with steel screw piles, a maximum working capacity (vertical load) of about 500 kN to 600 kN is usually achievable. Higher capacities may be possible, however it would be prudent to carry out a load testing programme to prove the load capacities of heavily loaded piles and ensure that excessive settlements do not occur under load.

Table 7 presents preliminary design parameters for CFA piles. CFA piles are likely to be the most suitable pile type if piles are selected to support proposed structures.

Table 7: Design Parameters for CFA Piles

Unit	Allowable End-Bearing Pressure[b,c] (kPa)	Allowable Shaft Adhesion[a,d] (kPa)	Ultimate End-Bearing Pressure[b,c] (kPa)	Ultimate Shaft Adhesion[a,d] (kPa)*	Young's Modulus, E (MPa)
2a – Sand MD	400[c]	15	1,250[c]	25	20
2b – Sand MD to VD	800[c]	30	2,500[c]	50	40
3 – Interbedded Sand and Clay	NA[c]	30	NA[c]	50	20
4a – Sand MD to VD	1,650	50	5,000	100	60
4b – Sand D to VD	3,000	60	10,000	200	120

Notes:

(a) Shaft adhesion should only be adopted where piles have a minimum embedment of at least 2 pile diameters into the relevant bearing stratum.

(b) To adopt these end bearing values piles should have a minimum embedment of 0.5 m into the relevant bearing stratum.

(c) Piles end bearing on clay interbeds and above clays interbeds (Units 2a, 2b and 3) require detailed geotechnical assessment.

(d) For uplift load, the shaft adhesion should be factored down by 0.6.

For limit state design a geotechnical reduction factor (ϕ_g) is applied to the ultimate geotechnical pile capacity assessed using the ultimate parameters above. In accordance with AS2159-2009, ϕ_g is dependent on assignment of an Average Risk Rating (ARR) which takes into account various geotechnical uncertainties, redundancy of the foundation system, construction supervision, and the quantity and type of pile testing. The assessment of ϕ_g therefore depends on the structural design of the foundation system as well as the design and construction method, and testing (if any) to be required by the designer and done by the piling contractor. Where testing is undertaken, it may be possible to adopt a ϕ_g value that results in a more economical design. To assist with preliminary design, a ϕ_g value of 0.4 could be adopted, assuming no pile load testing. Once the pile designer has evaluated the ARR, this value could be revised.

The use of limit state design also requires that serviceability performance of the foundation system be assessed, including pile group interaction effects. Such assessment should be carried out by an experienced geotechnical professional using well-established and soundly based methods. The elastic modulus values above may be adopted for such assessment, but it should be recognised that the accuracy of settlement prediction is a function of construction methodology as well as the assessed values of material stiffness, both of which can have inherent uncertainty. Therefore, the accuracy of settlement predictions may be no better than ± 50%. Where foundation settlement is critical to the performance of the structure, serviceability pile load testing should be carried out to confirm the design assumptions and/or assess prediction accuracy.

8.8 Pavement CBR

The results of the investigation have indicated that the subgrade for the site consists of sandy fill. Laboratory testing of the sandy fill provided CBR values of 10% to 13%.

Based on the above, a design CBR value of 10% may be adopted for pavement thickness design on compacted sandy material.

During construction, verification CBR testing should be undertaken of the actual subgrade materials to confirm that the conditions are consistent with the design. The design CBR is intended to control, but not eliminate possible areas of weaker subgrade, which would require treatment if encountered.

In practice, the performance of the pavements is often governed by construction control and by the moisture regimes within the subgrade and pavement layers, with pavement design assuming that conditions remain at equilibrium levels over the life of the pavement. Therefore, the design of suitable surface and subsurface drainage for the site will be important to ensure suitable pavement performance. The design, construction and maintenance of surface and subsurface drainage systems should be undertaken in accordance with the relevant guides.

8.9 Soil Aggressivity

The soil aggressivity test results were assessed in accordance with Australian Standard AS2159-2009 Piling – "Design and Installation". Chemical test results indicate a moderate exposure classification to concrete elements and mild exposure classification to steel elements.

8.10 Seismic Design

Based on AS1170.4-2007 – Structural design actions Part 2: Earthquake actions in Australia" the following parameters should be adopted for seismic design:

- Seismic Hazard Factor (Z) 0.08
- Sub-Soil Class C_e – Shallow soil site

9. Limitations

DP has prepared this report for this project at Botany in accordance with DP's proposal dated 26 May 2023. The work was carried out under CO-OP's Sub consultancy Agreement Project 100239. This report is provided for the exclusive use of CO-OP for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site.

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

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Appendix A

About This Report

About this Report

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Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Appendix B

Drawings

0 10 20 30 40 50 75 100m

1:1000 @ A3

NOTE:
1: Base image from Nearmap.com (Dated 12.04.2020)
2: Test locations are measured using a high-precision differential GPS.

LEGEND

- Geotechnical/Environmental Borehole Location
- Environmental Borehole Location
- Cone Penetration Test (CPT) Location
- BH6/GW6 — Borehole with Groundwater Well
- Site Boundary

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Geotechnics / Environment / Groundwater

CLIENT: CO-OP Studio Pty Ltd		TITLE: **Test Location Plan**	PROJECT No: 99679.00
OFFICE: Sydney	DRAWN BY: IT	**Botany Aquatic Centre**	DRAWING No: 1
SCALE: 1:1000 @ A3	DATE: 03.06.2020	**2 Myrtle Street, Botany**	REVISION: 0

Appendix C

Borehole Logs and CPT Plots

Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Symbols & Abbreviations

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Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

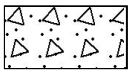
Symbols & Abbreviations

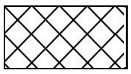
Graphic Symbols for Soil and Rock

General

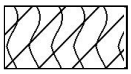

Asphalt

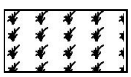

Road base

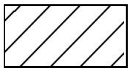

Concrete

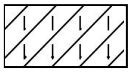

Filling

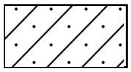
Soils


Topsoil

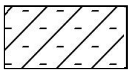

Peat

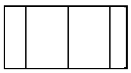

Clay

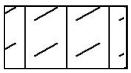

Silty clay

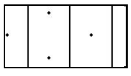

Sandy clay

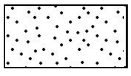

Gravelly clay

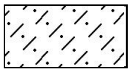

Shaly clay

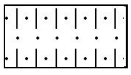

Silt


Clayey silt


Sandy silt

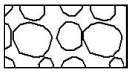

Sand

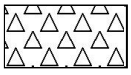

Clayey sand


Silty sand


Gravel

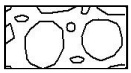

Sandy gravel


Cobbles, boulders

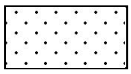

Talus

Sedimentary Rocks


Boulder conglomerate


Conglomerate


Conglomeratic sandstone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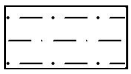
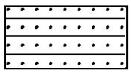
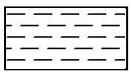
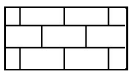

Siltstone

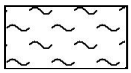

Laminite

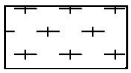

Mudstone, claystone, shale

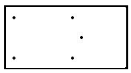

Coal


Limestone

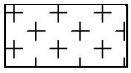
Metamorphic Rocks

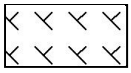

Slate, phyllite, schist

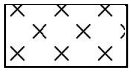

Gneiss

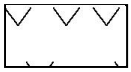

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

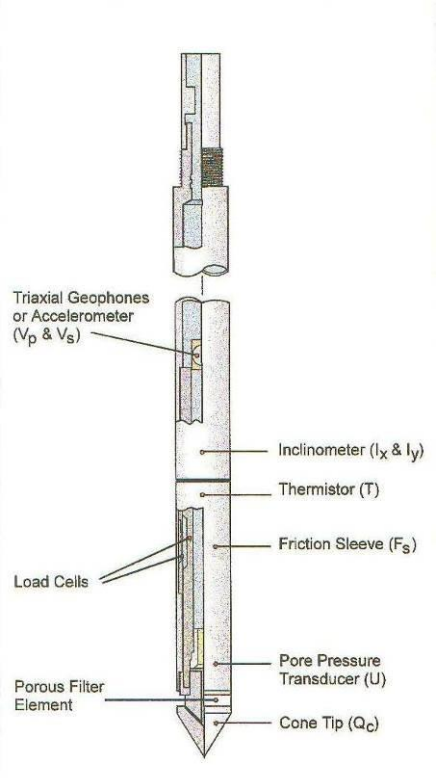


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

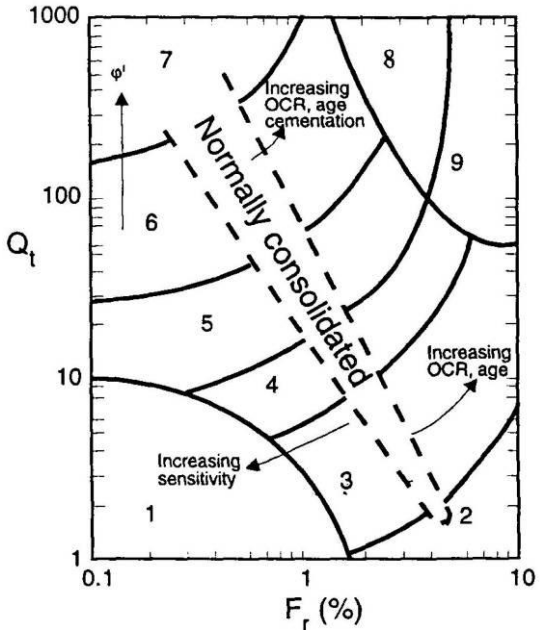


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

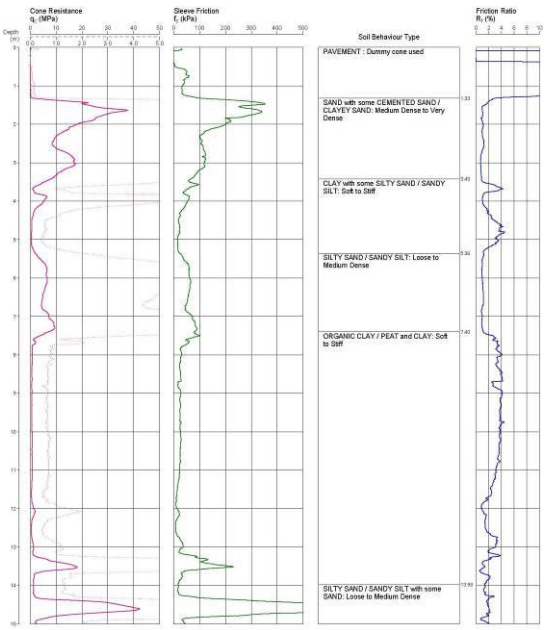


Figure 4: Sample Cone Plot

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.2 AHD
EASTING: 333834
NORTHING: 6243014
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 99679.00
DATE: 8/5/2020
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
	0.25	CONCRETE SLAB: 250mm thick, up to 20mm aggregate, 8mm reinforcement at 150mm depth							
		FILL/SAND: fine to medium, dark brown, with fine to medium gravel (igneous), moist, apparently variably compacted		A/E	0.25		PID = 8 ppm		
				A/E	0.4 0.45		PID = 8 ppm		
	0.55	SAND SP: fine to medium, pale grey and brown, dry, loose, aeolian			0.5				
8				A/E	0.9		PID = 6 ppm		
	1	Below 1.1m: grading to brown to dark brown, trace silt		S	1.0		4,4,5 N = 9		1
					1.45				
9		Below 1.6m: grading to pale brown and brown, moist							
	2			A	1.9 2.0			▼ 08-05-20	2
		Below 2.1m: grading to pale grey							
		Below 2.35m: wet			2.5				
10				S			1,3,3 N = 6		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				3
11	3								
	4								4
12									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Diatube to 0.25m, Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.35m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.2 AHD
EASTING: 333822
NORTHING: 6243058
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 99679.00
DATE: 8/5/2020
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
		ASPHALT							
	0.15	FILL/Gravelly SAND: fine to medium, dark brown, trace gravel (concrete) and clay, moist, apparently variably compacted		A/E	0.15 0.2		PID = 7 ppm		
				A/E	0.4 0.5		PID = 7 ppm		
	0.7	FILL/SAND: fine to medium, pale grey and dark brown, trace fine gravel (igneous), moist, apparently poorly compacted		A/E	0.9 1.0				
	1.15	SAND SP: fine to medium, pale brown, moist, loose, aeolian		S/E			3,2,4 N = 6 PID = 7 ppm		
		Below 1.4m: grading to dark brown, trace silt			1.45				
		Below 1.6m: grading to brown		E	1.6 1.7				
				A	1.8 1.9				
		Below 1.95m: grading to pale grey							
		Below 2.4m: wet			2.5			▼ 08-05-20	
				S			4,4,4 N = 8		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.40m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.0 AHD
EASTING: 333808
NORTHING: 6243107
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 99679.00
DATE: 8/5/2020
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
7	0.03	ASPHALT (good condition)		A	0.05		PID = 5 ppm		
		FILL/Gravelly SAND: fine to medium, dark brown, trace clay and silt, moist, apparently variably compacted			0.1				
				E	0.2				
					0.25				
				A/E	0.5		PID = 6 ppm		
	0.65	FILL/SAND: fine to medium, dark brown, trace gravel (igneous), moist, apparently poorly compacted			0.6				
				B	0.9		PID = 8 ppm		
6	1			A/E	1.0				1
	1.1			S/E	1.1				
		SAND SP: fine to medium, pale grey, moist, loose to medium dense, aeolian		S	1.15		3,4,8 N = 12		
				S	1.3		PID = 6 ppm		
				S	1.45				
		Below 1.7m: grading to brown and dark brown, trace silt							
				A/E	1.9		PID = 9 ppm		
5	2				2.0				2
		Below 2.4m: wet						▼ 08-05-20	
					2.5				
				S			3,3,5 N = 8		
4	2.95	Bore discontinued at 2.95m			2.95				3
		Target depth reached							
3	4								4
2	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.4m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.4 AHD
EASTING: 333885
NORTHING: 6243022
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 99679.00
DATE: 11/5/2020
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
9	0	FILL/Silty SAND: fine to medium, dark grey and brown, with rootlets, trace gravel (igneous), moist, variably compacted		A/E	0.05 0.15		PID = 9 ppm		
		Below 0.4m: with gravel (sandstone)		A/E	0.5 0.6		PID = 10 ppm		
	1			A/E	0.9 1.0		PID = 10 ppm		1
10	1.5	SAND SP: fine to medium, pale grey, moist, loose, aeolian		S/E	1.45		4,3,2 N = 5 PID = 10 ppm		
	2	Below 2.1m: grading to brown and dark brown, trace silt		A/E	1.9 2.0		PID = 10 ppm		2
11		Below 2.7m: grading to pale brown		S	2.5		4,3,4 N = 7		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				
12	3								3
13	4								4
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.4 AHD
EASTING: 333877
NORTHING: 6243050
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 99679.00
DATE: 11/5/2020
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
9	0.8	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and gravel, moist, apparently poorly compacted		A/E	0.05 0.15		PID = 6 ppm		
				A/E*	0.5 0.6		PID = 10 ppm		
10	1.8	FILL/Gravelly SAND: fine to medium, brown and dark brown, with clay, moist, variably compacted		A/E	0.9 1.0		PID = 9 ppm		
				A/E			19,30,15 N = 45 PID = 12 ppm		
		At 1.4m: with brick fragments			1.45				
11	2.95	SAND SP: fine to medium, pale grey, moist, medium dense, aeolian		A/E	1.9 2.0				
				A	2.4 2.5				
		Below 2.65m: grading to brown and dark brown, trace silt		S			6,4,6 N = 10 PID = 7 ppm		
12		Bore discontinued at 2.95m Target depth reached			2.95				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD4/110520 taken at 0.5-0.6m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.0 AHD
EASTING: 333921
NORTHING: 6243021
DIP/AZIMUTH: 90°/--

BORE No: BH6/GW6
PROJECT No: 99679.00
DATE: 12/5/2020
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
8	0.16	CONCRETE SLAB: 160mm diameter, <20mm aggregate, 10mm reinforcement at 110mm depth							Flush gatic cover and well cap
		FILL/Silty SAND: fine to medium, dark brown, with gravel, bitumen and ceramic fragments, moist, apparently poorly compacted		A/E	0.2 0.25		PID = 3 ppm		Concrete from 0m to 0.2m
				A/E	0.5 0.6		PID = 2 ppm		Sand backfill from 0.2m to 0.5m
	0.7	SAND SP: fine to medium, pale grey, moist, medium dense, aeolian		A/E	0.9 1.0		PID = 3 ppm		Bentonite from 0.5m to 1.2m
9	1			S			10,17,12 N = 29		Plain PVC casing from 0.1m to 2m
		Below 1.45m: grading to brown, trace silt			1.45				
				A	1.9 2.0				
10	2	Below 2.2m: grading to pale grey							
				S	2.5		4,5,6 N = 11		
11	3				2.95			22-05-20	
				S	3.5		6,7,5 N = 12		Sand backfill from 1.2m to 6m
12	4				3.95				
				S	4.5		5,7,8 N = 15		Slotted screen from 2.5m to 6m
13	5				4.95				
		Below 5.5m: dense		S	5.5		11,16,26 N = 42		
	6.0	Bore discontinued at 6.0m Target depth reached			5.95				End cap

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** HW to 3.5m

TYPE OF BORING: Diatube to 0.16m, Solid Flight Auger (TC-bit) to 2.5m, Rotary to 6.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering and free groundwater observed at 2.85m in the well on 22/05/2020

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.8 AHD
EASTING: 333903
NORTHING: 6243055
DIP/AZIMUTH: 90°/--

BORE No: BH7
PROJECT No: 99679.00
DATE: 11/5/2020
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
8	0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and gravel, moist, apparently poorly compacted		A/E	0.05		PID = 8 ppm		
					0.15				
		Below 0.2m: grading to grey and dark grey							
				A/E	0.5		PID = 8 pm		
					0.6				
		Below 0.7m: with clay nodules, concrete fragments and gravel							
				A/E	0.9		PID = 8 ppm		
9	1				1.0				1
				S/E			4,4,4 N = 8 PID = 12 ppm		
	1.3	SAND SP: fine to medium, pale grey, moist, loose, aeolian							
					1.45				
				A/E	1.9		PID = 5 ppm		
10	2				2.0				2
		Below 2.3m: grading to dark brown and brown, trace silt							
					2.5				
		Below 2.7m: wet		S/E			3,4,6 N = 10	▼ 11-05-20	
	2.95				2.95				
11	3	Bore discontinued at 2.95m Target depth reached							3
	4								4
12	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.4m, Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.2 AHD
EASTING: 333896
NORTHING: 6243093
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 99679.00
DATE: 11/5/2020
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
9	0	FILL/Silty SAND: fine to medium, dark brown, with rootlets, trace gravel, moist, variably compacted		A/E*	0.05 0.15		PID = 11 ppm		
		Below 0.4m: with bitumen fragments		A/E	0.4 0.5		PID = 11 ppm		
		Below 0.8m: with gravel (sandstone) and PVC fragments, trace clay		A/E	0.9 1.0		PID = 15 ppm 4/140 refusal		
1	1	At 0.95m: with concrete fragments At 1.1m: bitumen band		A/E	1.14				1
				A/E	1.4 1.5		PID = 14 ppm		
10	1.8	SAND SP: fine to medium, pale brown, moist, medium dense, aeolian		A/E	1.9 2.0				
2	2	Below 2.3m: dark brown and brown, trace silt		A/E	2.4 2.5		PID= 15 ppm		2
11				S			13,12,9 N = 21		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				
12	3								3
	4								4
13	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.4m, Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD2/110520 taken at 0.05-0.15m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333895
NORTHING: 6243124
DIP/AZIMUTH: 90°/--

BORE No: BH9/GW9
PROJECT No: 99679.00
DATE: 12/5/2020
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
8	0.1	FILL/Silty SAND: fine to medium, dark brown, with rootlets, trace gravel, moist, apparently poorly compacted		A/E	0.1 0.15		PID = 1 ppm		Flush gatic cover and well cap Concrete from 0m to 0.2m
	0.35	FILL/Gravelly SAND: fine to medium, trace silt, bitumen fragments and clay, moist, apparently well compacted							Sand backfill from 0.2m to 0.4m
	0.65	Bulk sample: 0.6-1.3m		A/E	0.5 0.6		PID = 2 ppm		
		SAND SP: fine to medium, pale grey, moist, loose, aeolian		A/E	0.9 1.0		PID = 1 ppm		Bentonite from 0.4m to 1.3m Plain PVC casing from 0.1m to 1.9m
9	1			A/E			3,4,5 N = 9		1
		Below 1.3m: grading to brown and dark brown, trace silt			1.45				
		Below 1.9 m: wet						12-05-20	
	2			A/E	2.0		2,4,4 N = 8		2
10		Below 2.5m: grading to pale brown			2.45				
	3			S	3.15		5,4,5 N = 9		3
11					3.55				Sand backfill from 1.3m to 6m
	4	Below 4m: medium dense		S/E	4.0		5,6,7 N = 13 PID = <1 ppm		4 Slotted screen from 1.9m to 6m
12					4.45				
	5								5
				S/E	5.5		7,11,15 N = 26 PID = <1 ppm		
	6.0	Bore discontinued at 6.0m Target depth reached			5.95				End cap

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** HW to 3.5m

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 2.5m, Rotary to 6.0m

WATER OBSERVATIONS: Free groundwater observed at 1.9m during drilling and in the well on 22/05/2020

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333929
NORTHING: 6243125
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 99679.00
DATE: 11/5/2020
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
8	0.25	FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist, apparently poorly compacted		A/E	0.05 0.1		PID = 18 ppm		
		FILL/SAND: fine to medium, pale grey and dark grey, with gravel and a trace of rootlets, moist, apparently well compacted		A/E*	0.4 0.5		PID = 13 ppm		
	0.55	SAND SP: fine to medium, pale brown, moist, very loose to loose then loose, aeolian		A/E	0.9 1.0		PID = 16 ppm		
9	1	Below 1.1m: grading to brown and dark brown		S/E			2,2,2 N = 4		
		Below 1.5m: wet			1.45			▼ 11-05-20	
10	2	Below 2.2m: grading to pale grey		S/E	2.5		2,3,5 N = 8		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				
11	3								
12	4								
	5								

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD1/110520 taken at 0.4-0.5m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333938
NORTHING: 6243092
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 99679.00
DATE: 11/5/2020
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
8	0.0	FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist, apparently poorly compacted		A/E	0.05 0.15		PID = 11.5 ppm		
		Below 0.4m: with bitumen fragments and igneous gravel, strong hydrocarbon odour		A/E*	0.4 0.5		PID = 36 ppm		
	0.7	SAND SP: fine to medium, pale grey, moist, medium dense, aeolian			0.7				
	1			A/E B	0.9 1.0		PID = 14 ppm		1
				S/E			10,9,8 N = 17		
		Below 1.3m: brown to dark brown, trace silt			1.35 1.45				
9		Below 1.65m: wet						11-05-20	
	2								2
10					2.5				
				S/E			3,3,8 N = 11		
	3				2.95				3
11									
	4				4.0				4
				S/E			8,10,16 N = 26		
	4.45	Bore discontinued at 4.45m Target depth reached			4.45				
12									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.3m, Solid Flight Auger (TC-bit) to 4.0m, SPT to 4.45m

WATER OBSERVATIONS: Free groundwater observed at 1.65m

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD3/110520 taken at 0.4-0.5m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.6 AHD
EASTING: 333948
NORTHING: 6243041
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 99679.00
DATE: 12/5/2020
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
8	0	FILL/Silty SAND: fine to medium, dark brown, trace gravel, moist, apparently poorly compacted		A/E	0.1 0.2		PID = <1 ppm		
		Below 0.3m: with gravel, trace brick fragments and metal, apparently well compacted		A/E	0.5 0.6		PID = <1 ppm		
	0.7	SAND SP: fine to medium, pale grey, moist, loose to medium dense, aeolian			0.75				
	1			A/E	0.9 1.0		PID = 3 ppm		1
9				B S/E			7,8,10 N = 18 PID = <1 ppm		
		Below 1.35m: grading to brown and dark brown			1.45 1.5				
		Below 1.75m: grading to pale brown							
	2							▼ 12-05-20	2
10		Below 2.15m: wet							
		Below 2.5m: loose			2.5				
				S/E			2,3,4 N = 7 PID = <1 ppm		
	3				2.95				3
11					3.5				
				S			2,3,4 N = 7 PID = <1 ppm		
	3.95				3.95				
12		Bore discontinued at 4.45m Target depth reached							
	4								4
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** RB **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 3.5m, SPT to 3.95m

WATER OBSERVATIONS: Free groundwater observed at 2.15m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.3 AHD
EASTING: 333818
NORTHING: 6243036
DIP/AZIMUTH: 90°/--

BORE No: BH13
PROJECT No: 99679.00
DATE: 15/5/2020
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
	0.2	ASPHALT (good condition)							
	0.3	ROADBASE							
		FILL/SAND: fine to coarse, grey and dark grey, trace fine gravel (igneous), moist		E	0.3 0.4		PID = 1 ppm		
					0.5				
				S/E			5,6,6 N = 12 PID = 1 ppm		
	1.0	SAND SP: fine to medium, pale grey, moist, loose, aeolian			0.95				
		Below 1.3m: grading to pale yellow		E	1.4 1.5		PID = 2 ppm		
				S/E			2,3,4 N = 7 PID = 2 ppm		
		Below 1.8m: grading to orange-brown							
	1.95	Bore discontinued at 1.95m Target depth reached			1.95				

RIG: Explora **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m, SPT to 1.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.1 AHD
EASTING: 333806
NORTHING: 6243076
DIP/AZIMUTH: 90°/--

BORE No: BH14
PROJECT No: 99679.00
DATE: 15/5/2020
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
8	0.2	ASPHALT (good condition)							
		ROADBASE							
	0.5	VOID							
	0.7	FILL/SAND: fine to coarse, grey and dark brown, trace fine gravel (igneous), moist		S/E	1.0		1,0,0 N = 0 PID = 1 ppm		
9	1.5	SAND SP: fine to medium, pale grey, moist, loose to medium dense, aeolian			1.45				
				E	1.9 2.0		PID = <1 ppm		
		Below 2.2: wet						15-05-20	
				E	2.4 2.5		PID = 1 ppm		
10		Below 2.8m: grading to pale yellow		S/E			3,4,6 N = 10 PID = 1 ppm		
	2.95	Bore discontinued at 2.95m Target depth reached			2.95				
11									
12									

RIG: Explora **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.2m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.3 AHD
EASTING: 333841
NORTHING: 6243043
DIP/AZIMUTH: 90°/--

BORE No: BH15
PROJECT No: 99679.00
DATE: 18/5/2020
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
8	0.1	ASPHALT (good condition)							
		ROADBASE							
	0.4	FILL/Silty SAND: fine to coarse, dark brown, trace fine to medium gravel (asphaltic and igneous) and clay, dry, strong hydrocarbon odour		E	0.4 0.5		PID = 4 ppm		
				E	0.9 1.0		PID = 2 ppm		
1	1.0	SAND SP: fine to medium, pale grey to dark grey, hydrocarbon odour, dry, loose, aeolian		S/E			2,2,4 N = 6 PID = 3 ppm		1
				E	1.4 1.45		PID = 3 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				
9	2								2
10	3								3
11	4								4
12	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.2 AHD
EASTING: 333825
NORTHING: 6243091
DIP/AZIMUTH: 90°/--

BORE No: BH16
PROJECT No: 99679.00
DATE: 18/5/2020
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
	0.02	ASPHALT (good condition)							
	0.2	ROADBASE							
		FILL/Silty SAND: fine to coarse, dark brown, trace fine to medium gravel (asphaltic and igneous), moist		E	0.2 0.4		PID = 2 ppm		
				E	0.9		PID = 3 ppm		
	1.0	SAND SP: fine to medium, pale grey to dark grey, dry, loose, aeolian		S/E	1.0		1,3,4 N = 7 PID = 2 ppm		
				E	1.4 1.45		PID = 2 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 6.8 AHD
EASTING: 333793
NORTHING: 6243119
DIP/AZIMUTH: 90°/--

BORE No: BH17/GW17
PROJECT No: 99679.00
DATE: 15/5/2020
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
7	0.2	ASPHALT (good condition)							Flush gatic cover and well cap Asphalt from 0m to 0.05m Sand backfill from 0.05m to 0.3m
	0.35	ROADBASE							
		FILL/Silty SAND: fine to coarse, pale brown to brown, with clay, trace fine gravel (igneous), moist, hydrocarbon odour		E	0.4 0.5		PID = 11 ppm		
				S/E			5,2,2 N = 4 PID = 6 ppm		
	0.9			E	0.9 0.95		PID = 4 ppm		
8	1	FILL/SAND: fine to coarse, pale grey and grey, trace fine gravel (igneous), moist			1.0				Plain PVC casing from 0.05m to 2m Bentonite from 0.3m to 2.1m
				E	1.4 1.5		PID = 4 ppm		
				S/E			1,3,4 N = 7 PID = 3 ppm		
				E	1.9 1.95		PID = 3 ppm	15-05-20	
	2 2.0	SAND SW: fine to coarse, pale brown, wet, loose, aeolian			2.0				
9				E	2.4 2.5		PID = 3 ppm		
				S/E			2,2,3 N = 5 PID = 3 ppm		
	3				2.95				
10		Below 3.5m: grading to pale yellow-grey			3.5				
				S/E			2,3,5 N = 8 PID = 1 ppm		
	4				3.95				Slotted screen from 2m to 6m Sand backfill from 2.1m to 6m
11		Below 4.5m: grading to pale yellow, loose to medium dense			4.5				
				S/E			3,7,10 N = 17 PID = 1 ppm		
	5				4.95				
					5.5				
				S/E			1,2,4 N = 6 PID = 1 ppm		
	6.0	Bore discontinued at 6.0m Target depth reached			5.95				End cap

RIG: Explora **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 6.0m.

WATER OBSERVATIONS: Free groundwater observed at 2m during drilling and at 2.1m in the well on 20/05/2020

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.5 AHD
EASTING: 333904
NORTHING: 6243114
DIP/AZIMUTH: 90°/--

BORE No: BH18
PROJECT No: 99679.00
DATE: 19/5/2020
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
8	0.0	FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, moist		E	0.0–0.1		PID = 1 ppm		
	0.4	Below 0.4m: with fine gravel (asphaltic)		E	0.4–0.5		PID = 2 ppm		
	0.5	FILL: Sandy GRAVEL/FLY ASH: with clinker and fine to medium asphaltic gravel		S/E	0.5–0.59		25/90 refusal		
	0.8	SAND SP: fine to medium, pale grey to grey, moist, loose, aeolian					PID = 2 ppm		
1				E	0.9–1.0		PID = 3 ppm		1
9		Below 1.5m: grading to pale grey, orange and dark red-brown		E	1.5–1.6		PID = 4 ppm		
		Below 1.8m: grading to yellow to pale yellow							
2		Below 2m: wet						19-05-20	2
10		Below 2.5m: grading to pale yellow-grey, loose to medium dense							
3									3
11									
4	4.0	Bore discontinued at 4.0m Target depth reached							4
12									
5									5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 4m

WATER OBSERVATIONS: Free groundwater observed at 2m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333934
NORTHING: 6243118
DIP/AZIMUTH: 90°/--

BORE No: BH19
PROJECT No: 99679.00
DATE: 19/5/2020
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
		FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, trace gravel (asphaltic) and clinker, moist, strong hydrocarbon odour		E	0.0 0.1		PID = 7 ppm		
	0.4	Below 0.1m: grading to brown FILL: Sandy GRAVEL/FLY ASH: with clinker and fine to coarse asphaltic gravel		E S	0.4 0.5 0.6		PID = 16 ppm 25/100 refusal PID = 11 ppm		
	1.0	SAND SP: fine to medium, pale yellow-grey, slight hydrocarbon odour, moist, loose, aeolian		E	1.0 1.1		PID = 1 ppm		
		Below 1.3m: grading to yellow-orange, odourless, wet		E	1.4		PID = 1 ppm	▼ 19-05-20	
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: Free groundwater observed at 1.3m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333945
NORTHING: 6243099
DIP/AZIMUTH: 90°/--

BORE No: BH20
PROJECT No: 99679.00
DATE: 19/5/2020
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
8	0.0	FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, trace gravel (asphaltic), moist		E	0.0–0.1		PID = 2 ppm		
		Below 0.1m: grading to brown							
		Below 0.4m: with fine gravel (asphaltic)		E	0.4–0.5		PID = 2 ppm		
	0.6	SAND SP: fine to medium, pale yellow-grey, moist, medium dense, aeolian		S/E			8,9,10 N = 19 PID = 1 ppm		
1					0.95				1
	1.2			E	1.1–1.2		PID = 1 ppm		
		Bore discontinued at 1.2m Target depth reached							
9	2								2
10	3								3
11	4								4
12	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.8 AHD
EASTING: 3339823
NORTHING: 6243108
DIP/AZIMUTH: 90°/--

BORE No: BH21
PROJECT No: 99679.00
DATE: 19/5/2020
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
8	0.0	FILL/Silty SAND: fine to coarse, dark brown, with clay, trace gravel (asphaltic), clinker, roots and rootlets, moist		E	0.0 0.1		PID = 1 ppm		
	0.4	FILL: Sandy GRAVEL/FLY ASH: with clinker		E	0.4 0.5		PID = 2 ppm		
	0.6	SAND SP: fine to medium, pale yellow, moist, loose to medium dense, aeolian		S/E			4,4,6 N = 10 PID = 2 ppm		
	1				0.95				1
	1.1			E	1.0 1.1		PID = 1 ppm		
9		Bore discontinued at 1.1m Target depth reached							
	2								2
10									
	3								3
11									
	4								4
12									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.4 AHD
EASTING: 333949
NORTHING: 6243075
DIP/AZIMUTH: 90°/--

BORE No: BH22
PROJECT No: 99679.00
DATE: 19/5/2020
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
		FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, trace fine gravel (asphaltic) and clinker, moist, strong hydrocarbon odour		E	0.0 0.1		PID = 2 ppm		
	0.4	Below 0.1m: grading to brown FILL: Sandy GRAVEL/FLY ASH: with fine to medium asphaltic gravel , clinker and clay, strong hydrocarbon odour		E	0.4 0.5		PID = 7 ppm		
		Between 0.5m-0.8m: with concrete		S/E			25,13,15 N = 28 PID = 3 ppm		
	1.0	SAND SP: fine to medium, pale yellow-grey and grey to dark grey, moist, loose to medium dense, aeolian		E	0.95 1.0 1.1		PID = 1 ppm		
				E	1.4		PID = 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.5 AHD
EASTING: 333947
NORTHING: 6243057
DIP/AZIMUTH: 90°/--

BORE No: BH23
PROJECT No: 99679.00
DATE: 19/5/2020
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
8	0.0	FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, trace fine gravel (asphaltic), moist		E	0.0 0.1		PID = 3 ppm		
		Below 0.1m: grading to brown							
	0.4	FILL: Sandy GRAVEL/FLY ASH: with fine to medium asphaltic gravel and clinker		E	0.4 0.5		PID = 2 ppm		
				S/E			6,8,10 N = 18 PID = 2 ppm		
	0.9	SAND SP: fine to medium, pale yellow-grey and grey to dark grey, moist, loose to medium dense, aeolian		E	0.9 0.95 1.0		PID = 2 ppm		
		Below 1.3m: grading to brown and dark grey							
9		Below 1.4m: grading to dark brown and dark grey		E	1.4		PID = 2 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				
10									
11									
12									

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.7 AHD
EASTING: 333919
NORTHING: 6243048
DIP/AZIMUTH: 90°/--

BORE No: BH24
PROJECT No: 99679.00
DATE: 19/5/2020
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
8	0.0	FILL/SAND: fine to coarse, dark brown, with silt, trace roots and rootlets, moist		E	0.0 0.1		PID = 2 ppm		
	0.4	FILL: Sandy GRAVEL/FLY ASH: with fine to medium asphaltic gravel and clinker		E S/E	0.4 0.5		PID = 3 ppm 22,14,7 N = 21 PID = 13 ppm		
9	0.9	SAND SP: fine to medium, pale yellow-grey and grey to dark grey, moist, loose to medium dense, aeolian		E	0.9 0.95 1.0		PID = 4 ppm		
	1	Below 1.4m: grading to dark brown, dark grey and orange, trace clay		E	1.4 1.5		PID = 2 ppm		
	2	Below 2m: grading to pale yellow to yellow						19-05-20	
10		Below 2.3m: wet							
	3	Below 3m: grading to yellow-grey							
11									
	4	4.0 Bore discontinued at 4.0m Target depth reached							
12									
	5								

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 4m

WATER OBSERVATIONS: Free groundwater observed at 2.3m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.4 AHD
EASTING: 333891
NORTHING: 6243040
DIP/AZIMUTH: 90°/--

BORE No: BH25
PROJECT No: 99679.00
DATE: 19/5/2020
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
9	0.0	FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, moist		E	0.0 0.1		PID = 2 ppm		
	0.4	FILL/SAND: fine to coarse, brown to dark brown, trace roots and rootlets, moist		E S/E	0.4 0.5		PID = 4 ppm 1,1,R refusal SPT = refusal on 3rd blow		
	0.8	FILL: Sandy GRAVEL/FLY ASH: with fine to medium asphaltic gravel, clinker and red-brown clay, strong hydrocarbon odour			0.8		PID = 2 ppm		
1	1.0	FILL/SAND: fine to coarse, dark brown, trace clinker, clay, roots and rootlets, moist		E	0.9 1.0		PID = 2 ppm		1
10	1.6	SAND SP: fine to medium, pale grey to dark grey, moist, loose to medium dense, aeolian Below 1.8m: fine to coarse, grading to dark brown, red-brown and pale grey		E S/E E	1.4 1.5 1.9 1.95 2.0		PID = 17 ppm 11,13,11 N = 24 PID = 6 ppm PID = 4 ppm		
2	2.1	Bore discontinued at 2.1m Target depth reached							2
11									
3									3
12									
4									4
13									
5									5
1									

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 2.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.4 AHD
EASTING: 333980
NORTHING: 6243023
DIP/AZIMUTH: 90°/--

BORE No: BH26
PROJECT No: 99679.00
DATE: 18/5/2020
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
9	0.0	FILL/Silty SAND: fine to coarse, brown to dark brown, with fine to medium gravel (asphaltic), roots and rootlets, dry		E	0.0 0.1		PID = 1 ppm		
				E	0.4 0.5		PID = 1 ppm		
		At 0.7m: with fly ash		S/E			6,8,8 N = 16 PID = 1 ppm		
	0.9	SAND SP: fine to medium, pale yellow, pale grey and dark grey, moist, loose to medium dense, aeolian		E	0.9 0.95 1.0		PID = 2 ppm		
				E	1.4		PID = 2 ppm		
10	1.5	Bore discontinued at 1.5m Target depth reached			1.5				
11									
12									
13									

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.4 AHD
EASTING: 333889
NORTHING: 6243033
DIP/AZIMUTH: 90°/--

BORE No: BH27
PROJECT No: 99679.00
DATE: 19/5/2020
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
		FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, moist		E	0.0 0.1		PID = 3 ppm		
	0.4	FILL/SAND: fine to coarse, brown to dark brown, trace clinker, clay, roots and rootlets, moist		E	0.4 0.5		PID = 2 ppm		
				S/E			2,1,2 N = 3 PID = 1 ppm		
					0.8				
				E	0.9 1.0		PID = 1 ppm		
				E	1.4 1.5		PID = 3 ppm		
				S/E			12,12,18 N = 30 PID = 2 ppm		
	1.8	SAND SP: fine to medium, pale grey and dark grey, moist, loose to medium dense, aeolian Below 2m: grading to dark red-brown, brown and orange			1.95				
				E	2.0 2.1		PID = 2 ppm		
				E	2.4		PID = 2 ppm		
	2.5	Bore discontinued at 2.5m Target depth reached			2.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 2.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.7 AHD
EASTING: 334038
NORTHING: 6243032
DIP/AZIMUTH: 90°/--

BORE No: BH28
PROJECT No: 99679.00
DATE: 15/5/2020
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
9	0.3	FILL/Silty SAND: fine to medium, brown and grey, trace rootlets, moist							
		At 0.3m: concrete boulders encountered Bore discontinued at 0.3m Refusal on concrete							

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** JH **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 0.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.7 AHD
EASTING: 334036
NORTHING: 6243031
DIP/AZIMUTH: 90°/--

BORE No: BH28A
PROJECT No: 99679.00
DATE: 15/5/2020
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
		FILL/Silty SAND: fine to medium, brown and grey, trace rootlets, moist		E*	0.0		PID = <1 ppm		
					0.2				
9		At 0.4m: trace clinker		E	0.3		PID = 1 ppm		
					0.5				
		At 0.7m: with roots, clinker, ceramic and plastic		S/E			3,3,7 N = 10 PID = 1 ppm		
	1	Below 0.9m: grading to brown with pale grey			0.95				1
				E	1.0		PID = 1 ppm		
	1.1	FILL/SAND : fine to medium, pale grey, moist, medium dense			1.1				
10				S/E			4,8,11 N = 19 PID = 1 ppm		
		Below 1.4m: grading to very pale grey			1.4				
				E	1.45		PID = 1 ppm		
					1.5				
				E	1.9		PID = <1 ppm		
	2	2.0 Bore discontinued at 2.0m Refusal on concrete			2.0				2
11									
	3								3
12									
	4								4
13									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** JH **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD1/20200515 taken at 0-0.2m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.6 AHD
EASTING: 334061
NORTHING: 6243035
DIP/AZIMUTH: 90°/--

BORE No: BH29
PROJECT No: 99679.00
DATE: 15/5/2020
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
		FILL/Silty SAND: fine to medium, brown and grey, trace rootlets, moist		E	0.0		PID = <1 ppm		
					0.2				
				E	0.3		PID = 1 ppm		
		Below 0.5m: trace gravel (sandstone)			0.5				
				S/E			5,6,7 N = 13 PID = 1 ppm		
	1				0.95				1
				E	1.0		PID = 1 ppm		
	1.2				1.1				
		SAND SP: fine to medium, pale grey to dark grey, moist, medium dense, aeolian		S/E			9,8,11 N = 19 PID = 2 ppm		
					1.45				
				E	1.5		PID = <1 ppm		
		Below 1.7m: grading to pale grey and mottled orange-brown			1.7				
	2				2.0				2
		Below 2.2m: grading to mottled yellow and orange-brown		S/E			11,9,10 N = 19 PID = 2 ppm		
	2.45	Bore discontinued at 2.45m Target depth reached			2.45				
	3								3
	4								4
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** JH **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 9.7 AHD
EASTING: 334076
NORTHING: 6243042
DIP/AZIMUTH: 90°/--

BORE No: BH30/GW30
PROJECT No: 99679.00
DATE: 13/5/2020
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
10	0.0	FILL/Silty SAND: fine to coarse, dark brown, with roots and rootlets, trace gravel (igneous) and clinker, moist		E	0.0		PID = 4 ppm		Flush gatic cover and well cap Concrete from 0m to 0.1m
					0.2				
				E	0.3		PID = 6 ppm		Coarse sand from 0.1m to 0.75m
	0.55	SAND SW: fine to coarse, pale to dark grey, moist, loose to medium dense, aeolian			0.5				
				S/E			6,8,9 N = 17 PID = <1 ppm		
					0.9				
1				E	0.95		PID = 3 ppm		Plain PVC casing from 0.1m to 1.9m
					1.0				
					1.2				
11		Below 1.2m: grading to red-brown Below 1.3m: grading to pale orange-brown		E			PID = 2 ppm		Bentonite from 0.75m to 1.8m
					1.5				
				S/E			3,5,4 N = 9 PID = 3 ppm		
2		Below 1.9m: wet			1.95			13-05-20	
12					2.5				
				S/E			3,4,7 N = 11 PID = 2 ppm		
3					2.95				
13					3.5				
		Below 3.7m: grading to pale grey		S/E			7,7,8 N = 15 PID = 2 ppm		
4					3.95				Sand backfill from 1.8m to 6m Slotted screen from 1.9m to 6m
14					4.5				
		Below 4.55m: grading to pale yellow-grey		S/E			2,5,12 N = 17 PID = 2 ppm		
5					4.95				
					5.5				
				S/E			6,13,21 N = 34 PID = 2 ppm		
	6.0	Bore discontinued at 6.0m Target depth reached			5.95				End cap

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater observed at 1.9m during drilling and at 2.0m in the well on 22/05/2020

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.3 AHD
EASTING: 333985
NORTHING: 6243048
DIP/AZIMUTH: 90°/--

BORE No: BH31
PROJECT No: 99679.00
DATE: 18/5/2020
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
		FILL/Silty SAND: fine to coarse, dark brown, with clay, roots and rootlets, moist		E	0.0 0.1		PID = 2 ppm		
				E	0.4 0.5		PID = 2 ppm		
	0.55	SAND SP: fine to medium, pale grey and dark grey, moist, loose, aeolian		S/E			7,4,4 N = 8 PID = 2 ppm		
				E	0.95 1.05		PID = 2 ppm		
	1.05	Bore discontinued at 1.05m Target depth reached							

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.2 AHD
EASTING: 334010
NORTHING: 6243042
DIP/AZIMUTH: 90°/--

BORE No: BH32
PROJECT No: 99679.00
DATE: 18/5/2020
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
8	0.0	FILL/Silty SAND: fine to coarse, dark brown and orange, with roots and rootlets, trace fine to medium gravel (asphaltic) and clay, moist		E	0.0		PID = 2 ppm		
					0.3				
				E*	0.4		PID = 2 ppm		
					0.5				
				S/E			3,2,2 N = 4 PID = 1 ppm		
	0.9				0.95				
1		FILL/SAND: fine to coarse, pale yellow and yellow, dry Below 1m: grading to dark brown and grey, with silt, trace fine gravel (igneous) and PVC, dry		E	1.0		PID = 1 ppm		1
					1.3				
				E	1.5		PID = 2 ppm		
	1.6				1.6				
9		SAND SP: fine to medium, pale grey to grey, dry, medium dense, aeolian Below 1.8m: grading to orange and brown to red-brown, moist		S/E			7,11,10 N = 21 PID = 1 ppm		
2					1.95				2
				E	2.0		PID = 1 ppm		
	2.1	Bore discontinued at 2.1m Target depth reached			2.1				
10	3								3
11	4								4
12	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD6/20200518 taken at 0.4-0.5m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.8 AHD
EASTING: 334034
NORTHING: 6243066
DIP/AZIMUTH: 90°/--

BORE No: BH33
PROJECT No: 99679.00
DATE: 18/5/2020
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
9	0	FILL/Silty SAND: fine to coarse, dark brown, trace bark, roots and rootlets, moist		E*	0.0		PID = 1 ppm		
		At 0.3m: trace coarse gravel (asphaltic), hydrocarbon odour			0.3				
				E	0.4 0.5		PID = 3 ppm		
				S/E			2,2,7 N = 9 PID = 1 ppm		
	1	Below 0.9m: trace medium gravel (asphaltic)		E	0.9 0.95 1.0		PID = 2 ppm		1
10				E	1.4 1.5		PID = 2 ppm		
		Below 1.5m: with pale grey and red clay nodules		S/E			8,12,10 N = 22 PID = 1 ppm		
	1.8	SAND SP: fine to medium, pale grey to grey, moist, medium dense, aeolian		E	1.9 1.95 2.0		PID = 1 ppm		
	2								2
11		Below 2.4m: grading to orange-brown and grey, loose		E	2.4 2.5		PID = 1 ppm		
				S/E			3,4,4 N = 8 PID = 1 ppm		
	2.95	Below 2.9m: wet			2.95			18-05-20	
	3	Bore discontinued at 2.95m Target depth reached							3
12									
	4								4
13									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 2.5m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.9m

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD3/20200518 taken at 0-0.3m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.5 AHD
EASTING: 334062
NORTHING: 6243055
DIP/AZIMUTH: 90°/--

BORE No: BH34
PROJECT No: 99679.00
DATE: 15/5/2020
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
		FILL/Silty SAND: fine to medium, brown, trace gravel (igneous) and roots, dry		E*	0.0		PID = <1 ppm		
					0.2				
	0.3	FILL/Sandy GRAVEL: fine, dark grey and brown, trace roots, dry		E	0.3		PID = <1 ppm		
9					0.5				
	0.7	SAND SP: fine to medium, pale grey, moist, medium dense, aeolian		S/E			9,5,7 N = 12 PID = 1 ppm		
	1			E	0.95		PID = <1 ppm		1
					1.1				
10				E	1.4		PID = 1 ppm		
					1.5				
		Below 1.7m: mottled brown and orange		S/E			7,10,12 N = 22 PID = 1 ppm		
	1.95	Bore discontinued at 1.95m Target depth reached			1.95				
	2								2
11									
	3								3
12									
	4								4
13									
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** JH **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m, SPT to 1.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD2/20200515 taken at 0-0.2m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.6 AHD
EASTING: 333994
NORTHING: 6243080
DIP/AZIMUTH: 90°/--

BORE No: BH35
PROJECT No: 99679.00
DATE: 18/5/2020
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
8	0.0	FILL/Silty SAND: fine to coarse, dark brown, with clay, bark, roots and rootlets, trace fine gravel (sandstone), tile and geofabric, moist		E	0.0 0.1		PID = 2 ppm		
				E	0.4 0.5		PID = 3 ppm		
				S/E			12,12,12 N = 24 PID = 2 ppm		
				E	0.9 0.95		PID = 2 ppm		
9	1.0	SAND SP: fine to medium, pale grey and dark grey, moist, loose to medium dense, aeolian Below 1.2m: grading to orange and brown to red-brown			1.0				
				E	1.4		PID = 2 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 9 AHD
EASTING: 334017
NORTHING: 6243058
DIP/AZIMUTH: 90°/--

BORE No: BH36
PROJECT No: 99679.00
DATE: 18/5/2020
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
9	0	FILL/Silty SAND: fine to coarse, pale yellow and dark brown, with roots and rootlets, trace gravel (asphaltic) and bark, moist		E	0.0		PID = 5 ppm		
					0.3				
				E*	0.4		PID = 2 ppm		
		At 0.5m: fly ash, concrete and fine to medium gravel (asphaltic)			0.5				
				S/E			11,10,9 N = 19 PID = 1 ppm		
10	1			E	0.9 0.95		PID = 4 ppm		1
					1.0				
				E	1.4		PID = 2 ppm		
		Below 1.5m: with fine to coarse gravel (sandstone) and clay			1.5				
				S/E			2,3,5 N = 8 PID = 1 ppm		
11	2			E	1.9 1.95		PID = 2 ppm		2
					2.0				
	2.4	SAND SP: fine to medium, orange-brown and grey, moist, loose to medium dense, aeolian		E	2.4		PID = 1 ppm		
		At 2.5m: tree root encountered			2.5				
				S			SPT = refusal on tree root		
		Below 2.9m: wet		E	2.9 2.95		PID = 2 ppm	18-05-20	
12	3	3.0 Bore discontinued at 3.0m Target depth reached			3.0				3
13	4								4
14	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 3m

WATER OBSERVATIONS: Free groundwater observed at 2.9m

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD4/20200518 taken at 0.4-0.5m. Unable to conduct SPT at 2.5-2.95m due to refusal on tree root.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8 AHD
EASTING: 334043
NORTHING: 6243072
DIP/AZIMUTH: 90°/--

BORE No: BH37
PROJECT No: 99679.00
DATE: 15/5/2020
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
8		FILL/Silty SAND: fine to medium, brown, trace concrete and rootlets, moist		E	0.0		PID = 2 ppm		
					0.2				
				E	0.3		PID = <1 ppm		
					0.5				
				S/E			6,5,6 N = 11 PID = <1 ppm		
	0.8								
9	1	SAND SP: fine to medium, pale grey, moist, loose to medium dense, aeolian		E	0.95		PID = <1 ppm		1
					1.1				
		Below 1.5m: grading to mottled brown and orange			1.5				
				S/E			4,5,5 N = 10 PID = <1 ppm		
		Below 1.8m: grading to pale yellow, moist							
10	1.95				1.95				
	2	Bore discontinued at 1.95m Target depth reached							2
11	3								3
12	4								4
13	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** JH **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.5m, SPT to 1.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 7.7 AHD
EASTING: 333999
NORTHING: 6243086
DIP/AZIMUTH: 90°/--

BORE No: BH38
PROJECT No: 99679.00
DATE: 18/5/2020
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
8	0.0	FILL/Silty SAND: fine to coarse, dark brown, with clay, roots and rootlets, trace fine gravel (sandstone) and bark, moist		E	0.0–0.1		PID = 1 ppm		
				E	0.4–0.5		PID = 2 ppm		
				S/E			7,11,23 N = 34 PID = 2 ppm		
		At 0.8m: ~50mm diameter timber particle board with PVC outer shell		E	0.9–1.0		PID = 2 ppm		
9	1.3	SAND SP: fine to medium, pale grey, orange and brown to red-brown, moist, loose, aeolian		E	1.4–1.5		PID = 2 ppm		
				S/E			5,4,5 N = 9 PID = 2 ppm		
		Below 1.9m: wet		E	1.9–2.0		PID = 2 ppm	18-05-20	
10	2.0	Bore discontinued at 2.0m Target depth reached							
11									
12									

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.9m

WATER OBSERVATIONS: Free groundwater observed at 1.9m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.8 AHD
EASTING: 334024
NORTHING: 6243067
DIP/AZIMUTH: 90°/--

BORE No: BH39
PROJECT No: 99679.00
DATE: 18/5/2020
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
9	0	FILL/Silty SAND: fine to coarse, dark brown, trace medium gravel (asphaltic), roots and rootlets, moist		E*	0.0		PID = 1 ppm		
					0.3				
				E	0.4		PID = 1 ppm		
					0.5				
		At 0.6m: trace concrete		S/E			5,5,10 N = 15 PID = 1 ppm		
				E	0.9		PID = 1 ppm		
10	1				0.95				1
					1.0				
		Below 1.4m: with fine to medium gravel (asphaltic) and fine gravel (sandstone), trace clay		E	1.4		PID = 1 ppm		
					1.5				
				S/E			4,5,5 N = 10 PID = 1 ppm		
	1.95			E	1.9		PID = 1 ppm		
11	2	SAND SP: fine to medium, pale grey, dark grey and dark brown, moist, medium dense, aeolian			1.95				2
					2.0				
		Below 2.4m: with orange		E	2.4		PID = 1 ppm		
					2.5				
				S/E			6,6,6 N = 12 PID = 1 ppm		
	2.95	Below 2.9m: grading to pale yellow to yellow, wet			2.95			▼	
12	3	Bore discontinued at 2.95m Target depth reached						18-05-20	3
13	4								4
	5								5

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger (TC-bit) to 1.9m, SPT to 2.95m

WATER OBSERVATIONS: Free groundwater observed at 2.9m

REMARKS: Location coordinates are in MGA94 Zone 56. * Field replicate BD5/20200518 taken at 0-0.3m.

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: CO-OP Studio Pty Ltd
PROJECT: Botany Aquatic Centre
LOCATION: 2 Myrtle Street, Botany

SURFACE LEVEL: 8.2 AHD
EASTING: 333905
NORTHING: 6243098
DIP/AZIMUTH: 90°/--

BORE No: BH40
PROJECT No: 99679.00
DATE: 19/5/2020
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
9	0.0	FILL/Silty SAND: fine to medium, dark brown, with clay, roots and rootlets, moist		E	0.0 0.1		PID = 1 ppm		
		Below 0.5m: grading to dark red-brown, brown and orange		E	0.4 0.5		PID = 1 ppm		
				S/E			2,1,1 N = 2 PID = 1 ppm		
				E	0.9 0.95 1.0		PID = 1 ppm		
		At 1m: scrap cable encountered Below 1m: with fine to medium gravel (asphaltic)							
				E	1.4 1.5		PID = 2 ppm		
10				S/E			5,5,4 N = 9 PID = 2 ppm		
	1.9	SAND SP: fine to medium, pale grey and dark grey, moist, loose, aeolian		E	1.9 1.95 2.0		PID = 1 ppm		
		Below 2.3m: grading to dark red-brown and orange Below 2.4m: wet		E	2.4		PID = 1 ppm	▼ 19-05-20	
	2.5	Bore discontinued at 2.5m Target depth reached			2.5				

RIG: Scout 1 **DRILLER:** Ground Test **LOGGED:** AMS **CASING:** Uncased

TYPE OF BORING: Hand Auger to 0.5m, Solid Flight Auger (TC-bit) to 2.5m

WATER OBSERVATIONS: Free groundwater observed at 2.4m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: Botany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

REDUCED LEVEL: 7.2

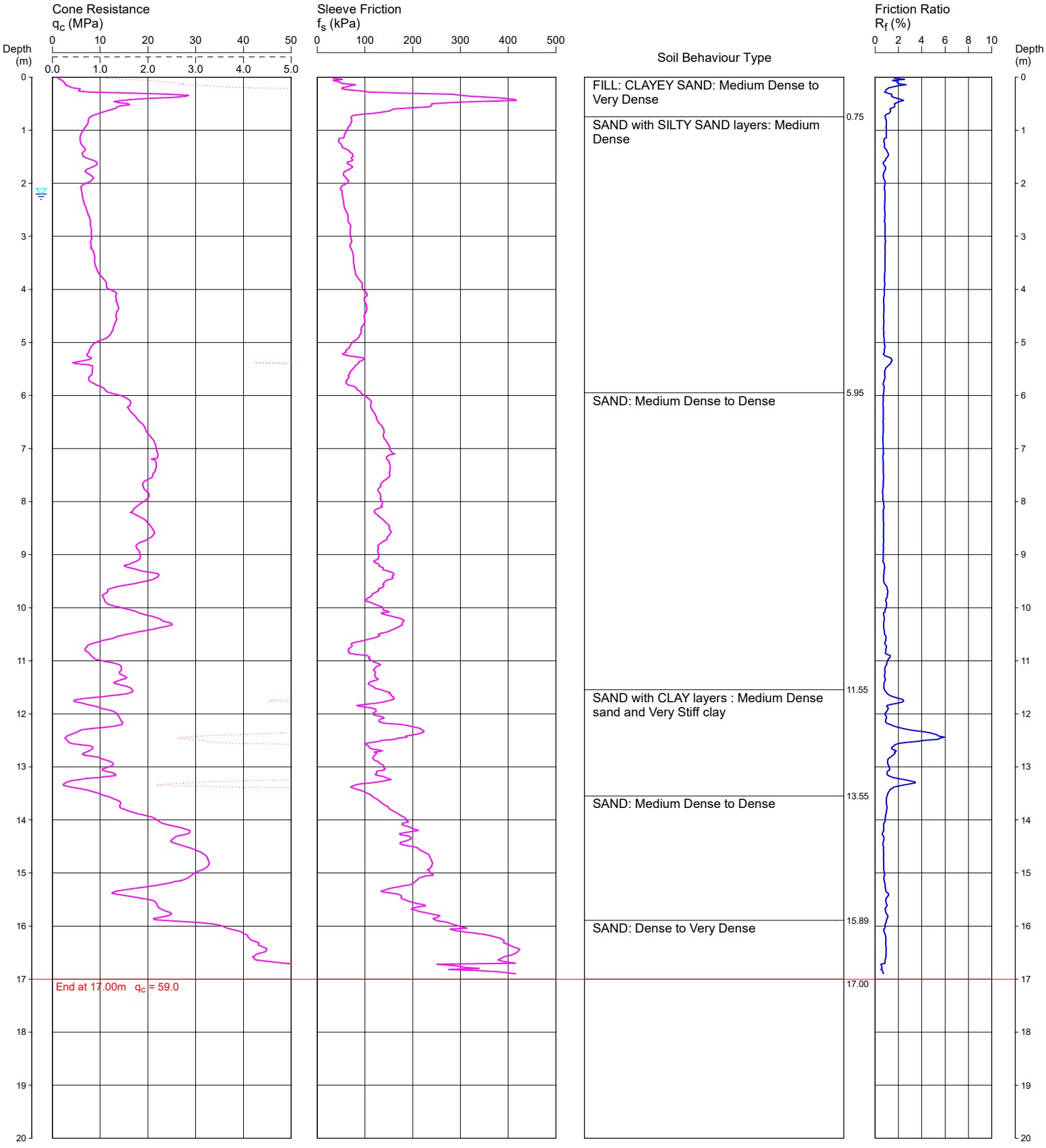
COORDINATES: 333823E 6243123N MGA

CPT1

Page 1 of 1

DATE 12/05/2020

PROJECT No: 99679.00



REMARKS: TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 2.20 m AFTER REMOVAL OF RODS

Water depth after test: 2.20m depth (measured)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT1.CP5

Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: Botany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

REDUCED LEVEL: 7.3

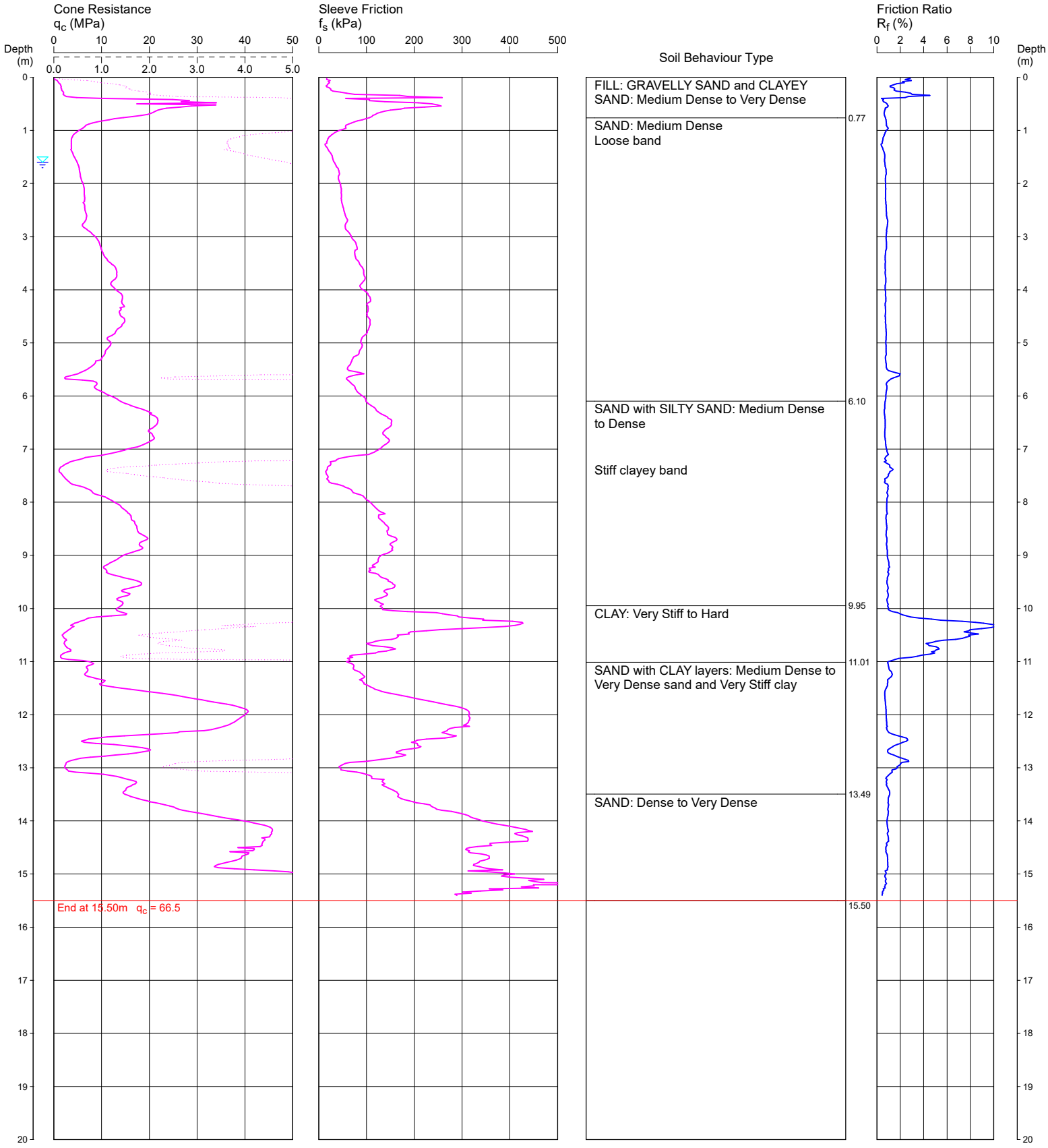
COORDINATES: 333930E 6243124N MGA

CPT2

Page 1 of 1

DATE 12/05/2020

PROJECT No: 99679.00



REMARKS: HOLE PRE-DRILLED TO 0.40 m
TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 1.60 m AFTER REMOVAL OF RODS

Water depth after test: 1.60m depth (measured)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT2.CP5

Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: Botany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

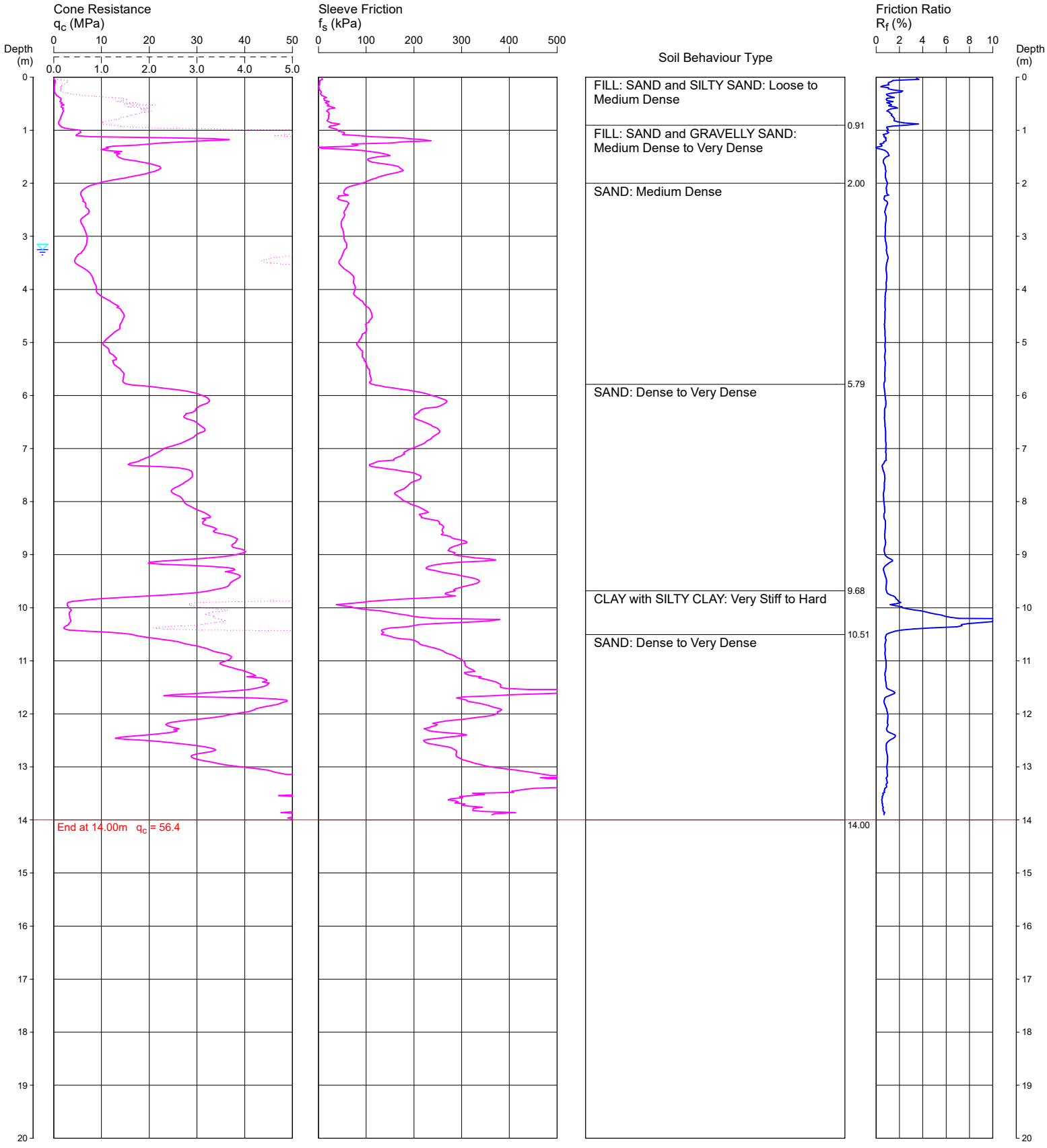
REDUCED LEVEL: 8.4

COORDINATES: 333874E 6243052N MGA

CPT3

DATE 12/05/2020

PROJECT No: 99679.00



REMARKS: HOLE PRE-DRILLED TO 0.40 m
TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 3.25 m AFTER REMOVAL OF RODS

Water depth after test: 3.25m depth (measured)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT3.CP5

Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: BBotany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

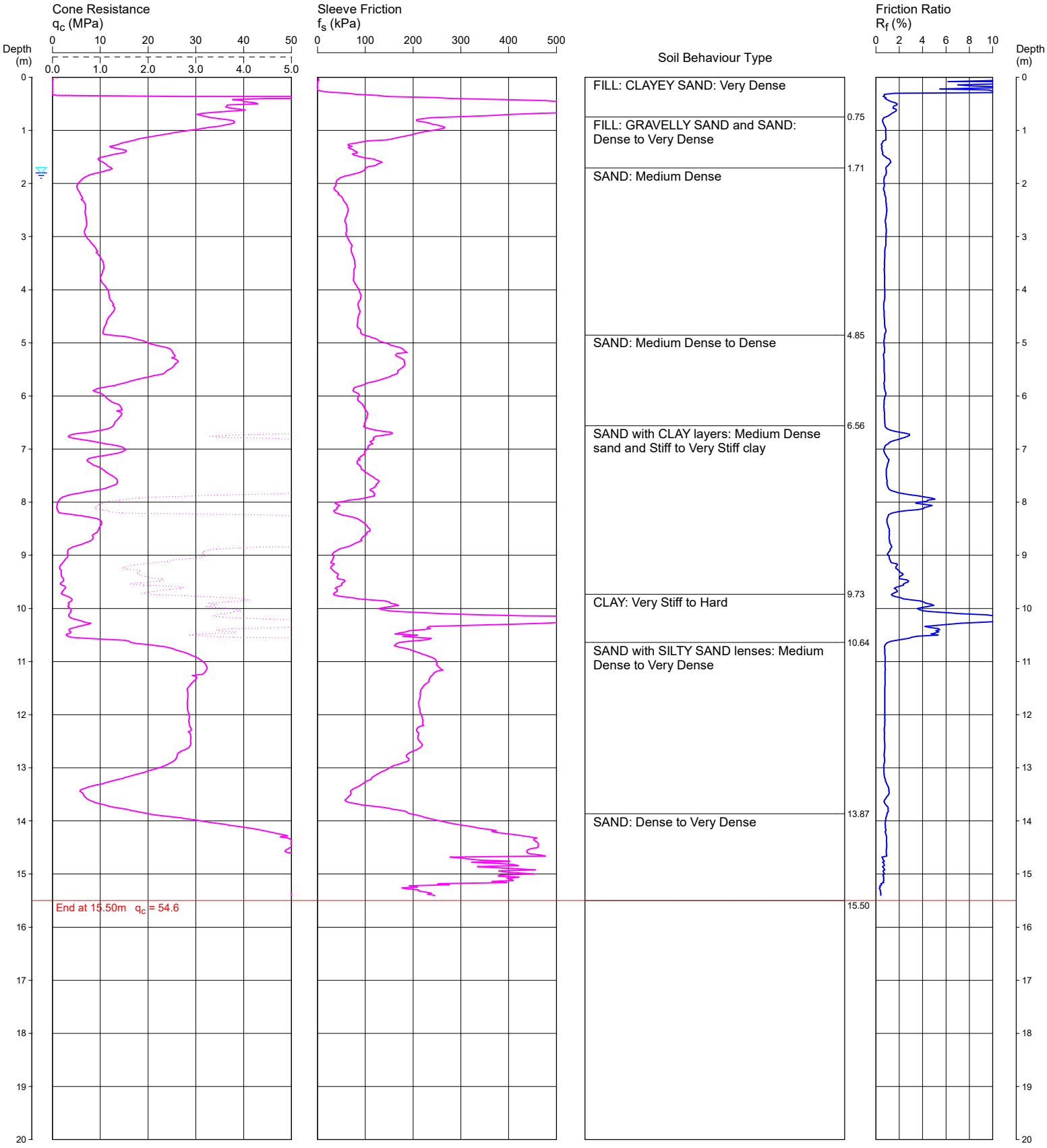
REDUCED LEVEL: 7.5

COORDINATES: 333936E 6243090N MGA

CPT4

DATE 12/05/2020

PROJECT No: 99679



REMARKS: HOLE PRE-DRILLED TO 0.30 m
TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 3.25 m AFTER REMOVAL OF RODS

Water depth after test: 1.80m depth (measured)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT4.CP5

Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: Botany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

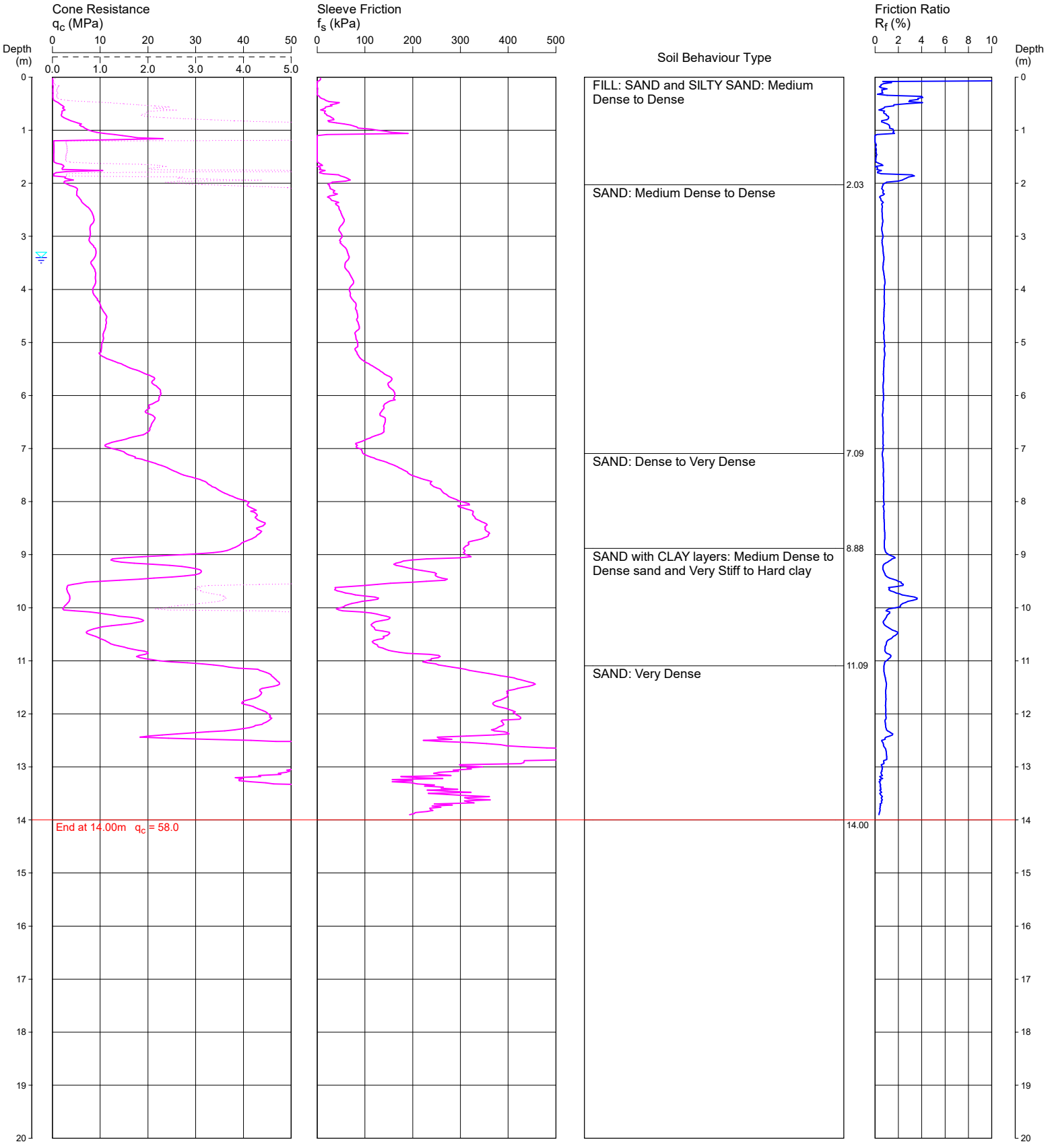
REDUCED LEVEL: 8.4

COORDINATES: 333883E 6243021N MGA

CPT5

DATE 12/05/2020

PROJECT No: 99679.00



REMARKS: HOLE PRE-DRILLED TO 0.50 m, DUMMY CONE USED FROM 1.16 m TO 1.80 m TO PENETRATE FILL
TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 3.40 m AFTER REMOVAL OF RODS

Water depth after test: 3.40m depth (assumed)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT5.CP5

Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CO-OP Studio Pty Ltd

PROJECT: Botany Aquatic Centre

LOCATION: 2 Myrtle Street, Botany

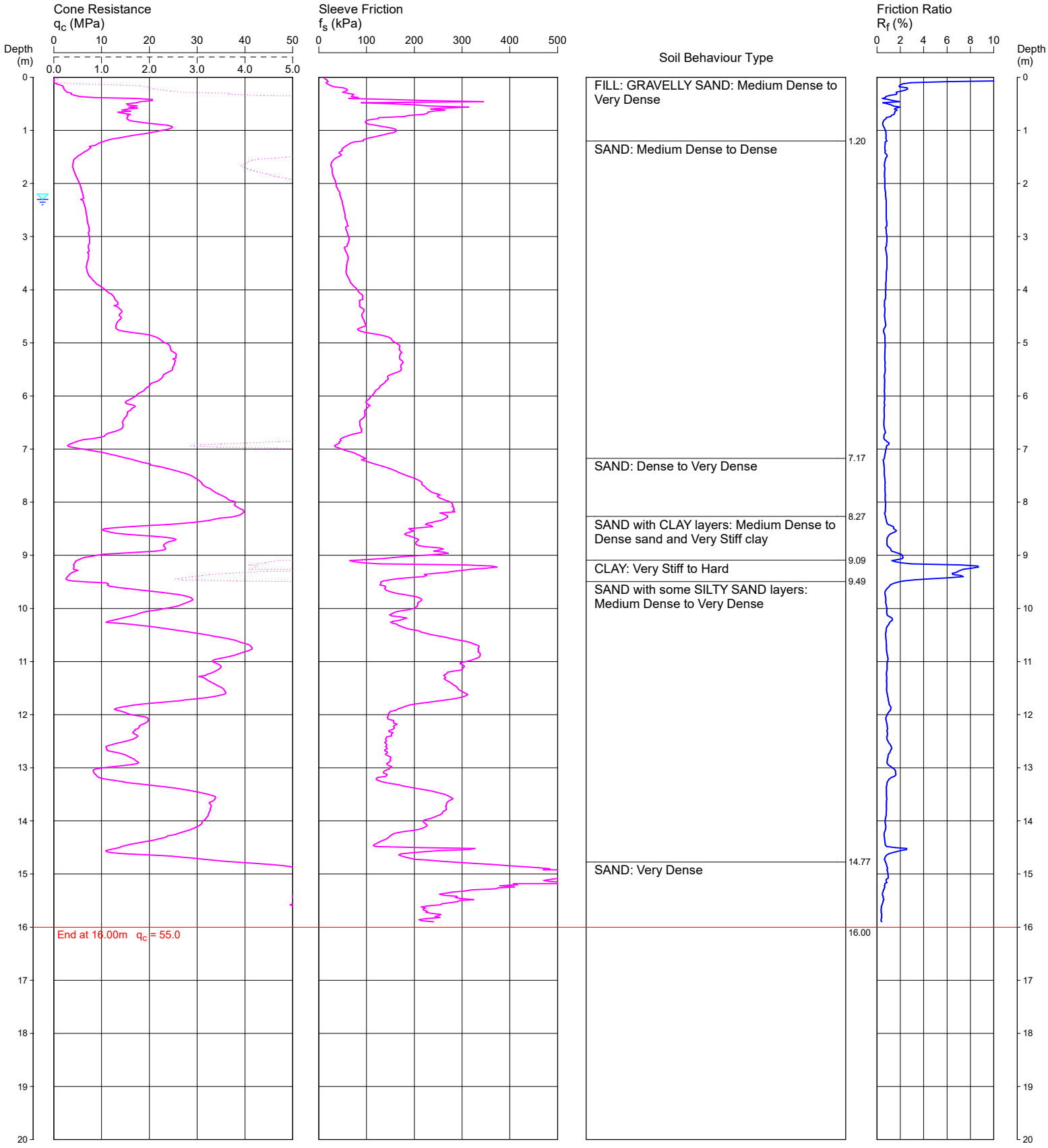
REDUCED LEVEL: 7.6

COORDINATES: 333946E 6243041N MGA

CPT6

DATE 12/05/2020

PROJECT No: 99679.00



REMARKS: HOLE PRE-DRILLED TO 0.50 m
TEST TERMINATED DUE TO CONE TIP REFUSAL
GROUNDWATER MEASURED AT 2.30 m AFTER REMOVAL OF RODS

Water depth after test: 2.30m depth (measured)

File: \\DPSYDNAS01\Projects\99679.00 - BOTANY, corner Myrtle St and Jasmine St\4.0 Field Work\4.2 Testing\CPT 12.05.2020\interpreted\CPT6.CP5
Cone ID: 170707 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
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Appendix D

Laboratory Test Results

Material Test Report

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

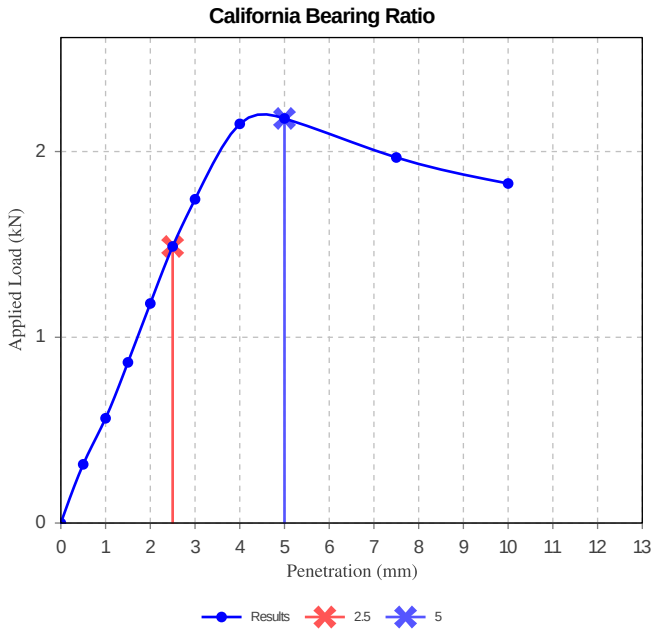
Accredited for compliance with ISO/IEC 17025 - Testing

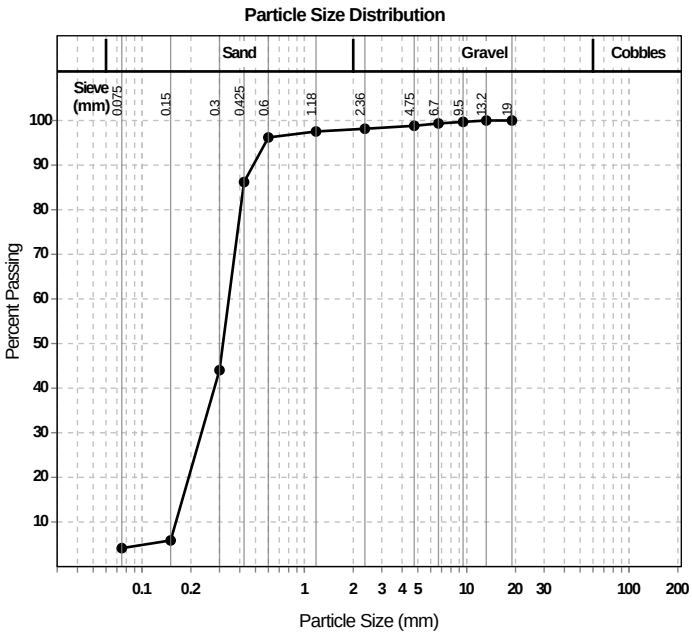
Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100A
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 25/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH9 (0.6-1.35m)**
Material: SAND(SP): fine to medium grained, pale grey, brown & dark brown ,with a trace of silt, moist, loose, alluvial

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.74		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.74		
Field Moisture Content (%)	13.5		
Moisture Content at Placement (%)	13.7		
Moisture Content Top 30mm (%)	17.9		
Moisture Content Rest of Sample (%)	17.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2.4		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**99**		
4.75 mm	**99**		
2.36 mm	**98**		
1.18 mm	**98**		
0.6 mm	**96**		
0.425 mm	**86**		
0.3 mm	**44**		
0.15 mm	**6**		
0.075 mm	**4**		





Material Test Report

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

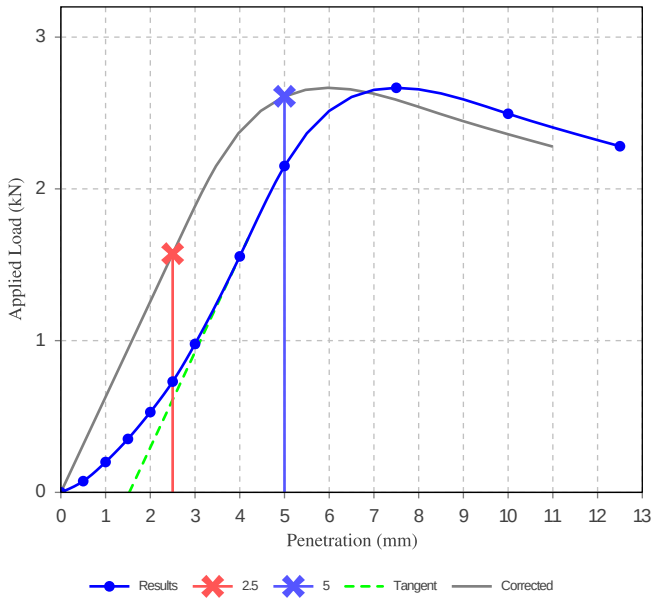
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100B
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 25/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH11 (0.7-1.35m)**
Material: SAND(SP): fine to medium grained, pale grey and brown to dark brown, with a trace of silt, moist, medium dense, alluvial

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**13**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.75		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.75		
Field Moisture Content (%)	14.4		
Moisture Content at Placement (%)	14.6		
Moisture Content Top 30mm (%)	17.6		
Moisture Content Rest of Sample (%)	16.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2		
Swell (%)	-1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**99**		
4.75 mm	**99**		
2.36 mm	**99**		
1.18 mm	**99**		
0.6 mm	**98**		
0.425 mm	**87**		
0.3 mm	**47**		
0.15 mm	**7**		
0.075 mm	**4**		

Material Test Report

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

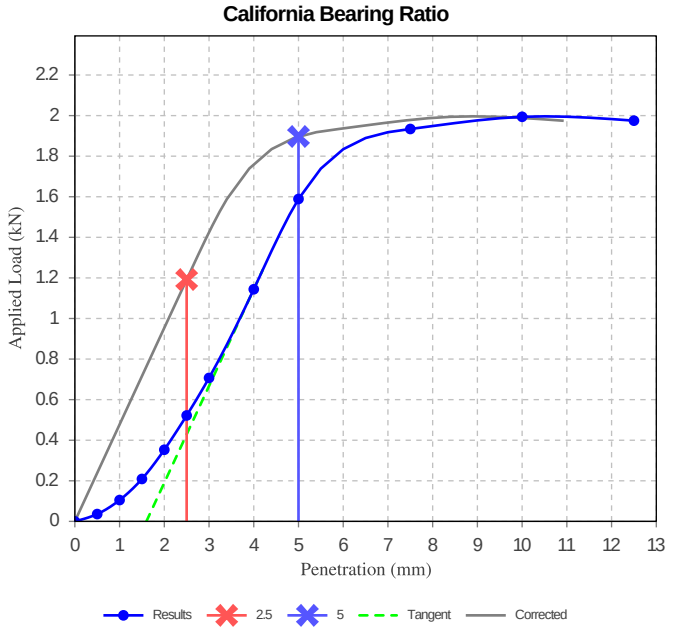
Accredited for compliance with ISO/IEC 17025 - Testing

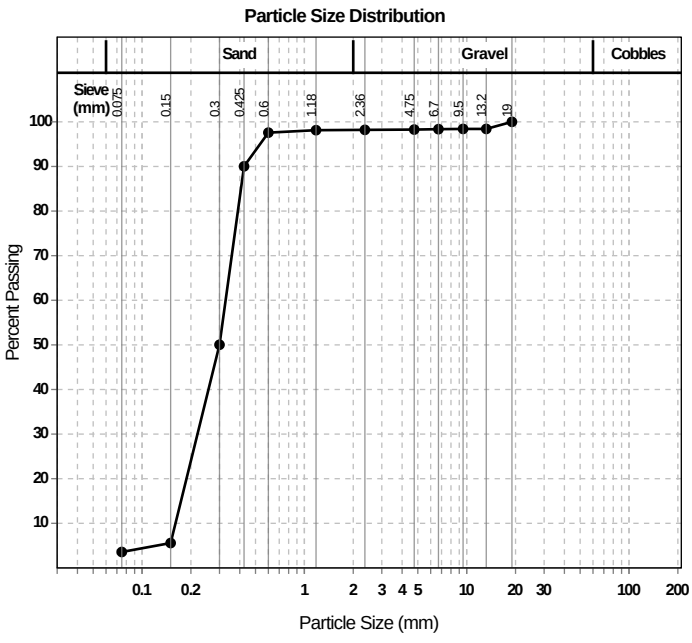
Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100C
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 25/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH12 (0.75-1.5m)**
Material: SAND(SP): fine to medium grained, pale grey and brown and dark brown, with trace silt, moist, loose to medium dense, alluvial

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.72		
Field Moisture Content (%)	7.4		
Moisture Content at Placement (%)	11.6		
Moisture Content Top 30mm (%)	18.9		
Moisture Content Rest of Sample (%)	19.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2.8		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**98**		
9.5 mm	**98**		
6.7 mm	**98**		
4.75 mm	**98**		
2.36 mm	**98**		
1.18 mm	**98**		
0.6 mm	**98**		
0.425 mm	**90**		
0.3 mm	**50**		
0.15 mm	**6**		
0.075 mm	**4**		





Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
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Phone: (02) 9809 0666
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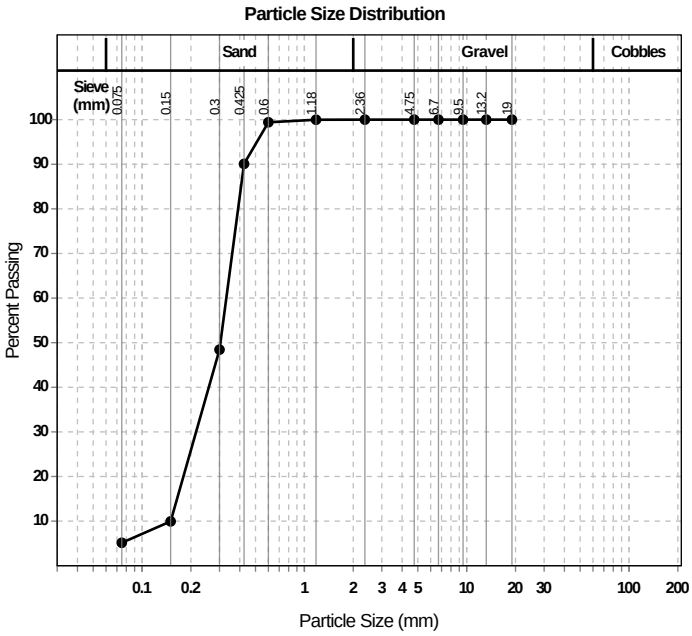
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100D
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 14/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH6 (1.9-2.0m)**
Material: SAND(SP): fine to medium grained, pale grey and brown, with a trace of silt, medium dense, moist, alluvial

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**100**		
0.6 mm	**99**		
0.425 mm	**90**		
0.3 mm	**48**		
0.15 mm	**10**		
0.075 mm	**5**		



Material Test Report

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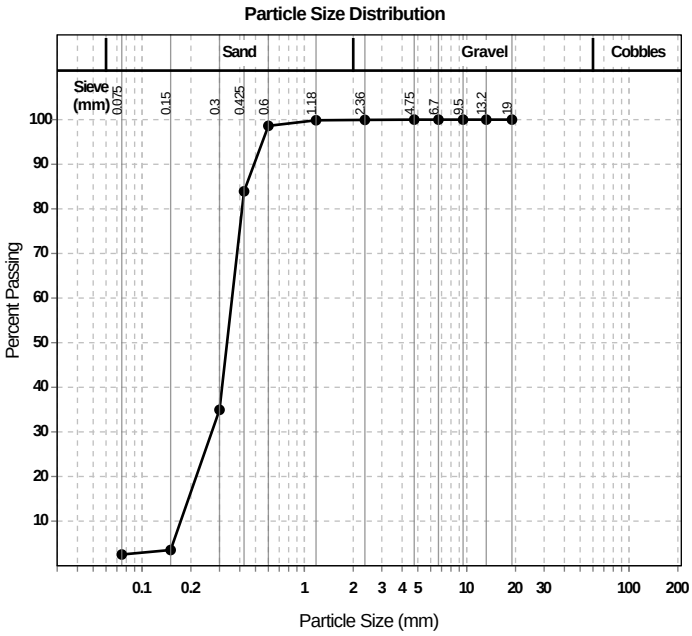
NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100E
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 14/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH10 (0.9-1.0m)**
Material: SAND(SP): fine to medium grained, pale brown, with trace silt, moist, loose to medium dense, aeolian

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**100**		
0.6 mm	**99**		
0.425 mm	**84**		
0.3 mm	**35**		
0.15 mm	**4**		
0.075 mm	**3**		



Material Test Report

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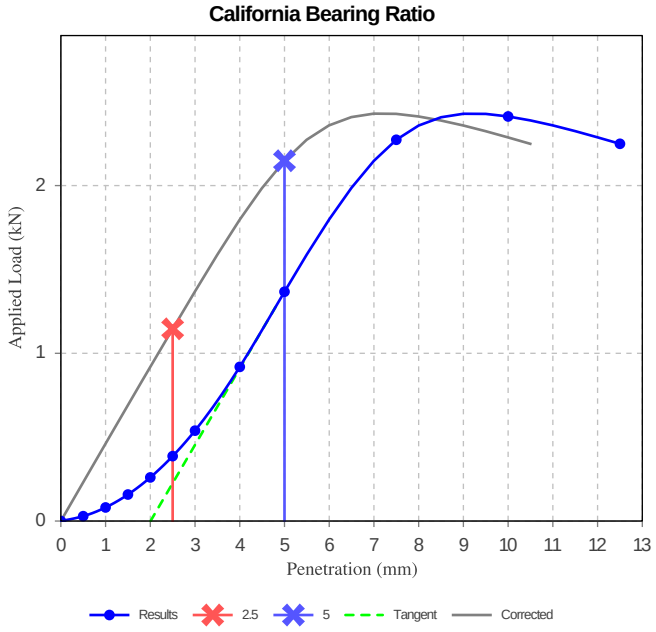
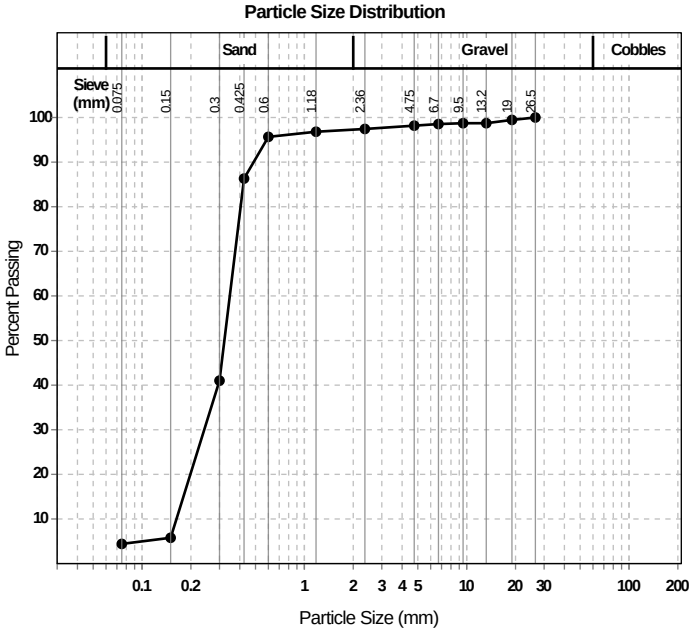
Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **99679.00-1**
Issue Number: 1
Date Issued: 28/05/2020
Client: CO-OP STUDIO PTY LTD
Level 7, 657 Pacific Highway, St Leonards NSW 2000
Contact: Steven Donaghey
Project Number: 99679.00
Project Name: Botany Aquatic Centre
Project Location: corner Myrtle St and Jasmine St, Botany
Work Request: 6100
Sample Number: SY-6100F
Date Sampled: 11/05/2020
Dates Tested: 14/05/2020 - 25/05/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH3 (0.6-1.1m)**
Material: SAND(SP): fine to medium grained, pale brown, with trace gravel and silt

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.76		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.75		
Field Moisture Content (%)	3.0		
Moisture Content at Placement (%)	13.9		
Moisture Content Top 30mm (%)	16.3		
Moisture Content Rest of Sample (%)	16.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	20		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.5		

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**99**		
13.2 mm	**99**		
9.5 mm	**99**		
6.7 mm	**99**		
4.75 mm	**98**		
2.36 mm	**97**		
1.18 mm	**97**		
0.6 mm	**96**		
0.425 mm	**86**		
0.3 mm	**41**		
0.15 mm	**6**		
0.075 mm	**4**		





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CERTIFICATE OF ANALYSIS 242711

Client Details

Client	Douglas Partners Pty Ltd
Attention	Wen-Fei Yuan
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**99679.01, Botany**
Number of Samples	11 SOIL
Date samples received	12/05/2020
Date completed instructions received	12/05/2020

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	19/05/2020
Date of Issue	18/05/2020

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lucy Zhu
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Diego Bigolin, Team Leader, Inorganics
Jaimie Loa-Kum-Cheung, Metals Supervisor
Josh Williams, Senior Chemist
Lucy Zhu, Asbestos Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Moisture					
Our Reference		242711-1	242711-5	242711-6	242711-9
Your Reference	UNITS	BH1/0.45-0.5	BH2/0.4-0.5	BH2/1.1-1.4	BH3/0.9-1.0
Depth		0.45-0.5	0.4-0.5	1.1-1.4	0.9-1.0
Date Sampled		08/05/2020	08/05/2020	08/05/2020	08/05/2020
Type of sample		SOIL	SOIL	SOIL	SOIL
Date prepared	-	13/05/2020	13/05/2020	13/05/2020	13/05/2020
Date analysed	-	14/05/2020	14/05/2020	14/05/2020	14/05/2020
Moisture	%	18	9.6	4.8	3.8

Soil Aggressivity			
Our Reference		242711-4	242711-10
Your Reference	UNITS	BH1/2.5-2.95	BH3/1.9-2.0
Depth		2.5-2.95	1.9-2.0
Date Sampled		08/05/2020	08/05/2020
Type of sample		SOIL	SOIL
pH 1:5 soil:water	pH Units	7.2	4.9
Electrical Conductivity 1:5 soil:water	µS/cm	37	100
Chloride, Cl 1:5 soil:water	mg/kg	28	24
Sulphate, SO4 1:5 soil:water	mg/kg	30	90

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.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

Method ID	Methodology Summary
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-022	Determination of VOCs sampled onto coconut shell charcoal sorbent tubes, that can be desorbed using carbon disulphide, and analysed by GC-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS.
Org-022/025	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-MS/GC-MSMS. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	4	7.2	7.2	0	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	4	37	39	5	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	4	28	20	33	98	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	4	30	27	11	103	[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

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CERTIFICATE OF ANALYSIS 242857

Client Details

Client	Douglas Partners Pty Ltd
Attention	Ayla Sorensen, Wen-Fei Yuan
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**99679.01, Botany**
Number of Samples	27 Soil
Date samples received	13/05/2020
Date completed instructions received	13/05/2020

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	20/05/2020
Date of Issue	20/05/2020

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Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
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Dragana Tomas, Senior Chemist
Hannah Nguyen, Senior Chemist
Josh Williams, Senior Chemist
Lucy Zhu, Asbestos Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		242857-1	242857-3	242857-6	242857-10	242857-11
Your Reference	UNITS	BH4/0.9-1	BH5/0.5-0.6	BH7/0.9-1	BD2/110520	BH8/0.9-1.0
Date Sampled		11/05/2020	11/05/2020	11/05/2020	11/05/2020	11/05/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/05/2020	18/05/2020	18/05/2020	18/05/2020	18/05/2020
Date analysed	-	18/05/2020	18/05/2020	18/05/2020	18/05/2020	18/05/2020
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	17	1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	122	113	125	112	121

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		242857-14	242857-15	242857-19	242857-20	242857-22
Your Reference	UNITS	BH10/0.4-0.5	BD1/110520	BH11/0.9-1.0 (light colour)	BH11/1-1.3	TS
Date Sampled		11/05/2020	11/05/2020	11/05/2020	11/05/2020	11/05/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/05/2020	18/05/2020	18/05/2020	18/05/2020	18/05/2020
Date analysed	-	18/05/2020	18/05/2020	18/05/2020	18/05/2020	18/05/2020
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	[NA]
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	108%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	110%
Ethylbenzene	mg/kg	<1	<1	<1	<1	109%
m+p-xylene	mg/kg	<2	<2	<2	<2	108%
o-Xylene	mg/kg	<1	<1	<1	<1	106%
naphthalene	mg/kg	<1	2	<1	<1	[NA]
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	[NA]
Surrogate aaa-Trifluorotoluene	%	118	105	122	122	109

vTRH(C6-C10)/BTEXN in Soil		
Our Reference		242857-23
Your Reference	UNITS	TB
Date Sampled		11/05/2020
Type of sample		Soil
Date extracted	-	18/05/2020
Date analysed	-	18/05/2020
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Total +ve Xylenes	mg/kg	<3
Surrogate aaa-Trifluorotoluene	%	134

Soil Aggressivity						
Our Reference		242857-1	242857-6	242857-8	242857-12	242857-16
Your Reference	UNITS	BH4/0.9-1	BH7/0.9-1	BH7/2.5-2.95	BH8/2.5-2.95	BH10/0.9-1.0
Date Sampled		11/05/2020	11/05/2020	11/05/2020	11/05/2020	11/05/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
pH 1:5 soil:water	pH Units	6.6	9.3	7.2	7.6	6.8
Electrical Conductivity 1:5 soil:water	µS/cm	[NA]	[NA]	16	35	11
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	<10	<10	<10

Soil Aggressivity		
Our Reference		242857-17
Your Reference	UNITS	BH10/1-1.45
Date Sampled		11/05/2020
Type of sample		Soil
pH 1:5 soil:water	pH Units	6.7

Soil Aggressivity		
Our Reference		242991-10
Your Reference	UNITS	BH12
Depth		3.5-3.95
Date Sampled		12/05/2020
Type of sample		Soil
pH 1:5 soil:water	pH Units	6.7
Electrical Conductivity 1:5 soil:water	µS/cm	10
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10