Douglas Partners Pty Ltd
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Memorandum

To	Henroth Investments Pty Ltd	Dan Maurici	dan@henroth.com.au
From	Scott Easton	**Date**	16 August 2019
Subject	Groundwater Measurements 3-12 Boondah Road, Warriewood	**Project No.**	85749.00

This provides the factual results of groundwater monitoring undertaken at 3-12 Boondah Road, Warriewood. The monitoring was carried out at the request of Henroth Investments Pty Ltd (Henroth).

Groundwater levels were measured on 8 August 2019 in wells previously installed by DP in 2016 (see attached Drawing 1). Bores 4 appears to have been destroyed.

A summary of the measured groundwater levels within the monitoring wells is provided in Table 1.

Table Summary o Ground ater Measurements in Monitoring Wells

Borehole (Well)	Surface RL (m, AHD)	Well Depth (m)	Measured Depth (m) and RL (m, AHD) to Groundwater in Monitoring Wells	
			23 November 2016	8 August 2019
1	2.4	4.9	1.6 (RL0.8)	1.7 (RL0.7)
2	2.3	4.0	1.2 (RL1.1)	1.0 (RL1.3)
3	4.1	5.8	2.7 (RL1.4)	2.9 (RL1.2)
4	2.1	4.0	1.4 (RL0.7)	destroyed

Groundwater levels will fluctuate and may temporarily rise by at least 1 m (or higher and up to flood levels) following prolonged rainfall. Further monitoring would be required to assess fluctuations in groundwater levels.

We trust the above satisfies your present requirements. Please contact the undersigned should you have any queries.

Yours faithfully,
Douglas Partners Pty Ltd

Scott Easton
Principal

Attached: About this Report
Drawing 1 – Location of Boreholes

About this Report

Douglas Partners

Introduction

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opyright

orehole 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.

Ground ater

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.

eports

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.

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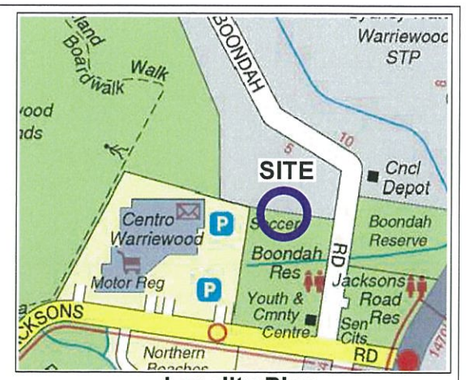

Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 17 November 2016)
2: Test locations are approximate only and are shown with reference to existing features.

0 10 20 30 40 60 80 100 150 200 250m
1:2500 @ A3

LEGEND
Borehole location

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Henroth Investments Pty Ltd	TITLE: **Location of Boreholes**	PROJECT No: 85749.00
	OFFICE: Sydney / DRAWN BY: PSCH	**Proposed Bulky Goods Centre**	DRAWING No: 1
	SCALE: 1:2500 @ A3 / DATE: 25.11.2016	**3-12 Boondah Road, WARRIEWOOD**	REVISION: 0

Douglas Partners
Geotechnics / Environment / Groundwater

Memorandum

To	Henroth Investments Pty Ltd	Dan Maurici	dan@henroth.com.au
From	Scott Easton	**Date**	2 May 2017
Subject	Response to Comments 10-12 Boondah Road, Warriewood	**Project No.**	85749.00.R.003

Introduction

Further to our preliminary geotechnical assessment of the proposed development at 10-12 Boondah Road and 6 Jackson Road, Warriewood (85749.00.R.002, 15 December 2016), this memo has been prepared to provide responses to comments raised by the Northern Beaches Council. Specifically we have been asked to provide further information on the following issues:

- Acid Sulphate Soils
- Water Quality Impacts

Acid Sulphate Soils

Reference to mapping of soils in the area, as well as DP's experience from other nearby sites, indicates that there is a high probability of acid sulphate soils (ASS) occurring on the site.

Detailed investigations during the detailed design phase of the project will quantify the extent of the acid sulphate soils on the site, but regional maps indicate that ASS are likely to occur below depths of 1-3 m, which is the approximate level of the groundwater at the site.

A detailed Acid Sulphate Soils Management Plan will be required for this site prior to commencement of construction to manage the impacts of ASS.

The hazards associated with ASS when constructing on the site are:

- When potential acid sulphate soils (PASS) are excavated from below the water table they will oxidise and form actual acid soils. These soils will be stored in a bunded containment area (or lined skip bins, depending on volumes) and treated with lime to neutralise the soils, prior to disposal off site or reuse on site.
- Any surface water passing through stockpiles of excavated ASS will potentially form acidic water which could impact on the downstream environment. Accordingly all excavated soils will be stored within a bunded area where the surface water can be contained, tested and treated prior to disposal into the environment.
- If the groundwater is lowered below historic levels the PASS may oxidise in-situ, resulting in a lowering of the pH of the groundwater which could impact on groundwater dependent ecosystems and the downstream environment. Accordingly the construction of basements below the groundwater level will be designed to minimise the impact on the groundwater levels by:
    - using deep impermeable shoring walls around the whole of the excavation, to minimise the groundwater inflow to the excavation during the construction;

- o reinjection of groundwater into the area surrounding the excavation to maintain water levels; and,
- o design of the permanent basement structure as a waterproof, 'tanked' structure such that there is no requirement for dewatering in the long term.

Water Quality Impacts

As indicated above, if the potential acid sulphate soils on the site are not managed correctly then the surface waters and/or the groundwater could be adversely impacted, resulting in lower pH values which could affect the water quality within the wetland and other downstream environments.

A detailed Acid Sulphate Soils Management Plan will be required for this site prior to commencement of construction to manage the impacts of ASS.

The design of the basement and its construction will target:

- minimising the amount of dewatering required and any consequent lowering of the groundwater levels, by the use of deep continuous impermeable shoring walls during construction, reinjection of groundwater into the area outside the excavation to help minimise drawdown of groundwater levels, and a permanent waterproof basement structure.
- Containing and treating any excavated ASS, and testing and treating any surface waters which have come into contact with these soils prior to disposal to the environment

During the detailed design stage numerical modelling can be undertaken to demonstrate the impacts of the proposed basements on the groundwater levels. Basement excavations below the groundwater table in acid sulphate soils are not uncommon in Sydney and can be carried out with minimal impact provided that appropriate investigations are carried out to inform the detail design and construction methods.

We trust the above satisfies your present requirements. Please contact the undersigned should you have any queries.

Yours faithfully,
Douglas Partners Pty Ltd Reviewed by

Scott Easton **Fiona MacGregor**
Principal Principal

Attached: About this Report

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Memorandum

To	Henroth Investments Pty Ltd	Dan Maurici	dan@henroth.com.au
From	Scott Easton	**Date**	15 December 2016
Subject	Preliminary Geotechnical Assessment 10-12 Boondah Road, Warriewood	**Project No.**	85749.00.R.001

Introduction

This provides a preliminary geotechnical assessment of the proposed development at 10-12 Boondah Road and 6 Jackson Road, Warriewood. The project is in the preliminary planning stages and specific details have not been confirmed, however it is understood that the development may include;

- a two storey Bulky Goods Centre with undercroft carparking on 10-12 Boondah Road. The undercroft floor level is about RL1.8 m AHD and may require excavation to depths of about 1-2 m below existing surface levels;
- a four storey residential building with a two level basement on the northern end of 10-12 Boondah Road. The basement may require excavation to depths of about 6 m below existing surface levels;
- public open space on 6 Jackson Road with board walks and access to the wetlands.

Geological Mapping

Reference to the 1:100 000 Geological Series Map for Sydney indicates that the site is underlain by Quaternary alluvial and estuarine sediment comprising peaty quartz sand, silt, and clay. The geological map information was confirmed by the field work which identified deep sands interbedded with clay bands and underlain by bedrock at approximately 20 m to 35 m depth.

Published mapping indicates that the site has a high probability of containing acid sulphate soils (ASS) between 1-3 m depth.

Pre ious In estigations

Douglas Partners Pty Ltd (DP) has carried out groundwater monitoring on the site in December 2016 and prepared a memorandum containing the results dated 5 December 2016 (Project 85749). The groundwater investigation included the drilling of four boreholes to depths of between 4.5 m and 6.0 m with groundwater monitoring wells installed in each borehole. Groundwater levels measured in the wells varied from RL0.8 m to RL1.0 m over most of the site (BH1 to BH3) and RL1.4 m on the slightly elevated northern end part of the site (BH4).

DP has also carried out geotechnical investigations for the Centro Shopping Centre to the south-west of the site. The investigations on that site have included boreholes, deep cone penetration tests and groundwater monitoring.

Geotechnical Model

Based on the limited investigations on the site and our previous investigations in the area it is anticipated that the geotechnical model for the site may include;

- Filling to depths of 1-2m; over
- Very loose to loose sand with clayey bands to depths of 4-8m; over
- Soft to stiff clay to depths of 10-15 m; over
- Dense to very dense sand to depths of 15-20 m; over
- Bedrock at depths of about 20-35 m; and
- A shallow groundwater table at depths of about 1-1.5 m (RL0.7 m to RL1.1 m) over most of the site and rising slightly to about RL1.5 m on the slightly elevated northern end of the site. Groundwater levels will fluctuate and may temporarily rise by at least 1 m (or higher and up to flood levels) following prolonged rainfall. Further monitoring would be required to assess fluctuations in groundwater levels.

omments

Further detailed geotechnical investigations will be required to assess the soil and groundwater profile on the site prior to detailed design and planning.

From a geotechnical point of view the site is suitable for the proposed development provided that appropriate design and construction is adopted. Further geotechnical review and advice will be required once further detailed investigations are completed and details of the proposed development have been confirmed. Some preliminary comments are provided below.

Excavations for the undercroft to depths of 1-2 m will be close to or below the groundwater table. Excavations for the two level basement to 6 m depth will extend below the groundwater table. Temporary dewatering will be required to temporarily lower the groundwater table to allow for excavation and construction of the basement structures. All below ground structures will need to be tanked and designed for potential elevated groundwater levels, probably to the ground surface (or flood levels).

Dewatering will need to consider potential impacts to surrounding properties and also potential acid sulphate soils. The dewatering may include reinjection of groundwater into the area outside the excavation to help minimise drawdown of groundwater levels and to maintain a more stable groundwater level. The use of impermeable shoring walls extending well below the excavation level may also be used to help reduce groundwater inflows during construction and also to reduce drawdown of water levels outside the excavation. Shoring walls embedded well below the bulk excavation level will most likely be required for the two level basement.

Where the basements are set well back from site boundaries and nearby structures it may be possible to use temporary batters at about 2H :1V (Horizontal:Vertical). Open excavations without shoring will however be associated with higher inflow rates and will almost certainly need to include reinjection to maintain water levels outside the excavation.

Alternatively excavations may be supported by shoring walls. Suitable shoring for excavations below the groundwater table may include;

- a secant pile wall, comprising interlocking Continuous Flight Auger (CFA) piles or CFA piles with jet grouted columns between the piles.
- a soil mixed wall system, constructed using specialised equipment to blend cement with the in-situ soils to create a soil-cement mix. There are several different systems available and further advice should be obtained from the specialist piling contractor regarding the suitability of the wall system to this site.
- sheet piles may be suitable but only where excavations are set well back from adjacent structures due to risks associated with vibration during installation.

Foundations for the new structures will depend on the actual ground conditions, building loads and settlement tolerances. Foundations may include;

- stiffened raft slab;
- piles founded in uniform dense sand or very stiff to hard clay;
- piles founded on rock.

We trust the above satisfies your present requirements. Please contact the undersigned should you have any queries.

Yours faithfully,
Douglas Partners Pty Ltd

Scott Easton
Principal

Reviewed by

Fiona MacGregor
Principal

Attached: About this Report

About this Report

Douglas Partners

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Ground ater

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
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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.

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Memorandum

To	Henroth Investments Pty Ltd	Dan Maurici	dan@henroth.com.au
From	Scott Easton	**Date**	5 December 2016
Subject	Groundwater Measurements 3-12 Boondah Road, Warriewood	**Project No.**	85749.00

This provides the factual results of groundwater monitoring undertaken for the proposed Bulky Goods Centre at 3-12 Boondah Road, Warriewood. The monitoring was carried out at the request of Henroth Investments Pty Ltd (Henroth).

Four boreholes (BH1 to BH4) were drilled at the locations nominated by Henroth (see attached Drawing 1). The boreholes were drilled to depths of between 4.5 m and 6.0 m using a bobcat sized and truck mounted drilling rig. Groundwater monitoring wells comprising Class 18 machine slotted PVC were installed in each of the boreholes. Steel protective covers were installed at the surface.

The borehole logs are attached and show the soil profile encountered and the monitoring well construction details. The boreholes were logged on site by a geotechnical engineer. The surface levels at each of the boreholes were measured using optical survey equipment relative to State Survey Mark (PM6869, RL2.603 m relative to Australia Height Datum [AHD]).

A summary of the measured groundwater levels within the monitoring wells is provided in Table 1.

Table 1: Summary of Groundwater Measurements in Monitoring Wells

Borehole (Well)	Surface RL (m, AHD)	Well Depth (m)	Measured Depth (m) and RL (m, AHD) to Groundwater in Monitoring Wells 23 November 2016
1	2.4	4.9	1.6 (RL0.8)
2	2.3	4.0	1.2 (RL1.1)
3	4.1	5.8	2.7 (RL1.4)
4	2.1	4.0	1.4 (RL0.7)

Measured water levels vary from RL0.8 m to RL1.0 m over most of the site (BH1 to BH3) and rise slightly to RL1.4 m on the elevated northern end part of the site (BH4). Groundwater levels will fluctuate and may temporarily rise by at least 1 m (or higher and up to flood levels) following prolonged rainfall. Further monitoring would be required to assess fluctuations in groundwater levels.

We trust the above satisfies your present requirements. Please contact the undersigned should you have any queries.

Yours faithfully,
Douglas Partners Pty Ltd

Scott Easton
Principal

Reviewed by

Ray Blinman
Principal

Attached: About this Report
Borehole Logs
Drawing 1 – Location of Boreholes

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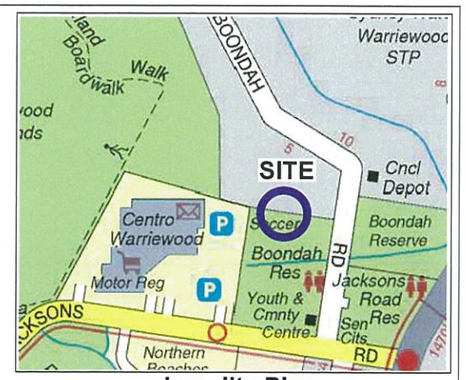

Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 17 November 2016)
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0 10 20 30 40 60 80 100 150 200 250m
1:2500 @ A3

LEGEND
Borehole location

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Henroth Investments Pty Ltd	TITLE: **Location of Boreholes**	PROJECT No: 85749.00
	OFFICE: Sydney / DRAWN BY: PSCH	**Proposed Bulky Goods Centre**	DRAWING No: 1
	SCALE: 1:2500 @ A3 / DATE: 25.11.2016	**3-12 Boondah Road, WARRIEWOOD**	REVISION: 0

BOREHOLE LOG

CLIENT: Henroth Investments Pty Ltd
PROJECT: Proposed Bulky Goods Centre
LOCATION: 3-12 Boondah Road, Warriewood

SURFACE LEVEL: 2.39 AHD^
EASTING: 342229.8
NORTHING: 6270135
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 85749.00
DATE: 21/11/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - red-brown, silty sand filling, humid							Gatic cover Backfill 0.0-0.2m Bentonite 0.2-0.6m
		0.5m: with a trace of shell fragments							
		1.2m: damp to moist							
		1.6m: saturated						23-11-16	Gravel 0.6-4.9m
	1.9	SAND - grey fine to coarse sand with a trace of clay, saturated							Machine slotted PVC screen 0.9-4.9m
	5.1	SANDY CLAY - dark grey sandy clay, saturated							End cap
	5.5	Bore discontinued at 5.5m - target depth reached							

RIG: Scout 1 **DRILLER:** W Gartside **LOGGED:** A McIntyre **CASING:** Uncased

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

WATER OBSERVATIONS: Free groundwater observed in well at 1.62m on 23/11/16

REMARKS: ^Co-ordinates obtained by Nearmaps, RL by Survey

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: Henroth Investments Pty Ltd
PROJECT: Proposed Bulky Goods Centre
LOCATION: 3-12 Boondah Road, Warriewood

SURFACE LEVEL: 2.25 AHD^
EASTING: 342226.4
NORTHING: 6270495.7
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 85749.00
DATE: 21/11/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - orange-brown, silty fine to medium sand filling with a trace of shells and terracotta fragments, humid		A	0.1-0.2				Gatic cover; Backfill 0.0-0.4m
				A	0.4-0.5				Bentonite 0.4-0.7m
	0.7	SAND - grey, fine to coarse sand with some clay, moist		A	0.9-1.0				
		1.2m: saturated						▼ 23-11-16	
	1.4	CLAYEY SAND - dark grey clayey sand, saturated		A	1.4-1.5				Gravel 0.7-4.0m
	1.9	SANDY CLAY - dark grey, sandy clay, saturated, slight organic odour		A/E	1.9-2.0				
				A	2.4-2.5				Machine slotted PVC screen 1.0-4.0m
	3.8	CLAY - light brown clay with some fine sand, MC>PL							End cap
				A	4.4-4.5				
	4.5	Bore discontinued at 4.5m - target depth reached							

RIG: Scout 1 **DRILLER:** W Gartside **LOGGED:** A McIntyre **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 4.5m

WATER OBSERVATIONS: Free groundwater observed in well at 1.2m on 23/11/16

REMARKS: ^Co-ordinates obtained by Nearmaps, RL by Survey

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Henroth Investments Pty Ltd
PROJECT: Proposed Bulky Goods Centre
LOCATION: 3-12 Boondah Road, Warriewood

SURFACE LEVEL: 4.1 AHD^
EASTING: 342177
NORTHING: 6270617
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 85749.00
DATE: 21/11/2016
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
4.1	0.0	FILLING - grey-brown sand filling with some fine gravel and a trace of charcoal, damp		A	0.1-0.2				Gatic cover; Backfill 0.0-0.1m; Bentonite 0.1-0.3m
				A	0.4-0.5				
				A/E	0.9-1.0				
2.9	1.2	SAND - orange-brown, slightly clayey sand, damp to moist		A	1.4-1.5				Gravel 0.8-5.8m
2.4	1.7	CLAY - orange clay with a trace of sand, MC~PL		A	1.9-2.0				
		2.2m: becoming orange-grey with a trace of ironstone gravel		A	2.4-2.5			▼ 23-11-16	
1.3	2.8	CLAY - grey mottled red-brown clay with a trace of sand and fine ironstone gravel, MC~PL		A	2.9-3.0				Machine slotted PVC screen 0.8-5.8m
				A	3.9-4.0				
-0.6	4.7	SILTY CLAY - light brown, silty clay with a trace of sand, MC>PL		A	4.9-5.0				
-1.9	6.0	Bore discontinued at 6.0m - target depth reached		A	5.9-6.0				End cap

RIG: Scout 1 **DRILLER:** W Gartside **LOGGED:** A McIntyre **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater observed in well at 2.67m on 23/11/16

REMARKS: ^Co-ordinates obtained by Nearmaps, RL by Survey

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Henroth Investments Pty Ltd
PROJECT: Proposed Bulky Goods Centre
LOCATION: 3-12 Boondah Road, Warriewood

SURFACE LEVEL: 2.1 AHD^
EASTING: 342425.7
NORTHING: 6270502.7
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85749.00
DATE: 23/11/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILLING - brown silty sand filling with some terracotta fragments (50mm), humid		A	0.1 0.2				
		FILLING - dark grey fine to coarse sand filling with some clay and fine basalt gravel, humid to damp		A/E	0.4 0.5				
	0.8	SAND - grey fine to coarse sand with a trace of silt, damp to moist		A	0.9 1.0				
		1.3m: wet		A	1.4 1.5			▼ 23-11-16	
		1.6m: saturated							
	1.7	CLAYEY SAND - dark grey, slightly clayey fine to coarse sand, saturated, organic odour		A	1.9 2.0				
				A	2.4 2.5				
				A	2.9 3.0				
		4.0m: becoming more clayey		A	3.9 4.0				
				A	4.9 5.0				
	5.8	CLAY - light grey clay with a trace of sand, MC<PL		A	5.9 6.0				
	6.0	Bore discontinued at 6.0m - target depth reached							

RIG: Bobcat **DRILLER:** G Marino **LOGGED:** A McIntyre **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater observed in well at 1.43m on 23/11/16

REMARKS: ^Co-ordinates obtained by Nearmaps, RL by Survey

SAMPLING & IN SITU TESTING LEGEND

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

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