Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Groundwater Modelling and Dewatering Management Plan

Doncaster Avenue Student Accommodation
4-18 Doncaster Avenue, Kensington

Prepared for
Blue Sky Private Real Estate Pty Ltd

Project 73965.06
October 2019

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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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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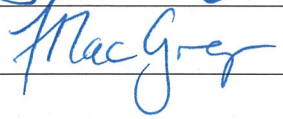
Reviewer		4/10/2019

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1. Introduction

The revised groundwater modelling and dewatering management plan (DMP) has been prepared by Douglas Partners Pty Ltd (DP) for a Doncaster Avenue student accommodation development at 4-18 Doncaster Avenue, Kensington. The groundwater modelling and the development of the DMP was commissioned by Mr Matt Hynes of Blue Sky Private Real Estate Pty Ltd and was undertaken in accordance with Douglas Partners' proposal SYD190541 dated 29 May 2019.

The proposed development includes the construction of three storey residential buildings with a common single level basement carpark that will require excavation to depths of approximately 3-4 m below existing ground level. The existing semi-detached houses on the central part of the site (No. 10-12 Doncaster Avenue) will be retained and refurbished. Site excavation and basement construction works will require dewatering in the short term and the basement will be tanked in the long term.

This report follows on from the original groundwater modelling carried out by DP (Ref: 73965.06.R.001.Rev0, dated 25 June 2019 and reflects the recent changes to the architectural design of the basement (i.e. enlargement of the basement footprint).

This DMP is based on previous work carried out by DP (refer Section 2) and is understood to accompany an “Application for a Groundwater Licence” to WaterNSW.

2. Previous Work

The information used to develop the conceptual groundwater model was obtained from the following previous investigations undertaken at the subject site:

- Douglas Partners Pty Ltd (2014), Report on Geotechnical Investigation, Proposed Residential Development, 4-12 Doncaster Avenue, Randwick, Project 73965;
- Douglas Partners Pty Ltd (2015), Report on Supplementary Geotechnical Investigation, Proposed Residential Development, 4-18 Doncaster Avenue, Kensington, Project 73965.02;
- Douglas Partners Pty Ltd (2017), Dewatering Management Plan, Proposed Residential Development, 4-18 Doncaster Avenue, Kensington, Project 73965.03.

3. Site Description

The site is a rectangular-shaped area of about 4,200 m^2 with a western frontage to Doncaster Avenue. At the time of preparing this report, most of the structures had been demolished with two storey brick heritage building retained on the central part of the site.

Existing ground surface levels on the site fall slightly to the south from approximately RL28.7 m to RL27.9 m, relative to Australian Height Datum (AHD).

On the properties to the south and east of the site, there were single storey brick houses and a tram yard with acoustic walls.

The property to the north of the site was vacant and covered with grass and a bitumen paved access road and car parking area. A substation (kiosk) was located near the north-western corner of the site and plans obtained from "Dial Before You Dig" indicate that electrical services run parallel to the northern boundary.

4. Recent Field Work

In order to supplement the previous groundwater investigation and testing, DP carried out additional groundwater level measurement, groundwater sampling and water quality testing in the installed groundwater monitoring wells (BH201 – BH203). The locations of these boreholes as well as previous cone penetration tests are shown in Drawing 1 in Appendix B. The descriptions of the soil strata encountered whilst drilling these three boreholes are given on the respective sheets in Appendix C.

The water samples obtained from the site were tested in a NATA accredited laboratory for a range of common contaminants.

5. Geotechnical & Hydrogeological Model

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. Bedrock comprising Hawkesbury Sandstone would be expected at significant depth. The field work confirmed the presence of sands to the investigation depths of 20 m.

A geotechnical cross section (Section A-A') showing the interpreted subsurface profile between the test locations is shown on Drawing 2 in Appendix B. The section shows interpreted geotechnical divisions of underlying soil together with the extent of the proposed basement. The descriptions shown on the cross section are generalised due to the variability in both material type and strength and should be used as an approximate guide only. Reference should be made to the CPT and bore results for more detailed information and descriptions of the soil profile.

5.1 Groundwater Levels

The groundwater levels observed during previous investigations and recently measured by DP are shown in Tables 1 and 2. There appears to be slight groundwater gradient of approximately 1% in a southerly direction.

Table 1: Summary of Groundwater Levels from CPTs (RL, m AHD)

Date	Groundwater Levels (RL, m AHD)					
	CPT101 (well)	CPT102	CPT1 (well)	CPT2	CPT3 (well)	CPT4 (well)
13 May 2014	-	-	26.3	26.4	26.5	26.6
6 June 2014 (wet weather)	-	-	26.5	26.5	26.6	26.7
9 December 2015	25.1	25.6	-	-	-	-

Table 2: Summary of Groundwater Levels from Boreholes (RL, m AHD)

Date	Groundwater Levels (RL, m AHD)		
	BH201	BH202	BH203
22 February 2017	26.1	26.1	26.4
25 March 2017	26.15	26.3	26.8
19 June 2019	26.0	26.1	26.8

A graphical summary of the monitoring data between February 2017 and March 2017 from data-loggers installed within two of the boreholes are shown in Figures 1 and 2. Daily rainfall information recorded by the Bureau of Meteorology at Randwick Street is also included on the graphs. It should be noted that the daily rainfall totals are reported as rainfall in the 24 hours to 9am.

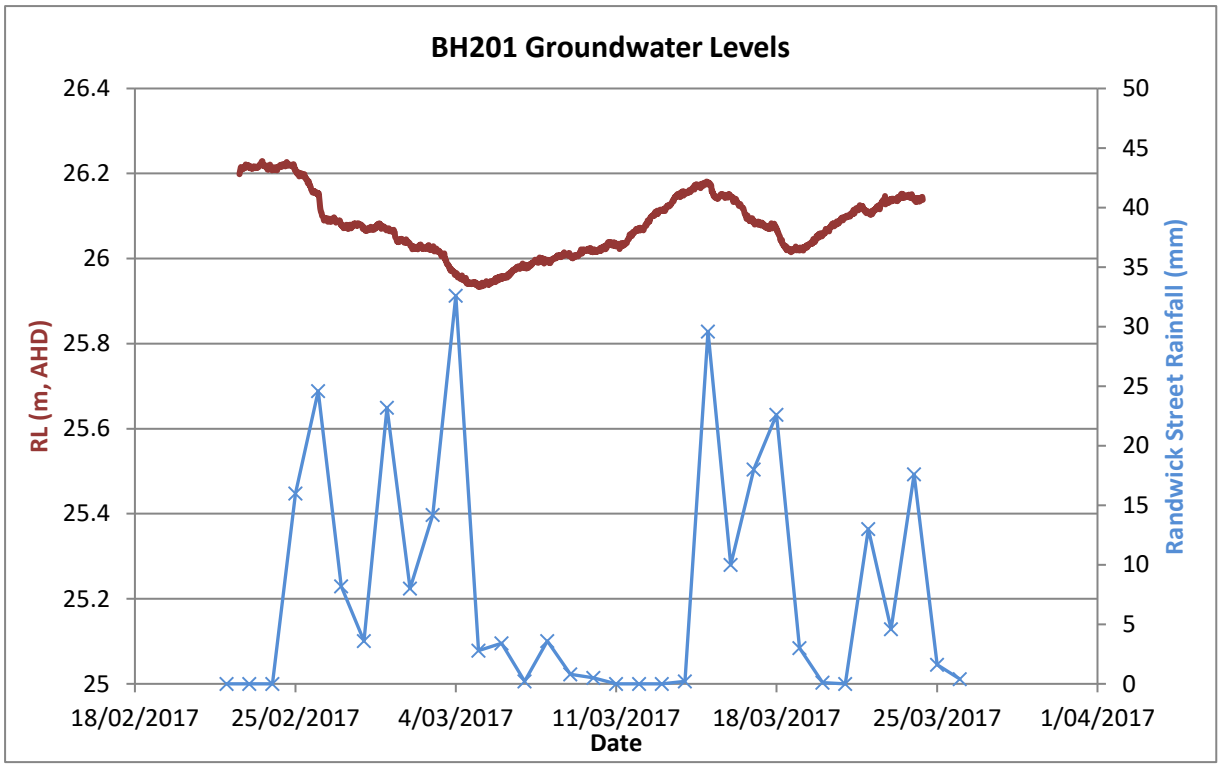


Figure 1: Results of Groundwater Monitoring at BH201

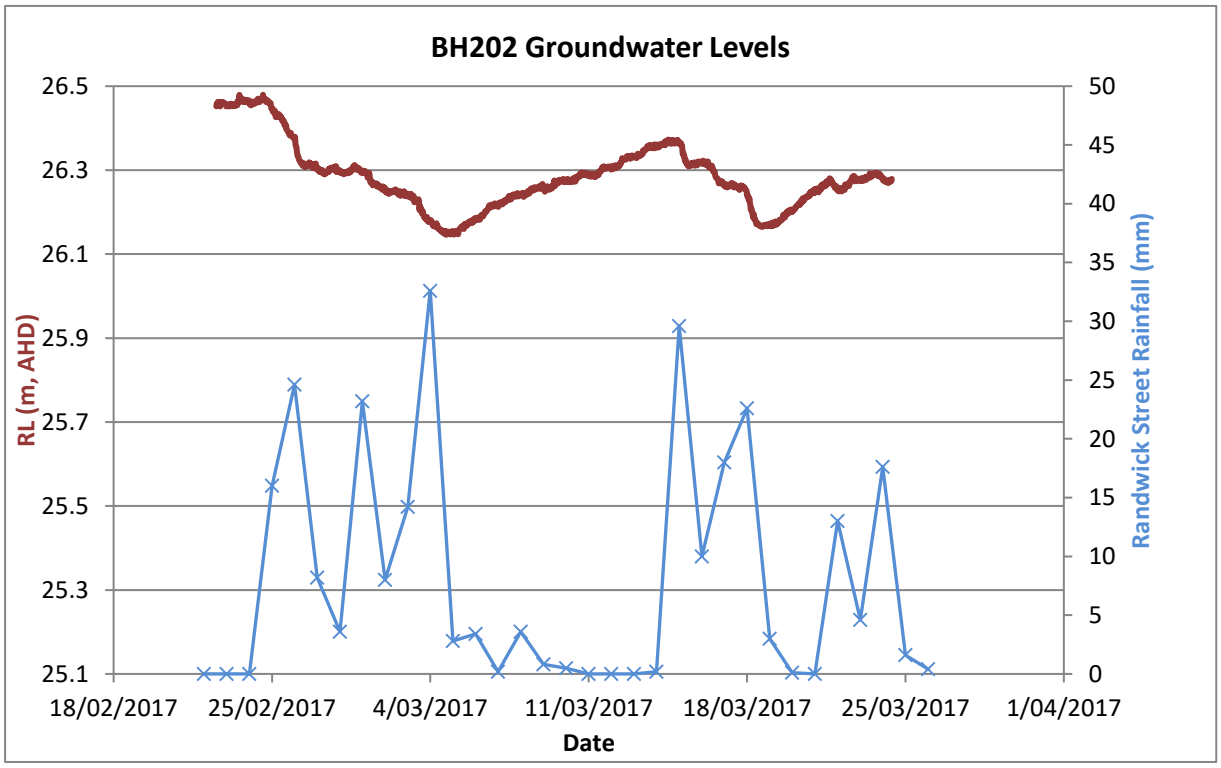


Figure 2: Results of Groundwater Monitoring at BH202

The monitoring indicates the groundwater table at the time of the investigations ranged from RL25.1 m to RL26.8 m (depths of between 2 m and 2.8m) with the groundwater surface generally falling towards the south at an average gradient of approximately 1%. The groundwater table was generally shallower on the northern part of the site, which is consistent with previous experience in the area.

The area of the Botany Sand Aquifer, extending from Botany Bay to Surry Hills and Centennial Park, contains over 30 monitoring bores installed by DWLC and numerous licensed bores. Extracted groundwater is used for industrial, domestic and irrigation purposes. Groundwater is also used for irrigation at Randwick Racecourse, Centennial Park and the University of New South Wales.

5.2 Permeability Testing

Testing was previously undertaken (DP 2017) to assess the hydraulic conductivity (permeability) of the upper sandy soils at locations BH201 and BH202 by conducting falling head or 'slug' tests. This comprised the placement of data loggers in each of the wells then filling the wells with water from a tank. The data loggers were used to progressively record the falling rate of the water level in the well and the data was used to calculate the permeability of the soils over the screened well section. Three tests were carried out in each of the wells with the results presented in Appendix C.

The results of the permeability tests indicate hydraulic conductivity (k) values of 1.9 $x10^{-4}$ m/sec to 3.4 $x10^{-4}$ m/sec in the upper sandy soils with an average value of 2.5 $x10^{-4}$ m/sec.

The k values estimated from the permeability tests are slightly higher than values outlined in published information for the Botany Sands, and DP's experience on surrounding sites which indicate k values of about 2 x 10^{-4} m/sec.

6. Proposed Development

Based on updated basement architectural drawings by Hayball (Job No. 2309, Drawing No.TP02.01 Rev 7, date: 27 September 2019), it is understood that the proposed development includes the construction of three storey residential buildings over a basement carpark. The proposed lower basement floor level (RL25.25 m) will require excavation to depths of approximately 3 m to 4 m below existing ground level. The basement footprint will be set back from the site boundaries at varying distances of between 0.4 m to 20.5 m.

The basement excavation was previously planned to be carried out with shoring walls along eastern, southern and partially western excavation faces, in combination with temporary battering in the north-western corner where there is sufficient room. The recent revision of the architectural design enlarged the basement footprint over the north-western part of the site, with relatively impermeable (secant) shoring walls to be constructed along all sides of the basement excavation to enable excavation of the basement and to reduce groundwater inflow.

It is understood that the excavation works will require temporary dewatering to control the groundwater inflow and the uplift pressure on the basement slab, during the site excavation and the construction of the raft slab. In the long-term the basement structure is to be tanked without further need of dewatering.

The temporary dewatering system is likely to comprise vertical well points (spears) installed at regular intervals around the basement perimeters, with a manifold pipe attached to each well point to pump and discharge the water to a sediment tank.

An OSD tank is also proposed to be constructed on site to the north west of the basement. The invert level of the tank is currently envisaged to be at RL26.5m but is understood to be modified during the detailed design stage to ensure that it is above the groundwater table so that the dewatering is no longer required for construction of the OSD tank.

7. Groundwater Modelling

7.1 Methodology

Groundwater modelling was undertaken to assess the potential inflow rates into the proposed basements during construction and the drawdown, or cone of depression, likely to be induced by the construction of the basement.

Groundwater model simulations were conducted using MODFLOW (McDonald & Harbaugh, 1988) developed by the United States Geological Survey. Modflow is a three-dimensional groundwater head and flow model, which is widely used, and is accepted as an industry standard. The model was based on site-specific data where possible, as well as estimates of unknown parameters based on experience with similar environments. The model was developed using the pre-processor or graphical interface program Visual MODFLOW Flex V4.1 by Schlumberger Water Services.

7.2 Conceptual Hydrogeological Model and Model Geometry

The aquifer surrounding the proposed development was simulated as a three-layer numerical model to represent the subsurface conditions surrounding the site. Information from the previous geotechnical investigations was used to construct the conceptual hydrogeological model, on which the numerical flow model is based.

The three layers allow for the vertical flow components and the secant wall depths to be simulated more accurately. The top of the model, i.e. top of Layer 1, was set to approximate the average ground surface across the site of RL 28.5 m. For simplicity, the conceptual model did not incorporate topography or variations in layer thickness. All layers were assigned as MODFLOW (Type 3) layers (confined / unconfined). Details of the model layers, together with the hydraulic parameters are provided in Table 2.

The northern model boundary was extended to coincide with wetlands in Centennial Park approximately 100 m to the north of the site. The southern, eastern and western boundaries were extended approximately 500 m from the site to ensure they did not impact upon the simulated results.

7.3 Boundary Conditions and Aquifer Parameters

The western and eastern boundaries were set as no-flow boundaries. Constant head conditions were applied to the northern and southern model boundaries.

The constant head 'far-end' boundary conditions were calibrated to generate a uniform hydraulic gradient of 1% from north to south, while matching the average measured hydraulic head on site of approximate RL+26.5 m, with an additional 0.5 m rise to account for groundwater fluctuations.

For the damming assessment, an increased uniform hydraulic gradient of 2% was assigned to the model that allows flow from north to south.

Aquifer parameters required for the three-layer model included horizontal (K_h) and vertical (K_v) hydraulic conductivity, as well as specific yield or storage coefficient. Natural variations in the permeability of the sediments around the site are likely to occur due to the variations in the silt or clay content, and grain size of the sand. Based upon the hydraulic conductivity estimates obtained from falling head test data and logging of the bores on-site, a uniform value of 3×10^{-4} m/sec was assigned as the horizontal hydraulic conductivity. In order to be conservative, the vertical conductivity was set as equal to the horizontal hydraulic conductivity for both layers.

Table 3: Model Layer Summary

Model Layer	Layer Represents	Typical Horizontal Hydraulic Conductivity (m/sec)	Typical Vertical Hydraulic Conductivity (m/sec)
1	Sandy Filling & Sand	3×10^{-4}	3×10^{-4}
2	Sand	3×10^{-4}	3×10^{-4}

7.4 Basement Dewatering – Drain Cells

The *MODFLOW* drain package is often used to simulate water loss caused by dewatering from the groundwater regime. Drain 'cells' set with a conductance of 2,000 m^2/day simulated the dewatering spears during construction of the basement. The drain cells were placed at RL23.75 m in the numerical model to represent the spears installed to 1.5 m depth below the lower basement floor level (RL25.25 m) to allow for a nominal 0.5 m thick raft slab and 1 m dry surface for subgrade preparation.

The inflow into the drain cells, representing the basement dewatering system, were monitored throughout the model simulation using the Zone Budget module of MODFLOW.

7.5 Basement Shoring Walls

It is understood that relatively impermeable secant pile shoring walls will be installed around the proposed basement. It is understood that the toe level of the shoring walls is yet to be finalised during the detailed design stage, however, this level is usually required to be at least 5 m below the bulk excavation level to reduce the hydraulic exit gradient and thus the risk of piping failure. On this basis the toe of the shoring walls was simulated at RL19.75 m.

The secant walls were simulated by applying a horizontal flow barrier (HFB) to the cells along the perimeter of the basement excavation. The HFB representing the shoring wall was assigned a uniform 0.3 m thickness with a very low permeability of 1.0 x 10^{-9} m/s.

7.6 Groundwater Modelling Simulations

The model was run under various transient conditions which included an assumed construction dewatering period of up 365 days to assess the dewatering flow rates required for the site and the effect on the water table.

The model simulations comprised:

Run 1 – A transient scenario to estimate the volume of water removed by the spear points in phases of dewatering (i.e. 1 day, 5 days, 10 days, 20 days, 1 month, 2 months, 3 months, 6 months, 9 months and 12 months) in the 'drained' basement during construction.

Run 2 – A long-term steady-state scenario (with 2% hydraulic gradient) to estimate damming effect in the 'tanked' basement after completion.

8. Groundwater Modelling Results

8.1 Groundwater Inflow

Groundwater inflow into the drain cells representing the excavation dewatering system was monitored throughout the model simulations using the 'zone budget' module of MODFLOW. The inflow rates represent the estimated total rate of groundwater flowing into the excavation and the volume (per unit time) requiring extraction via the dewatering system (spears and pumps) in order to dewater the basement excavation during construction.

Simulated results are summarised in Table 4. During the early stages of construction, inflow rates will be higher and will then gradually decrease as the hydraulic gradient around the excavation decreases. Inflows during early dewatering works are predicted to be about 66 L/sec. Towards the end of construction, inflows are predicted to be about 42 L/sec.

Table 4: Predictive Model Simulated Inflow Results (i.e. Dewatering pumping rates)

Elapsed Time	Dewatering Flow Rate		
	m^3 / day	L / sec	ML / day
1	5720	66	5.7
5	5048	58	5.0
10	4366	51	4.4
20	4001	46	4.0
30	3769	44	3.8
60	3681	43	3.7
90	3604	42	3.6
180	3591	42	3.6
270	3588	42	3.6
365	3588	42	3.6

The inflow rates are sensitive to the actual permeability of the sand deposits surrounding the basement excavation, which will naturally vary according to variations in silt, clay, and sand content and the presence of low permeable clay pockets. The estimates given above are expected to be moderately conservative.

8.2 Drawdown and Settlement in Sand during Temporary Dewatering

The simulated lowered groundwater levels, or impact to the water table, outside the basement footprint during construction for Model Run 1 is shown in Figure 3. The model results indicate a drawdown of about 1.0 m extending up to approximately 120 m from the basement boundaries. The maximum drawdown closer to the secant walls is estimated to be generally less than 2.5 m. The predicted drawdown around the retained heritage building is in the range of 2 m to 2.5 m.

The groundwater modelling indicates that the drawdown on neighbouring properties would be generally less than 2 m, with a small portion of the light rail yard along its western boundary potentially experiencing a drawdown between 2.0 m and 2.5 m.

As outlined in DPs previous geotechnical report, it is expected that a drawdown of less than 2 m would be within the range of historic low groundwater levels and therefore settlements due to drawdown of 2 m within the sands should be relatively minor (less than 5 mm). The structures within the zone of 2 m to 2.5 m drawdown (i.e. the heritage houses retained on site and the light rail yard in close proximity to the proposed basement) are likely to experience an additional settlement of 2-3 mm (a total of 7-8mm). It is suggested that the proposed shoring and dewatering scheme should be designed to target a drawdown of no more than 2.5 m immediately outside of the proposed basement footprint.

The actual magnitude and extent of the drawdown will depend upon the integrity of the shoring wall and its ability to 'seal' off the horizontal flow of groundwater through the sand. The modelling has assumed that the wall is of good construction with no gaps and that no major leaks develop through the shoring walls during construction. The results are also dependent upon the type of dewatering system installed onsite, and particularly the depth of dewatering spears / wells. The modelling has assumed that the wells / spears would be installed to RL 23.75 m, approximately 4 m above the toe of the secant walls.

Figure 3 – Simulated Groundwater Drawdown Levels During Temporary Dewatering

8.3 Potential Damming due to Tanked Basement

The long-term steady state case simulated in Model Run 2 indicates that there may be a very slight increase in groundwater head of less than 0.1 m on the northern (upstream) side of the tanked basement.

The sandy soils outside the basement perimeter are sufficiently permeable to allow the groundwater to flow around the site such that there are negligible head changes or "damming effect" in the surrounding groundwater flow.

9. Potential Effects on Neighbouring Properties

An assessment of the potential effects of dewatering on neighbouring properties and groundwater dependent ecosystems has been summarised in Table 5.

Table 6: Assessment of Potential Effects of Dewatering

Item	Comment
Proximity of Groundwater Dependent Ecosystems (GDEs)	No known groundwater dependent ecosystems in close proximity to the site.
Water Supply Losses by Neighbouring Groundwater Users	A review of registered bores within the area immediately surrounding the site was undertaken. The search identified three bores within a 300 m radius used for irrigation purposes. Due to the high permeability of the sand aquifer it is unlikely that the temporary dewatering of the site will impact on these irrigation bores.
Potential Subsidence of Neighbouring Structures	It is expected that dewatering within the excavation to lower the water table by about 3-3.5 m will result in a drawdown of groundwater levels outside the site of generally less than 2 m. This drawdown is within historical fluctuations and would not be expected to result in any significant settlement due to dewatering. Settlements outside the site due to drawdown of 2 m would be expected to be less than 5 mm. The heritage houses retained on site and the small portion of neighbouring light rail yard, due to their close proximity to the proposed basement, are likely to experience slightly more dewatering-related settlement of 7-8 mm, with a differential settlement of 2-3 mm. These values are considered generally tolerable, but close survey monitoring of the ground movements at the foundation of the heritage houses and at the light rail property boundary is recommended during the temporary dewatering.
Mounding of Water Upgradient of Structure	Groundwater wells to be installed upgradient of the structure to monitor potential mounding effects. It is expected that water will flow around and below the basement within the permeable sands and therefore no significant mounding is expected.

10. Monitoring and Reporting

The following monitoring and associated reporting is proposed during dewatering and should be undertaken during excavation and construction works on-site, until the tanked basement is constructed and the dewatering/depressurising pumps are switched off.

Table 5: Monitoring and Reporting requirements

Item	Monitoring	Monitoring Frequency	Reporting
Assess effect of wall on groundwater	Installation of 3 groundwater wells around perimeter wall (including at least one upgradient) and subsequent measurement of groundwater levels.	Daily for the first two weeks. After steady groundwater conditions are established then weekly.	Weekly
Groundwater Quality Sampling and Testing	Sampling and testing of water from wells and excavation, or the point of discharge Contaminant and physical properties tested to be nominated by the authority accepting water but to include: • Heavy Metals and PAH • pH & conductivity • Suspended Solids • Turbidity • Dissolved Oxygen Levels	Two rounds of groundwater sampling and testing initially. Subject to relatively uniform results groundwater testing to be carried out fortnightly or as otherwise agreed with authority accepting water.	
Groundwater inflow rates	Groundwater inflow to be measured in collection tanks or point of discharge using flow meter.	Twice daily, or once collection point is filled (whichever is more frequent), for the first two weeks. After steady groundwater inflow rates are established then daily.	Weekly
Quantity of water disposed off-site (includes rainwater)	Calibrated Flowmeter connected to any pump-out system.	Automatically	Weekly

At the completion of excavation works a dewatering compliance report should be compiled and submitted to WaterNSW that includes a discussion on the results of dewatering monitoring.

11. Groundwater Contamination Sampling

Groundwater wells BH201, BH202 and BH203 were sampled on 12 June 2019. Due to damage to wells BH201 and BH203, only BH202 was developed by removing three well volumes (i.e. approximately 60 L) prior to sampling.

Groundwater levels were measured in the wells using an interface meter prior to development/sampling. Measurement for phase separated hydrocarbons (PSH) was undertaken concurrently. Well BH202 was allowed to recharge post development and groundwater levels re-measured prior to sampling. In summary water levels were recorded between 1.8 m bgl and 2.2 m bgl whilst no PSH was observed.

Prior to sampling, the wells were micro-purged using a low flow pump (Geopump peristaltic pump) until field parameters (pH, temperature, dissolved oxygen (DO), electrical conductivity, turbidity and redox) readings stabilised. Once field parameters had stabilised, samples were collected using the low flow pump. Samples were placed with a minimum of aeration into appropriately prepared bottles (supplied by the laboratory) containing sample preservatives. For analysis of dissolved metals the relevant sample fraction was filtered using an in-line disposable 0.45 µm filter that was changed between samples.

Groundwater levels and parameters recorded during sampling are shown on the field sheets included in Appendix E.

Samples from each well (plus quality assurance and quality control 'QA/QC' sample) were analysed at Envirolab Services Pty Ltd, a NATA accredited laboratory, for a combination the following common contaminants and parameters:

- Heavy metals (dissolved and total);
- Total recoverable hydrocarbons (TRH);
- Monocyclic aromatic hydrocarbons (MAH)- benzene, toluene, ethylbenzene, xylene (BTEX);
- Oil and grease;
- Polycyclic aromatic hydrocarbons (PAH);
- Phenol;
- Polychlorinated biphenyls (PCB);
- Organochlorine pesticides (OCP);
- Organophosphorus pesticides (OPP);
- pH;
- Electrical conductivity;
- Total suspended solids; and
- Hardness.

For screening purposes, the laboratory results have been compared against the assessment criteria provided in *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018)

for marine water at a 95% level of protection, for assessment of groundwater disposal to the stormwater system. Fresh water levels were adopted where marine water trigger levels were absent.

A summary of the results are provided in Tables 7 to 10 below. Laboratory certificate and chain of custody documentation are included in Appendix E.

Table 7: Results of Laboratory Analysis for Heavy Metals (Dissolved)

Sample	Heavy Metals							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BH201	1	<0.1	<1	<1	1	<0.05	<1	3
BH202	1	<0.1	<1	<1	<1	<0.05	<1	1
BH203	2	<0.1	<1	<1	<1	<0.05	<1	2
ANZG	13	5.5	27	1.3	4.4	0.1	70	15

Table 8: Results of Laboratory Analysis for Heavy Metals (Total)

Sample	Heavy Metals							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BH201	1	<0.1	<1	<1	4	<0.05	<1	6
BH202	1	<0.1	<1	<1	3	<0.05	<1	4
BH203	5	<0.1	1	11	17	<0.05	<1	13
ANZG	13	5.5	27	1.3	4.4	0.1	70	15

Table 9: Results of Laboratory Analysis for Hydrocarbons

Sample	Polycyclic Aromatic Hydrocarbons		Total Petroleum Hydrocarbons		Monocyclic Aromatic Hydrocarbons (BTEX)			
	Benzo(a) pyrene	Total PAH	C6-C10	C10-C40	Benzene	Toluene	Ethyl-benzene	Total Xylene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BH201	<0.1	NIL	<10	<250	<1	<1	<1	<3
BH202	<0.1	NIL	<10	<250	<1	<1	<1	<3
BH203	<0.1	NIL	<10	<250	<1	<1	<1	<3
ANZG	ND	ND	ND	ND	700	ND	ND	625

Table 10: Results of pH, electrical conductivity, oil and grease

Sample	pH	Electrical Conductivity	Total Suspended Solids	Oil and Grease
	pH units	µS/cm	mg/L	mg/L
BH201	6.7	190	8	<5
BH202	6.7	220	14	<5
BH203	6.9	520	44	<5
ANZG	6.5-8.0	-	50	ND

In summary contaminant concentrations were generally low with all results for TRH, BTEX, PAH, phenols, PCB, OCP, OPP, cadmium, mercury and nickel recorded below laboratory reporting limits.

Total metals concentrations were elevated relative to dissolved metal concentrations, however, were still generally low. In this regard there were slight exceedances for total copper and lead concentrations in well BH203. This is considered to be associated with the suspended sediment in the water column given the recorded TSS of 44 mg/L in well BH203. Total metal concentrations will need to be addressed using an onsite treatment system prior to disposal.

It is also noted that given the recorded pH values (in all three wells) and suspended solids concentrations (most notably in well BH203), these parameters may also need to be addressed through on site treatment during dewatering (subject to monitoring results).

The suitability of the groundwater for disposal to stormwater or sewer is to be confirmed by the authority receiving the water.

12. Limitations

Douglas Partners (DP) has prepared this report for this project at 4-18 Doncaster Avenue, Kensington in accordance with DP's proposal SYD190541.P.001 dated 30 May 2019 and acceptance received from Mr Matt Haynes dated 30 May 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Blue Sky Private Real Estate Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of 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 previous investigations. 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 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 / environmental / groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

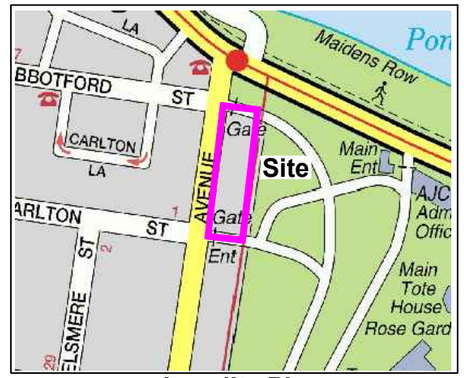
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate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

Site Inspection

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

Appendix B

Drawings



Locality Plan

NOTE:
2: Base image from Nearmap.com (Date 12.5.2019)
2: Test locations are approximate only and are shown with reference to existing features.

0 5 10 15 20 30 40 60m

1:600 @ A3

LEGEND

- Previous CPT (1, 2, 3, 4, 101,102)
- Previous borehole (201, 202, 203)
- Interpreted Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Blue Sky Private Real Estate Pty Ltd		TITLE: **Test Locations**	PROJECT No: 73965.06
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Residential Development**	DRAWING No: 1
SCALE: 1:600 @ A3 approx.	DATE: 4.10.2019	**4-18 Doncaster Avenue, KENSINGTON**	REVISION: 1

A

A'

Approximate Site Boundary

203

CPT4 Offset - 12.1m Qc

CPT3 Offset 9.7m Qc

CPT2 Offset 9.7m Qc

CPT1 Offset - 17.0m Qc

202

CPT101 Offset - 15.2m Qc

201

CPT102 Offset 17.3m Qc

Approximate Site Boundary

SAND/SILTY SAND: vl-l

Approximate Water Level

Basement RL = 24.75

SAND: md-d

SAND: d-vd

ORGANIC CLAY/ PEAT: vs-f

SAND: md-d with vl/st silty/clayey bands

SAND: md-d with some st-h silty/clayey bands

SAND: vd

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

NOTE:
1. Subsurface conditions are accurate at the test locations only and variations may occur away from the test locations.
2. Strata layers shown are generalised and each layer can include bands of looser and denser sand, as well as some clay layers.
3. Summary logs only. Should be read in conjunction with detailed logs.
4. Ground surface level indicative only.

LEGEND

Sand
Filling
Clay
Silty Sand
Silty Clay

NOTE:
1. Subsurface conditions are accurate at test locations. Variations in subsurface conditions may occur between test locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only. Should be read in conjunction with detailed CPT logs.

SOIL CONSISTENCY

vs	- very soft	vl	- very loose
s	- soft	l	- loose
f	- firm	md	- medium dense
st	- stiff	d	- dense
vst	- very stiff	vd	- very dense
h	- hard		

TESTS / OTHER

- Water level

Horizontal Scale (metres)

Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Blue Sky Private Real Estate Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section A-A'**
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Residential Development**
SCALE: 1:400 (H) 1:200 (V) @ A3	DATE: 4.10.2019	**4-18 Doncaster Avenue, KENSINGTON**

PROJECT No:	73965.06
DRAWING No:	2
REVISION:	1

Appendix C

Results of Previous Investigation

CONE PENETRATION TEST

CLIENT: SKY BLUE COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-12 DONCASTER AVENUE, RANDWICK

REDUCED LEVEL: 28.5

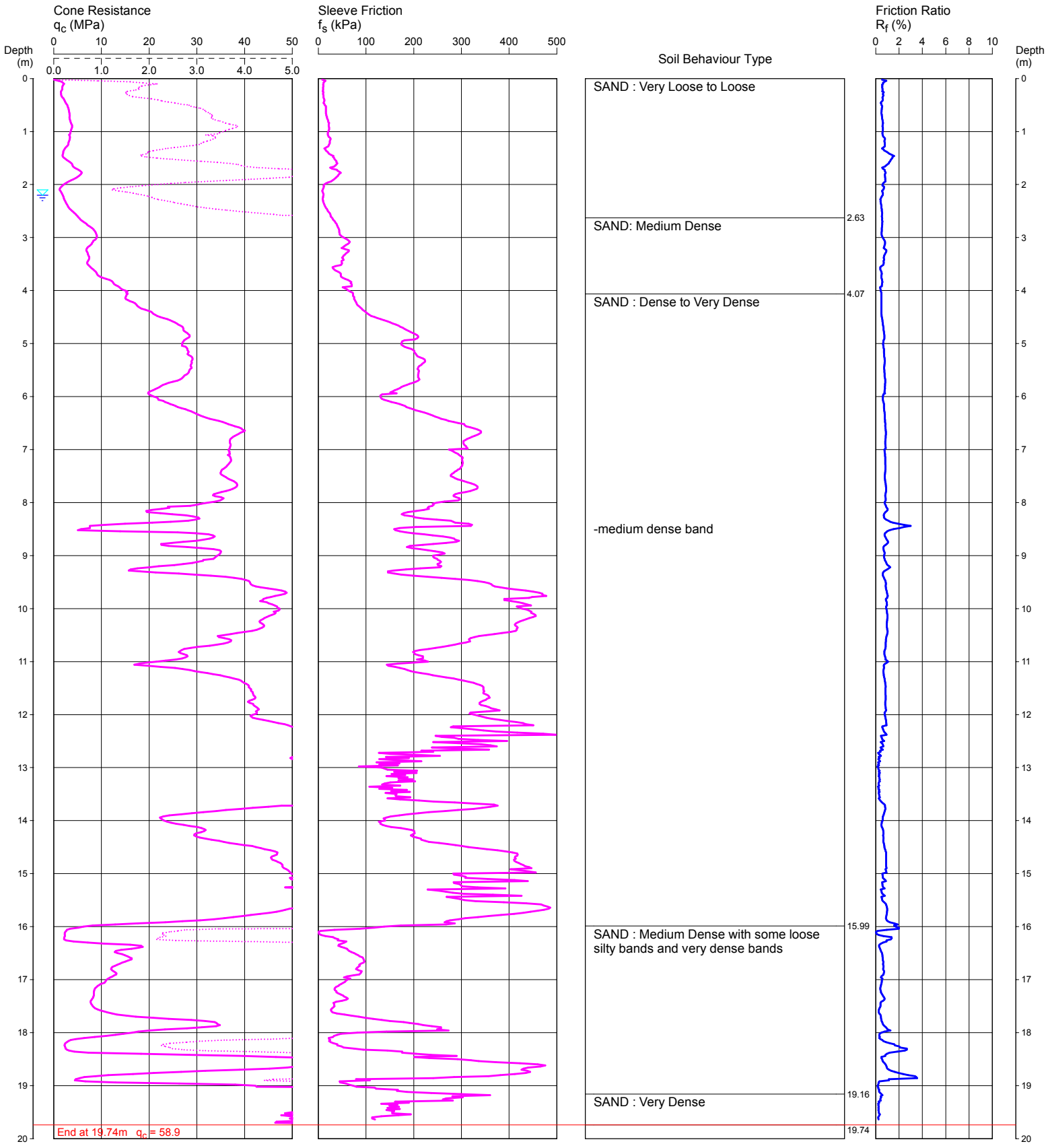
COORDINATES:

CPT1

Page 1 of 1

DATE 13/5/2014

PROJECT No: 73965



REMARKS: HOLE DISCONTINUED DUE TO EXCESSIVE ROD BOWING
GROUNDWATER OBSERVED AT 2.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.20m depth (assumed)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT1.CP5
Cone ID: 120619 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BLUE SKY COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-12 DONCASTER AVENUE, RANDWICK

REDUCED LEVEL: 28.5

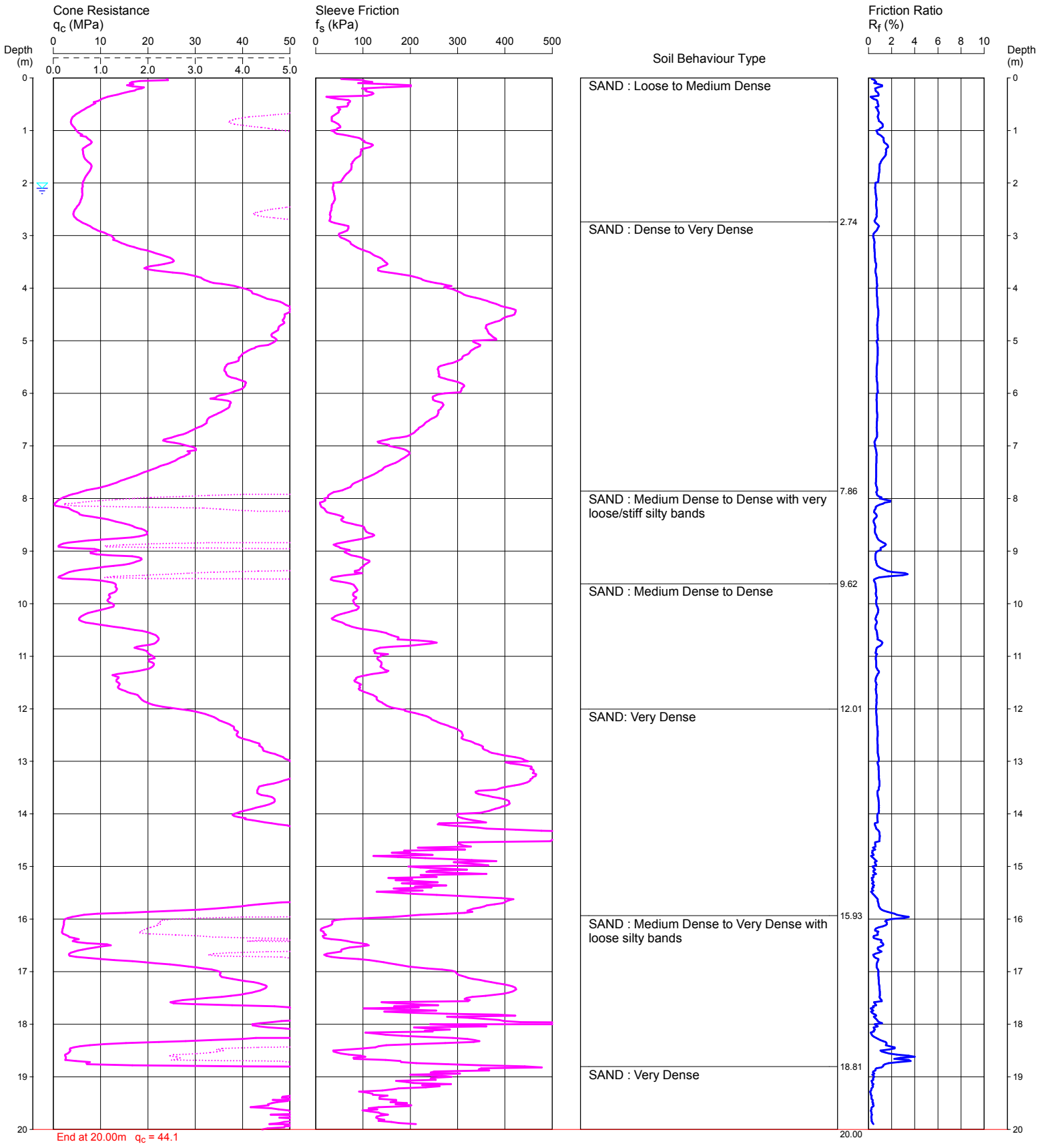
COORDINATES:

CPT2

Page 1 of 1

DATE 13/5/2014

PROJECT No: 73965



REMARKS: GROUNDWATER OBSERVED AT 2.1 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.10m depth (assumed)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT2.CP5

Cone ID: 120619 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SKY BLUE COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-12 DONCASTER AVENUE, RANDWICK

REDUCED LEVEL: 28.6

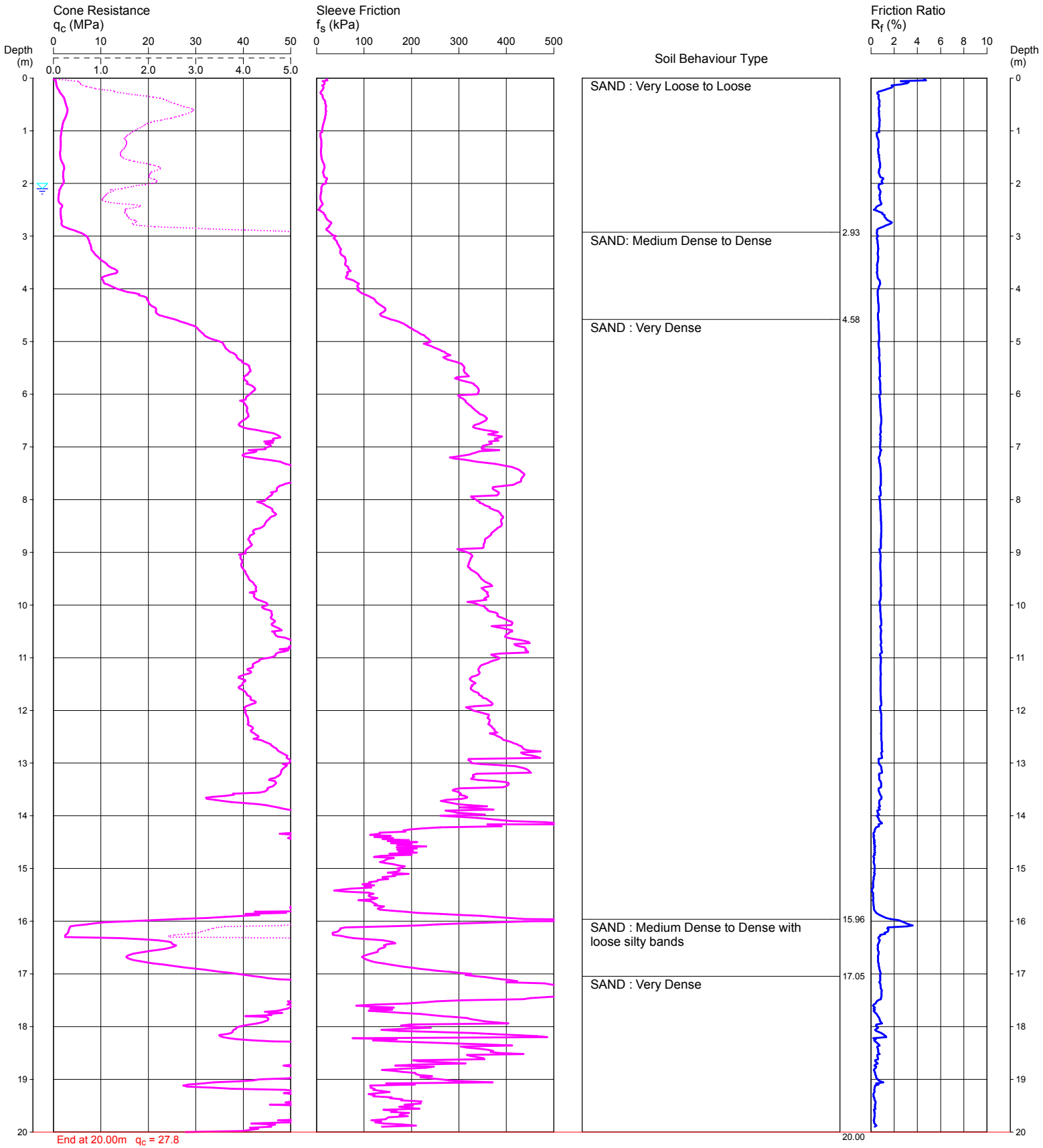
COORDINATES:

CPT3

Page 1 of 1

DATE 13/5/2014

PROJECT No: 73965



REMARKS: GROUNDWATER OBSERVED AT 2.1 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.10m depth (assumed)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT3.CP5

Cone ID: 120619 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SKY BLUE COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-12 DONCASTER AVENUE, RANDWICK

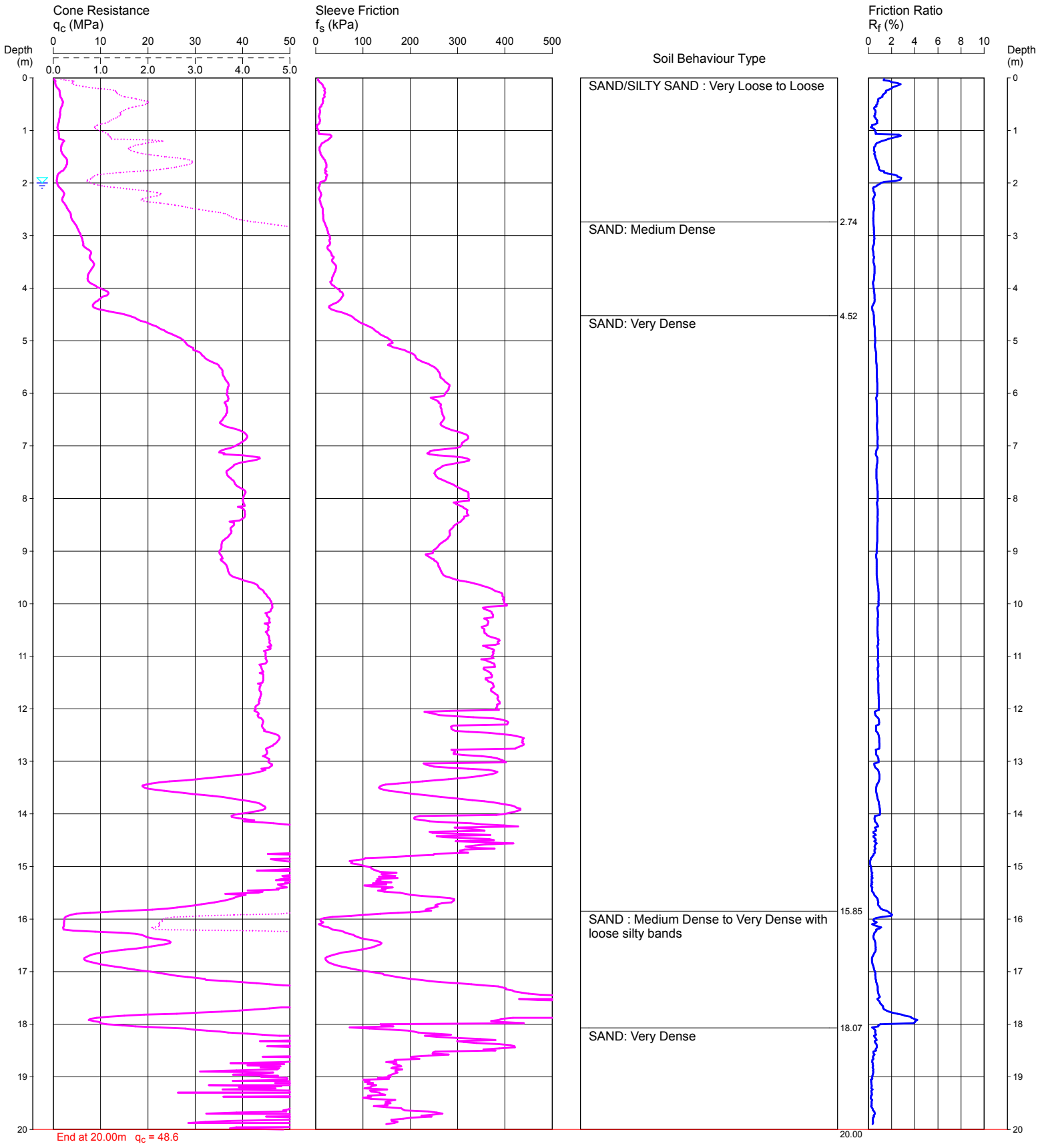
REDUCED LEVEL: 28.6

COORDINATES:

CPT4

DATE 13/5/2014

PROJECT No: 73965



REMARKS: GROUNDWATER OBSERVED AT 2.0 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.00m depth (assumed)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT4.CP5

Cone ID: 120619 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SKY BLUE COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-18 DONCASTER AVENUE, KENSINGTON

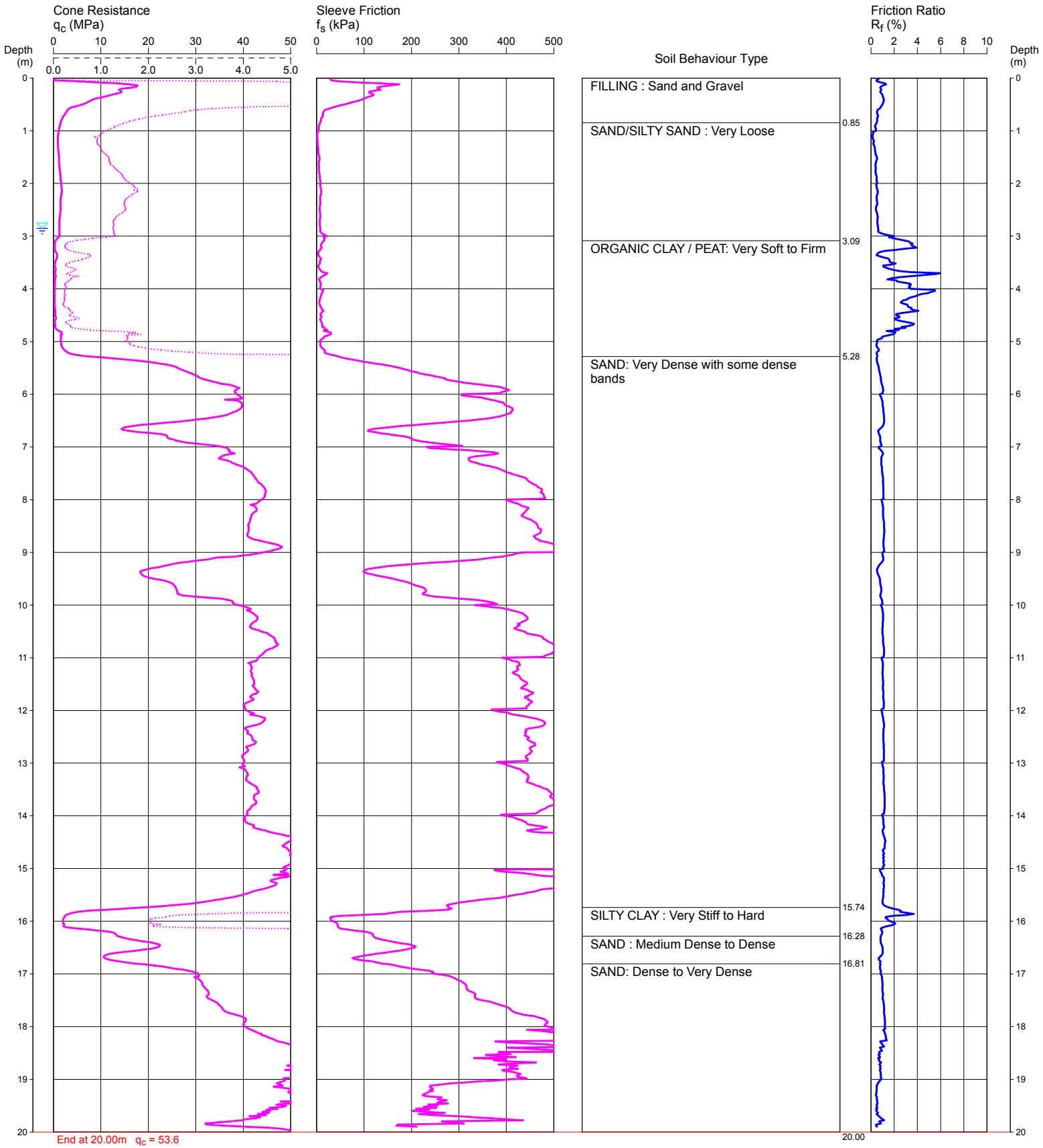
REDUCED LEVEL: 27.9

COORDINATES: 336013E 6246850N AHD

CPT101

DATE 9/12/2015

PROJECT No: 73965.02



REMARKS: STANDPIPE INSTALLED TO 4.9 m DEPTH AFTER WITHDRAWAL OF RODS. GROUNDWATER OBSERVED AT 2.85 m DEPTH IN INSTALLED STANDPIPE.

Water depth after test: 2.85m depth (measured)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT101.CP5

Cone ID: 120620 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SKY BLUE COMMERCIAL ASSET MANAGERS PTY LTD

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT

LOCATION: 4-18 DONCASTER AVENUE, KENSINGTON

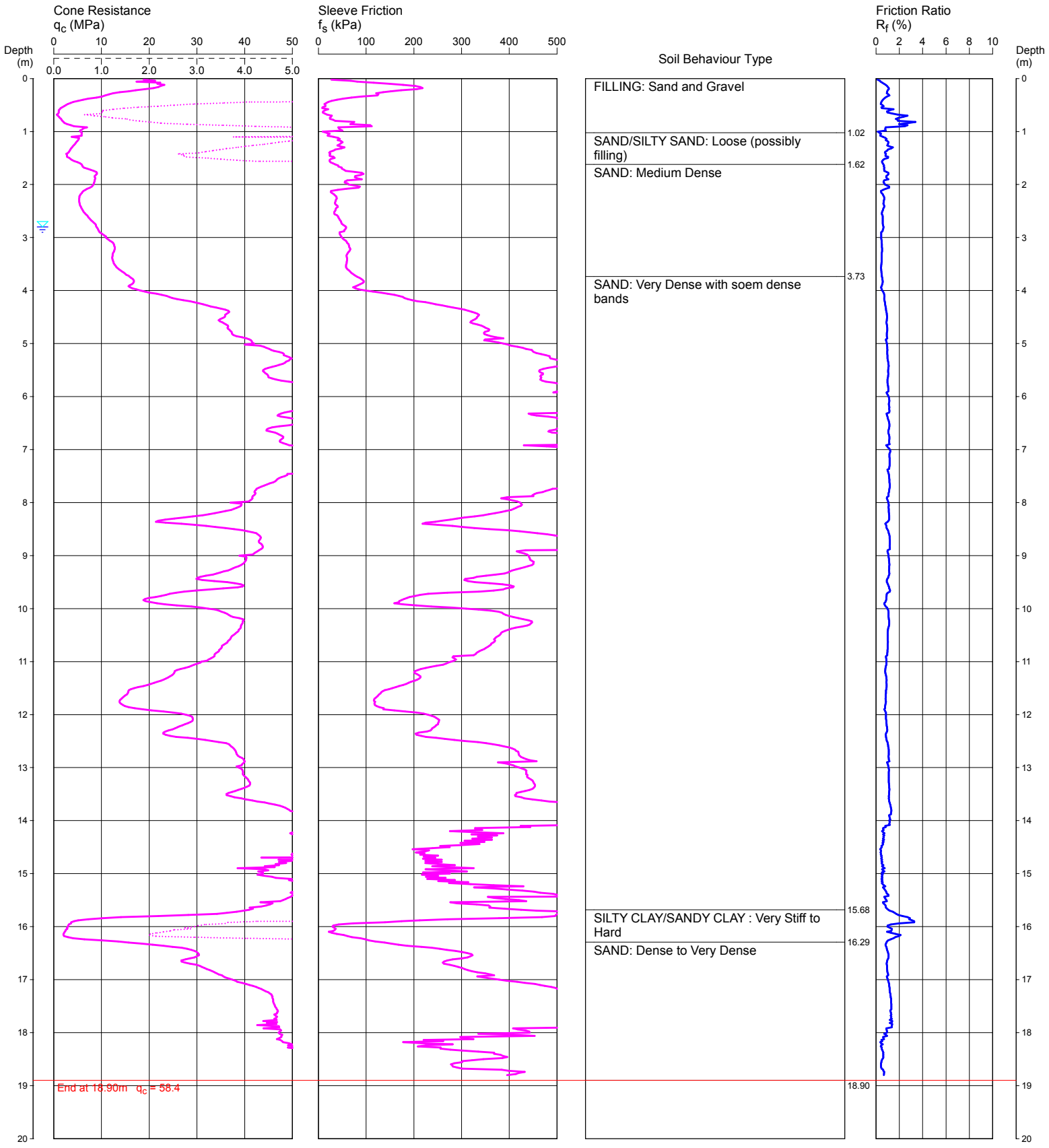
REDUCED LEVEL: 28.4

COORDINATES: 336049E 6246847N AHD

CPT102

DATE 9/12/2015

PROJECT No: 73965.02



REMARKS: HOLE DISCONTINUED DUE TO LIMIT OF THRUST.
HOLE COLLAPSE AT 2.8 m DEPTH AFTER WITHDRAWAL OF RODS.

Water depth after test: 2.80m depth (assumed)

File: P:\73965.05 - KENSINGTON, 4-18 Doncaster Ave, Geo\4.0 Field Work\4.2 Testing\CPT102.CP5
Cone ID: 120620 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Randwick Property Group Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 4-18 Doncaster Avenue, Kensington

SURFACE LEVEL: 28.1 AHD
EASTING: 336028
NORTHING: 6246848
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 73965.03
DATE: 17/2/2017
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
28.1	0.0	FILLING - dark grey, fine to coarse silty sand filling with some fine to medium gravel, damp		A	0.3				0.5m stick-up; Backfill 0.0-0.7m
		0.7m: with some ripped sandstone gravel and cobbles							
27.3	0.8	SAND - brown-grey, medium to coarse sand, damp		A	1.0				Bentonite 0.7-1.5m
		1.5m: becoming light brown and moist						▼	
		2.5m: becoming brown and moist to wet		A	2.5				
		2.8m: becoming very wet		A	3.0				
				A	3.5				Gravel 1.5-5.5m
				A	4.0				Machine slotted PVC screen 2.5-5.5m
22.6	5.5	Bore discontinued at 5.5m - limit of investigation							End cap

RIG: DT100 **DRILLER:** LC **LOGGED:** MB **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger (TC-bit) to 4.0m; Rotary to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 2.0m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Randwick Property Group Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 4-18 Doncaster Avenue, Kensington

SURFACE LEVEL: 28.3 AHD
EASTING: 336022
NORTHING: 6246901
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 73965.03
DATE: 17/2/2017
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
28	0	FILLING - dark grey, fine to coarse silty sand filling with some fine to medium gravel, damp							Gatic cover
		0.7m: with some ripped sandstone gravel and cobbles							
	0.8	SAND - brown-grey, medium to coarse sand, damp							Backfill 0.0-1.5m
27	1	1.5m: becoming light brown and moist							Bentonite 1.5-2.0m
	2							▼	Gravel 2.0-5.2m
26		2.5m: becoming brown and moist to wet							
	3	2.8m: becoming very wet							
25									
	4								Machine slotted PVC screen 2.2-5.2m
24									
	5								
	5.2	Bore discontinued at 5.2m - limit of investigation							End cap
23	6								
22	7								
21	8								
20	9								
19									

RIG: DT100 **DRILLER:** LC **LOGGED:** MB **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 5.2m

WATER OBSERVATIONS: Free groundwater observed at 2.2m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Randwick Property Group Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 4-18 Doncaster Avenue, Kensington

SURFACE LEVEL: 28.6 AHD
EASTING: 336036
NORTHING: 6246950
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 73965.03
DATE: 17/2/2017
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
28	0.2	SILTY SAND - dark brown medium to coarse silty sand, humid							Gatic cover
		SAND - grey medium to coarse sand, damp							Backfill 0.0-0.5m
		0.6m: light brown							Bentonite 0.5-1.0m
27	1	1.5m: brown-grey							Gravel 1.0-3.0m
	2	2.0m: becoming wet						▼	
		2.2m: becoming very wet							
26	2.3	SILTY CLAY - dark brown silty clay with some sand and organic matter, sulphur odour, moist		A	2.3				Machine slotted PVC screen 1.5-3.0m
					2.5				
	3			A	3.0				End cap
	3.05	SAND - light brown, medium to coarse sand, apparently saturated							
	3.3	Bore discontinued at 3.3m - hole collapse							
25	4								
24	5								
23	6								
22	7								
21	8								
20	9								
19									

RIG: Hand tools **DRILLER:** MB **LOGGED:** MB **CASING:** 90mm PVC to 2.5m

TYPE OF BORING: 110mm diameter hand auger to 2.5m; 50mm hand auger to 3.3m

WATER OBSERVATIONS: Free groundwater observed at 2.2m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Results of Permeability Testing

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

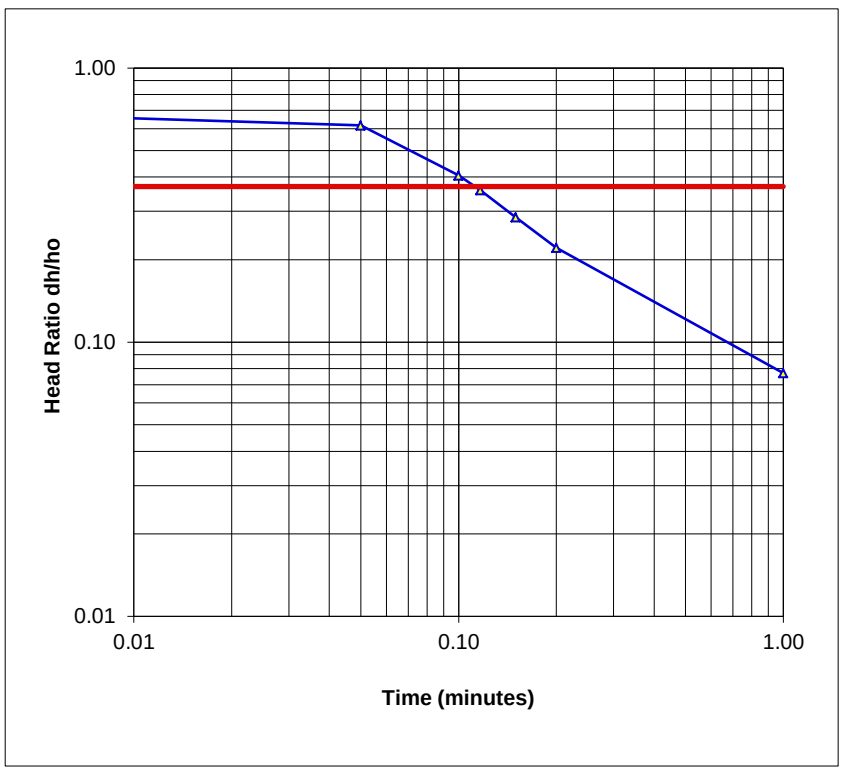
Description:	Standpipe in borehole	**Test No.**	201	Test 1
Material type:	Sand	Easting:	336028	m
		Northing	6246848	m
		Surface Level:	28.1	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.82	m
Length of well screen (Le)	4	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	0.82	1.18	1.000
0.05	1.272	0.73	0.617
0.10	1.522	0.48	0.405
0.117	1.577	0.42	0.358
0.15	1.663	0.34	0.286
0.20	1.739	0.26	0.221
1.00	1.909	0.09	0.077



To = 0.115 mins
6.9 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.3E-04**	m/sec
	=	**84.569**	cm/hour

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

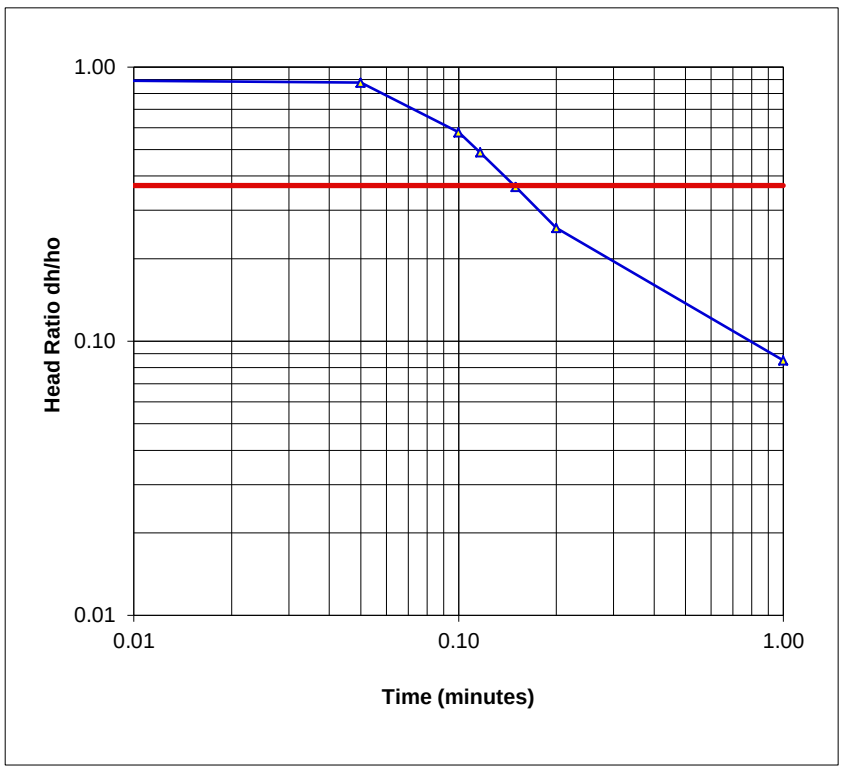
Description:	Standpipe in borehole	**Test No.**	201	Test 2
Material type:	Sand	Easting:	336028	m
		Northing	6246848	m
		Surface Level:	28.1	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.86	m
Length of well screen (Le)	4	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	0.87	1.13	0.994
0.05	1.001	1.00	0.876
0.10	1.341	0.66	0.578
0.117	1.444	0.56	0.488
0.15	1.584	0.42	0.365
0.20	1.705	0.30	0.259
1.00	1.903	0.10	0.085



To = 0.14 mins
8.4 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity **k = 1.9E-04** m/sec
= 69.468 cm/hour

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

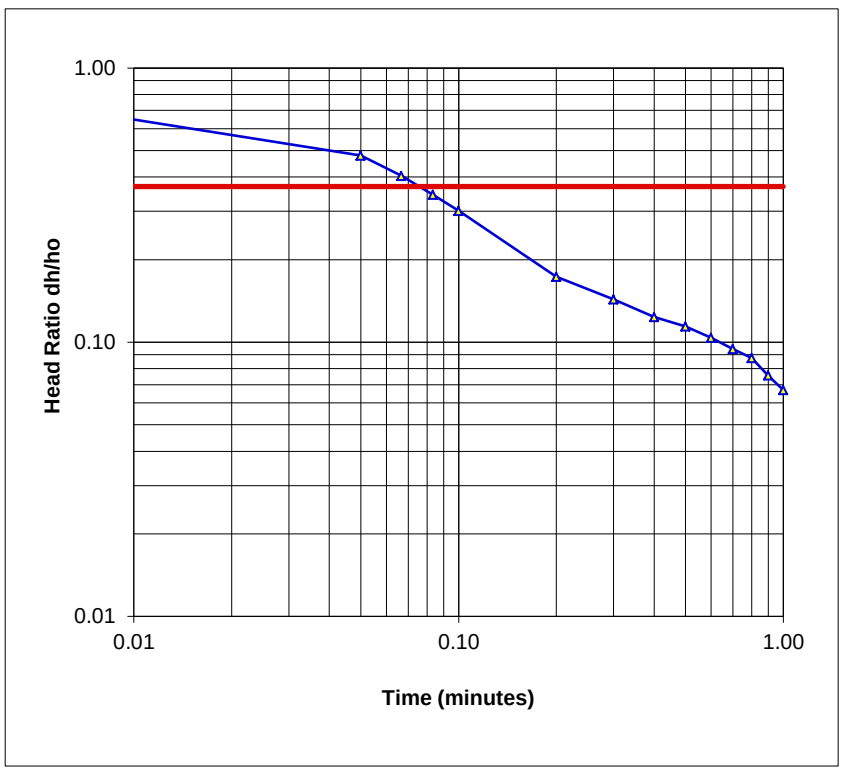
Description:	Standpipe in borehole	**Test No.**	201	Test 3
Material type:	Sand	Easting:	336028	m
		Northing	6246848	m
		Surface Level:	28.1	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.835	m
Length of well screen (Le)	4	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	0.835	1.17	1.000
0.05	1.442	0.56	0.479
0.067	1.529	0.47	0.404
0.083	1.598	0.40	0.345
0.1	1.649	0.35	0.301
0.2	1.798	0.20	0.173
0.3	1.833	0.17	0.143
0.4	1.856	0.14	0.124
0.5	1.867	0.13	0.114
0.6	1.879	0.12	0.104
0.7	1.89	0.11	0.094
0.8	1.898	0.10	0.088
0.9	1.912	0.088	0.076
1.0	1.922	0.078	0.067



To = 0.08 mins
4.8 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**3.4E-04**	m/sec
	=	**121.569**	cm/hour

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

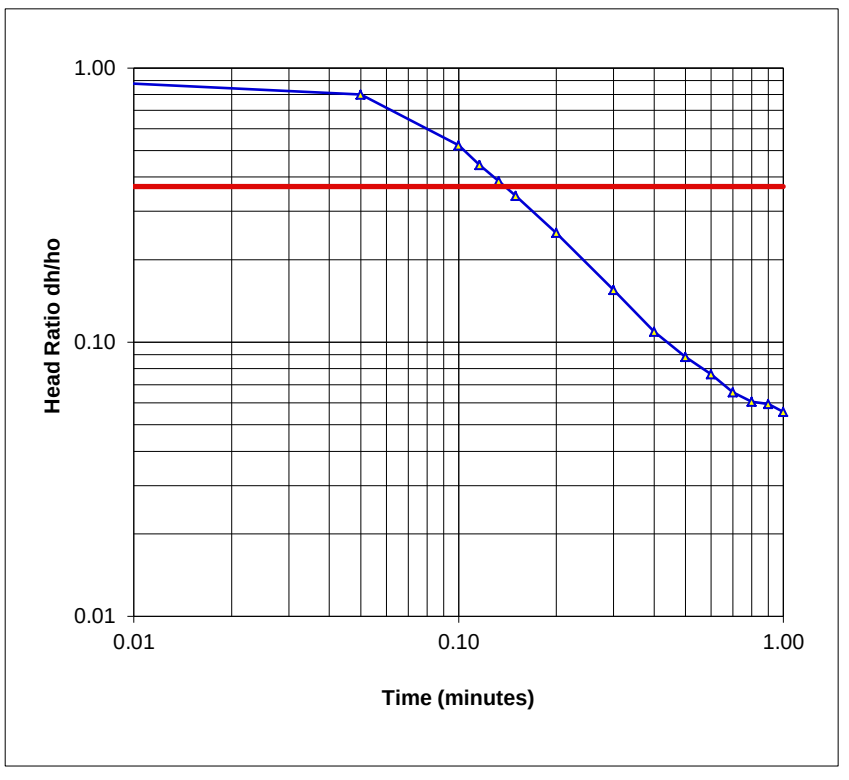
Description:	Standpipe in borehole	**Test No.**	202	Test 1
Material type:	Sand	Easting:	336022	m
		Northing	6246901	m
		Surface Level:	28.3	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	1.193	m
Length of well screen (Le)	3.2	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	1.19	1.01	1.000
0.05	1.394	0.81	0.800
0.10	1.674	0.53	0.522
0.116	1.754	0.45	0.443
0.133	1.811	0.39	0.386
0.15	1.856	0.34	0.342
0.2	1.948	0.25	0.250
0.3	2.044	0.16	0.155
0.4	2.09	0.11	0.109
0.5	2.111	0.09	0.088
0.6	2.123	0.08	0.076
0.7	2.134	0.07	0.066
0.8	2.139	0.061	0.061
0.9	2.14	0.06	0.060
1.0	2.144	0.056	0.056



To = 0.14 mins
8.4 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$ where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.3E-04**	m/sec
	=	**82.315**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

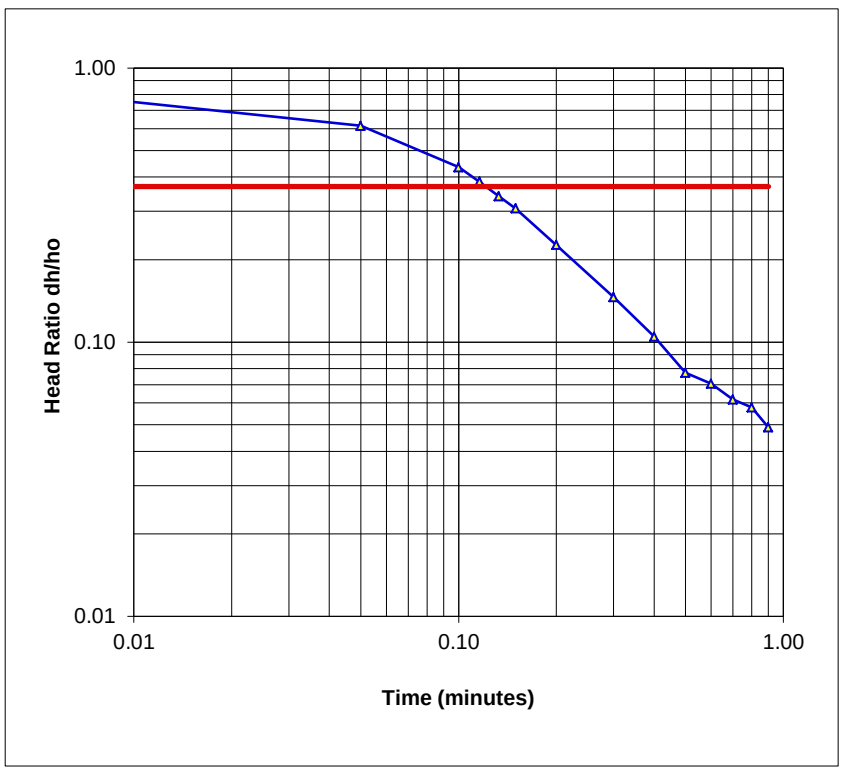
Description:	Standpipe in borehole	**Test No.**	202	Test 2
Material type:	Sand	Easting:	336022	m
		Northing	6246901	m
		Surface Level:	28.3	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	1.179	m
Length of well screen (Le)	3.2	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	1.18	1.02	1.000
0.05	1.572	0.63	0.615
0.10	1.756	0.44	0.435
0.116	1.807	0.39	0.385
0.133	1.852	0.35	0.341
0.15	1.886	0.31	0.308
0.2	1.969	0.23	0.226
0.3	2.051	0.15	0.146
0.4	2.093	0.11	0.105
0.5	2.121	0.08	0.077
0.6	2.128	0.07	0.071
0.7	2.137	0.06	0.062
0.8	2.141	0.059	0.058
0.9	2.15	0.05	0.049



To = 0.12 mins
7.2 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.7E-04**	m/sec
	=	**96.034**	cm/hour

Douglas Partners Pty Ltd
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www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client:	Randwick Property Development Pty Ltd	Project No:	73965.03
Project:	Proposed Residential Development	Test date:	22-Feb-17
Location:	4-18 Doncaster Avenue, Kensington	Tested by:	JS

Test Location

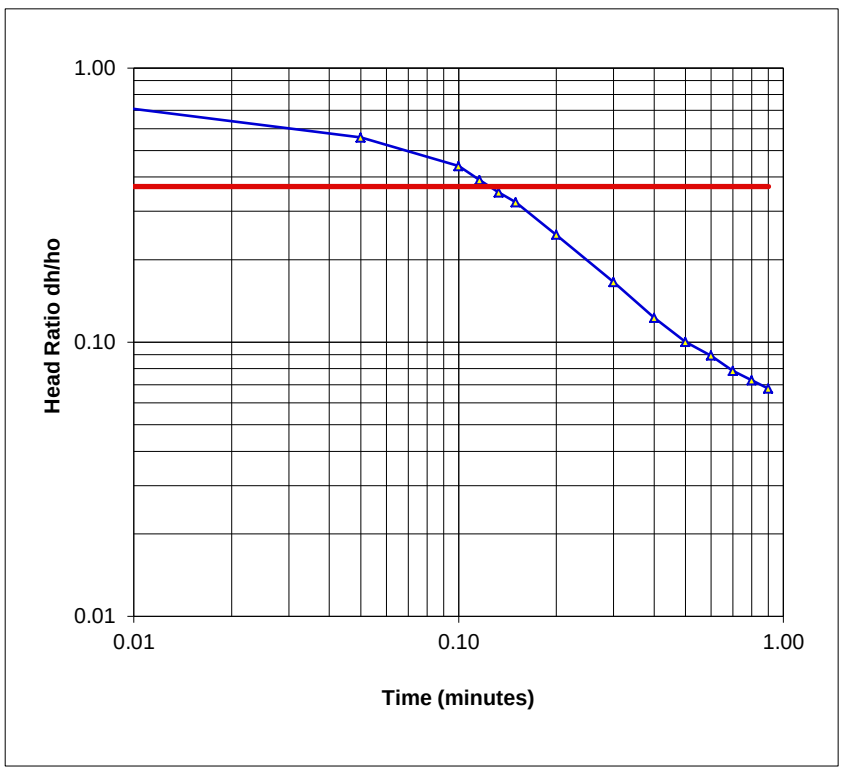
Description:	Standpipe in borehole	**Test No.**	202	Test 3
Material type:	Sand	Easting:	336022	m
		Northing	6246901	m
		Surface Level:	28.3	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	1.181	m
Length of well screen (Le)	3.2	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0.00	1.18	1.02	1.000
0.05	1.631	0.57	0.558
0.10	1.753	0.45	0.439
0.116	1.802	0.40	0.391
0.133	1.842	0.36	0.351
0.15	1.87	0.33	0.324
0.2	1.949	0.25	0.246
0.3	2.031	0.17	0.166
0.4	2.075	0.13	0.123
0.5	2.098	0.10	0.100
0.6	2.109	0.09	0.089
0.7	2.12	0.08	0.079
0.8	2.126	0.074	0.073
0.9	2.131	0.069	0.068



To = 0.125 mins
7.5 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.6E-04**	m/sec
	=	**92.192**	cm/hour

Appendix E

Results of Groundwater Quality Testing

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

CERTIFICATE OF ANALYSIS 219522

Client Details

Client	Douglas Partners Pty Ltd
Attention	Chamali Nagodavithane
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**73965.06, Kensington**
Number of Samples	4 Water
Date samples received	13/06/2019
Date completed instructions received	13/06/2019

Analysis Details

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

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

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

Report Details

Date results requested by	20/06/2019
Date of Issue	20/06/2019

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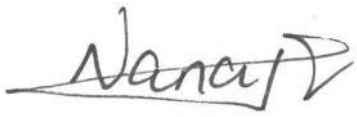
Results Approved By
Diego Bigolin, Team Leader, Inorganics
Giovanni Agosti, Group Technical Manager
Ken Nguyen, Reporting Supervisor
Nancy Zhang, Laboratory Manager, Sydney
Priya Samarawickrama, Senior Chemist
Steven Luong, Organics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water					
Our Reference		219522-1	219522-2	219522-3	219522-4
Your Reference	UNITS	BH201	BH202	BH203	BD1 190612
Date Sampled		12/06/2019	12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water	Water
Date extracted	-	14/06/2019	14/06/2019	14/06/2019	14/06/2019
Date analysed	-	17/06/2019	17/06/2019	17/06/2019	17/06/2019
TRH C_6 - C_9	µg/L	<10	<10	<10	<10
TRH C_6 - C_{10}	µg/L	<10	<10	<10	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	115	113	114	116
Surrogate toluene-d8	%	96	97	95	97
Surrogate 4-BFB	%	95	96	92	92

svTRH (C10-C40) in Water					
Our Reference		219522-1	219522-2	219522-3	219522-4
Your Reference	UNITS	BH201	BH202	BH203	BD1 190612
Date Sampled		12/06/2019	12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water	Water
Date extracted	-	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Date analysed	-	19/06/2019	19/06/2019	19/06/2019	19/06/2019
TRH C_{10} - C_{14}	µg/L	<50	<50	<50	<50
TRH C_{15} - C_{28}	µg/L	<100	<100	<100	<100
TRH C_{29} - C_{36}	µg/L	<100	<100	<100	<100
TRH >C_{10} - C_{16}	µg/L	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50	<50	[NT]
TRH >C_{16} - C_{34}	µg/L	<100	<100	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100	<100	<100
Surrogate o-Terphenyl	%	71	72	99	82

PAHs in Water - Low Level					
Our Reference	UNITS	219522-1	219522-2	219522-3	219522-4
Your Reference		BH201	BH202	BH203	BD1 190612
Date Sampled		12/06/2019	12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water	Water
Date extracted	-	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Date analysed	-	19/06/2019	19/06/2019	19/06/2019	19/06/2019
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	75	70	78	88

OCP in water - Trace level		
Our Reference	UNITS	219522-1
Your Reference		BH201
Date Sampled		12/06/2019
Type of sample		Water
Date extracted	-	19/06/2019
Date analysed	-	20/06/2019
HCB	µg/L	<0.001
alpha-BHC	µg/L	<0.001
gamma-BHC	µg/L	<0.001
beta-BHC	µg/L	<0.001
Heptachlor	µg/L	<0.001
delta-BHC	µg/L	<0.001
Aldrin	µg/L	<0.001
Heptachlor Epoxide	µg/L	<0.001
gamma-Chlordane	µg/L	<0.001
alpha-Chlordane	µg/L	<0.001
Endosulfan I	µg/L	<0.002
pp-DDE	µg/L	<0.001
Dieldrin	µg/L	<0.001
Endrin	µg/L	<0.001
pp-DDD	µg/L	<0.001
Endosulfan II	µg/L	<0.002
DDT	µg/L	<0.001
Endosulfan Sulphate	µg/L	<0.001
Methoxychlor	µg/L	<0.001
Mirex	µg/L	<0.002
Surrogate p-Terphenyl-d_{14}	%	104

OP in water Trace ANZECCF/ADWG		
Our Reference	UNITS	219522-1
Your Reference		BH201
Date Sampled		12/06/2019
Type of sample		Water
Date extracted	-	19/06/2019
Date analysed	-	20/06/2019
Azinphos-methyl (Guthion)	µg/L	<0.02
Bromophos ethyl	µg/L	<0.2
Chlorpyriphos	µg/L	<0.009
Chlorpyriphos-methyl	µg/L	<0.2
Diazinon	µg/L	<0.01
Dichlorovos	µg/L	<0.2
Dimethoate	µg/L	<0.15
Ethion	µg/L	<0.2
Fenitrothion	µg/L	<0.2
Malathion	µg/L	<0.05
Parathion	µg/L	<0.004
Methyl Parathion	µg/L	<0.2
Ronnel	µg/L	<0.2
Surrogate p-Terphenyl-d_{14}	%	104

PCB in water - trace level Aroclors		
Our Reference		219522-1
Your Reference	UNITS	BH201
Date Sampled		12/06/2019
Type of sample		Water
Date prepared	-	19/06/2019
Date analysed	-	20/06/2019
Aroclor 1016	µg/L	<0.01
Aroclor 1221	µg/L	<0.01
Aroclor 1232	µg/L	<0.01
Aroclor 1242	µg/L	<0.01
Aroclor 1248	µg/L	<0.01
Aroclor 1254	µg/L	<0.01
Aroclor 1260	µg/L	<0.01
Surrogate p-Terphenyl-d14	%	104

HM in water - dissolved					
Our Reference	UNITS	219522-1	219522-2	219522-3	219522-4
Your Reference		BH201	BH202	BH203	BD1 190612
Date Sampled		12/06/2019	12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water	Water
Date prepared	-	14/06/2019	14/06/2019	14/06/2019	14/06/2019
Date analysed	-	14/06/2019	14/06/2019	14/06/2019	14/06/2019
Arsenic-Dissolved	µg/L	<1	<1	2	<1
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1
Copper-Dissolved	µg/L	<1	<1	<1	<1
Lead-Dissolved	µg/L	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	<1	<1	<1	<1
Zinc-Dissolved	µg/L	3	1	2	4

HM in water - total				
Our Reference		219522-1	219522-2	219522-3
Your Reference	UNITS	BH201	BH202	BH203
Date Sampled		12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water
Date prepared	-	14/06/2019	14/06/2019	14/06/2019
Date analysed	-	14/06/2019	14/06/2019	14/06/2019
Arsenic-Total	µg/L	<1	<1	5
Cadmium-Total	µg/L	<0.1	<0.1	<0.1
Chromium-Total	µg/L	<1	<1	1
Copper-Total	µg/L	<1	<1	11
Lead-Total	µg/L	4	3	17
Mercury-Total	µg/L	<0.05	<0.05	<0.05
Nickel-Total	µg/L	<1	<1	<1
Zinc-Total	µg/L	6	4	13

Total Phenolics in Water		
Our Reference		219522-1
Your Reference	UNITS	BH201
Date Sampled		12/06/2019
Type of sample		Water
Date extracted	-	14/06/2019
Date analysed	-	14/06/2019
Total Phenolics (as Phenol)	mg/L	<0.05

Miscellaneous Inorganics				
Our Reference	UNITS	219522-1	219522-2	219522-3
Your Reference		BH201	BH202	BH203
Date Sampled		12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water
Date prepared	-	13/06/2019	13/06/2019	13/06/2019
Date analysed	-	13/06/2019	13/06/2019	13/06/2019
Electrical Conductivity	µS/cm	190	220	520
Total Suspended Solids	mg/L	8	14	44
pH	pH Units	6.7	6.7	6.9
Oil & Grease (LLE)	mg/L	<5	<5	<5

Cations in water Dissolved				
Our Reference	UNITS	219522-1	219522-2	219522-3
Your Reference		BH201	BH202	BH203
Date Sampled		12/06/2019	12/06/2019	12/06/2019
Type of sample		Water	Water	Water
Date digested	-	14/06/2019	14/06/2019	14/06/2019
Date analysed	-	14/06/2019	14/06/2019	14/06/2019
Calcium - Dissolved	mg/L	8.9	12	45
Magnesium - Dissolved	mg/L	2.9	3.4	8.7
Hardness	mgCaCO 3 /L	34	44	150

Method ID	Methodology Summary
Ext-054	Analysed by MPL Envirolab
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-003	Oil & Grease - determine gravimetrically following extraction with Hexane, in accordance with APHA latest edition, 5520-B.
Inorg-019	Suspended Solids - determined gravimetricially by filtration of the sample. The samples are dried at 104+/-5°C.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-003	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-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-012/017	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	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.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W6	[NT]
Date extracted	-			14/06/2019	1	14/06/2019	17/06/2019		14/06/2019	[NT]
Date analysed	-			17/06/2019	1	17/06/2019	17/06/2019		17/06/2019	[NT]
TRH C_6 - C_9	µg/L	10	Org-016	<10	1	<10	<10	0	93	[NT]
TRH C_6 - C_{10}	µg/L	10	Org-016	<10	1	<10	<10	0	93	[NT]
Benzene	µg/L	1	Org-016	<1	1	<1	<1	0	102	[NT]
Toluene	µg/L	1	Org-016	<1	1	<1	<1	0	96	[NT]
Ethylbenzene	µg/L	1	Org-016	<1	1	<1	<1	0	86	[NT]
m+p-xylene	µg/L	2	Org-016	<2	1	<2	<2	0	90	[NT]
o-xylene	µg/L	1	Org-016	<1	1	<1	<1	0	92	[NT]
Naphthalene	µg/L	1	Org-013	<1	1	<1	<1	0	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-016	105	1	115	102	12	99	[NT]
Surrogate toluene-d8	%		Org-016	100	1	96	98	2	99	[NT]
Surrogate 4-BFB	%		Org-016	98	1	95	94	1	99	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	219522-4
Date extracted	-			18/06/2019	3	18/06/2019	18/06/2019		18/06/2019	18/06/2019
Date analysed	-			19/06/2019	3	19/06/2019	19/06/2019		19/06/2019	19/06/2019
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	3	<50	<50	0	103	108
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	3	<100	<100	0	104	112
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	3	<100	<100	0	101	92
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	3	<50	<50	0	103	108
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	3	<100	<100	0	104	112
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	3	<100	<100	0	101	92
Surrogate o-Terphenyl	%		Org-003	85	3	99	83	18	80	82

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	219522-4
Date extracted	-			18/06/2019	[NT]	[NT]	[NT]	[NT]	18/06/2019	18/06/2019
Date analysed	-			19/06/2019	[NT]	[NT]	[NT]	[NT]	19/06/2019	19/06/2019
Naphthalene	µg/L	0.2	Org-012	<0.2	[NT]	[NT]	[NT]	[NT]	108	85
Acenaphthylene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	88	92
Phenanthrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	80	75
Anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	76	70
Pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	80	75
Benzo(a)anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	82	75
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-012	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	78	71
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	98	[NT]	[NT]	[NT]	[NT]	86	72

QUALITY CONTROL: OCP in water - Trace level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/06/2019	[NT]	[NT]	[NT]	[NT]	19/06/2019	[NT]
Date analysed	-			20/06/2019	[NT]	[NT]	[NT]	[NT]	20/06/2019	[NT]
HCB	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	121	[NT]
gamma-BHC	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	124	[NT]
Heptachlor	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	125	[NT]
delta-BHC	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	116	[NT]
Heptachlor Epoxide	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	100	[NT]
gamma-Chlordane	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-Chlordane	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	µg/L	0.002	Org-005	<0.002	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	101	[NT]
Dieldrin	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	107	[NT]
Endrin	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDD	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	111	[NT]
Endosulfan II	µg/L	0.002	Org-005	<0.002	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
DDT	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	106	[NT]
Methoxychlor	µg/L	0.001	Org-005	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mirex	µg/L	0.002	Org-012	<0.002	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d_{14}	%		Org-012	92	[NT]	[NT]	[NT]	[NT]	89	[NT]

QUALITY CONTROL: OP in water Trace ANZECCF/ADWG						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/06/2019	[NT]	[NT]	[NT]	[NT]	19/06/2019	[NT]
Date analysed	-			20/06/2019	[NT]	[NT]	[NT]	[NT]	20/06/2019	[NT]
Azinphos-methyl (Guthion)	µg/L	0.02	Ext-054	<0.02	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bromophos ethyl	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chlorpyriphos	µg/L	0.009	Ext-054	<0.009	[NT]	[NT]	[NT]	[NT]	100	[NT]
Chlorpyriphos-methyl	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	120	[NT]
Diazinon	µg/L	0.01	Ext-054	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dichlorovos	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dimethoate	µg/L	0.15	Ext-054	<0.15	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ethion	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	99	[NT]
Fenitrothion	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	119	[NT]
Malathion	µg/L	0.05	Ext-054	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Parathion	µg/L	0.004	Ext-054	<0.004	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Methyl Parathion	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ronnel	µg/L	0.2	Ext-054	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d_{14}	%		Ext-054	92	[NT]	[NT]	[NT]	[NT]	89	[NT]

QUALITY CONTROL: PCB in water - trace level Aroclors						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			19/06/2019	[NT]	[NT]	[NT]	[NT]	19/06/2019	[NT]
Date analysed	-			20/06/2019	[NT]	[NT]	[NT]	[NT]	20/06/2019	[NT]
Aroclor 1016	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	105	[NT]
Aroclor 1260	µg/L	0.01	Org-012/017	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Ext-054	92	[NT]	[NT]	[NT]	[NT]	89	[NT]

QUALITY CONTROL: HM in water - dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	219522-2
Date prepared	-			14/06/2019	1	14/06/2019	14/06/2019		14/06/2019	14/06/2019
Date analysed	-			14/06/2019	1	14/06/2019	14/06/2019		14/06/2019	14/06/2019
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		98	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	[NT]		100	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		101	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		102	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		100	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	<0.05	0	109	107
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		95	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	3	[NT]		98	[NT]

QUALITY CONTROL: HM in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Date analysed	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Arsenic-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Cadmium-Total	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Chromium-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Copper-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Lead-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Mercury-Total	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	109	[NT]
Nickel-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	95	[NT]
Zinc-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]

QUALITY CONTROL: Total Phenolics in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Date analysed	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			13/06/2019	[NT]	[NT]	[NT]	[NT]	13/06/2019	[NT]
Date analysed	-			13/06/2019	[NT]	[NT]	[NT]	[NT]	13/06/2019	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Total Suspended Solids	mg/L	5	Inorg-019	<5	[NT]	[NT]	[NT]	[NT]	116	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Oil & Grease (LLE)	mg/L	5	Inorg-003	<5	[NT]	[NT]	[NT]	[NT]	91	[NT]

QUALITY CONTROL: Cations in water Dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date digested	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Date analysed	-			14/06/2019	[NT]	[NT]	[NT]	[NT]	14/06/2019	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	105	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	109	[NT]

Result Definitions

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

Quality Control Definitions

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	73965.06	**Suburb:**	Kensington	**To:**	EnviroLab
Project Name:	Groundwater Sampling	**Order Number**			12 Ashley Street, Chatswood 2067
Project Manager:	DH	**Sampler:**	CLN	**Attn:**	Aileen Hie
Emails:	chamali.nagodavithane@douglaspartners.com.au			**Phone:**	(02) 9910 6200
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☑			**Email:**	Ahie@envirolab.com.au
Prior Storage:	☐ Esky ☐ Fridge ☐ Shelved	Do samples contain 'potential' HBM?	Yes ☐ No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)		

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil W - water)	Container Type (G - glass P - plastic)	Analytes: Combo 3L	Combo 4L	EC, TSS, hardness, pH	Metals (total)	oil & grease	OCP, OPP, PCB (trace)				Notes/preservation
BH201	1	12/06/19	W	G		x	x	x	x	x				4L: TRH, BTEX, PAH (low level), 8HM, phenolics
BH202	2	12/06/19	W	G	x		x	x	x					3L: TRH, BTEX, PAH (low level), 8 HM
BH203	3	12/06/19	W	G	x		x	x	x					
BD1 190612	4	12/06/19	W	G	x									
PQL (S) mg/kg														

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 219522
Date Received: 13/06/19
Time Received: 14:02
Received by: SB
Temp: ~~Cool~~/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

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

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container:

Relinquished by:

Transported to laboratory by:

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

Signed: **Received by:** ELS Sydney **Date & Time:** 13/06/19 14:02

Douglas Partners
Geotechnics / Environment / Groundwater

Groundwater Field Sheet

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

Project and Bore Installation Details	
Bore / Standpipe ID:	BH201 (stick up well)
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	12/6/19
Purged By:	CLN
GW Level (pre-purge):	2.08 m bgl
GW Level (post-purge):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	5.49 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	

Bore damaged - could not be developed (bailer unable to fit down well)

5.49 - 2.08 = 3.41
3.41 x 7.2 = 24.6
24.6 x 3 = 73.65

Micropurge and Sampling Details	
Date/Time:	12/6/19
Sampled By:	CLN
Weather Conditions:	Sunny
GW Level (pre-purge):	2.08 m bgl
GW Level (post sample):	2.07 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	5.49 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	~ 3 L
Equipment:	Peristaltic pump, WQM ppm µS NTU

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
14:21	23.2	4.41	434	5.95	—	-69
	21.2	3.25	363	5.97	—	-99
	20.9	3.06	311	5.98	—	-106
	20.8	2.97	272.9	~~5~~ 5.97	—	-105
	20.7	2.93	242	5.98	8.2	-105
	20.7	2.95	231	~~6~~ 5.99	7.9	-105
	20.7	2.88	217	6.01	6.7	-107
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl, Middle of water column
Sample Appearance (e.g. colour, siltiness, odour):	Clear
Sample ID:	BH201
QA/QC Samples:	N/A
Sampling Containers and filtration:	3 x amber, 2 x vials, 1 x purple, 1 x metal (filtered), 1 x metal (unfiltered)
Comments / Observations:	

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Groundwater Field Sheet

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

Project and Bore Installation Details	
Bore / Standpipe ID:	BH202 (gatic cover)
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	12/6/19
Purged By:	CLN
GW Level (pre-purge):	2.17 m bgl
GW Level (post-purge):	2.15 m bgl
PSH observed:	Yes / (No) (interface / (visual)). Thickness if observed:
Observed Well Depth:	4.93 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	twister pump, bailer

4.93 - 2.17 = 2.76
2.76 x 7.2 = 19.9
19.9 x 3 = ~60L

Micropurge and Sampling Details	
Date/Time:	12/6/19
Sampled By:	CLN
Weather Conditions:	sunny
GW Level (pre-purge):	2.15 m bgl
GW Level (post sample):	2.2 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	4.93 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	~3 L
Equipment:	Penpump, W&M

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1 °C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
	19.9	5.24	2608	6.44	—	-62
	20.3	4.09	245	6.30	—	-68
	20.5	3.89	237	6.29	48.6	-72
	20.6	3.71	233	6.29	42.1	-74
	20.6	3.61	232	6.30	39.2	-76
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl, Middle of water column
Sample Appearance (e.g. colour, siltiness, odour):	Clear
Sample ID:	BH202
QA/QC Samples:	BD1
Sampling Containers and filtration:	3x amber, 2x vials, 1x purple, 1x metal (filtered) 1x metal (unfiltered)
Comments / Observations:	

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Groundwater Field Sheet

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

Project and Bore Installation Details	
Bore / Standpipe ID:	BH203 (Stick up)
Project Name:	
Project Number:	73965.02
Site Location:	4-8 Doncaster Av, Kensington
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	12/6/19
Purged By:	CLN
GW Level (pre-purge):	1.82 m bgl
GW Level (post-purge):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	2.79 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	

Bore damaged - could not be developed (bailer / pump unable to fit down well)

Micropurge and Sampling Details	
Date/Time:	12/6/19
Sampled By:	CLN
Weather Conditions:	Sunny
GW Level (pre-purge):	1.82 m bgl
GW Level (post sample):	1.82 m bgl
PSH observed:	Yes / (No) ((interface) / visual). Thickness if observed:
Observed Well Depth:	2.79 m bgl
Estimated Bore Volume:	L
Total Volume Purged:	~3 L
Equipment:	Peristaltic pump, WQM

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
36	20.3	5.01	332	6.53	—	36
	20.5	3.89	358	6.59	—	-44
	20.6	3.23	394	6.61	—	-114
	20.6	2.70	414	6.56	213	-147
	20.6	2.42	426	6.54	143	-167
	20.6	2.13	441	6.55	136	-180
	20.6	1.97	456	6.55	109	-189
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl, Middle of water column
Sample Appearance (e.g. colour, siltiness, odour):	dark brown (2 x amber) clear (remainder bottles)
Sample ID:	BH203
QA/QC Samples:	N/A
Sampling Containers and filtration:	3 x amber, 2 x vials, 1 x purple, 1 x metal (filtered) / 1 x metal (unfiltered)
Comments / Observations:	