



FOUNDATION
EARTH
SCIENCES

HYDROGEOLOGICAL REPORT AND DEWATERING MANAGEMENT PLAN

Property Address

16-20 Carrington Road, Castle Hill NSW 2154

Prepared for

ARADA Pty Ltd

Date

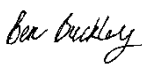
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ABBREVIATIONS

AIP	<i>Australian Institute of Petroleum Ltd</i>	QA/QC	<i>Quality Assurance, Quality Control</i>
ANZECC	<i>Australian and New Zealand Environment and Conservation Council</i>	RAC	<i>Remediation Acceptance Criteria</i>
AST	<i>Aboveground Storage Tank</i>	RAP	<i>Remediation Action Plan</i>
BGL	<i>Below Ground Level</i>	RPD	<i>Relative Percentage Difference</i>
BTEX	<i>Benzene, Toluene, Ethyl benzene and Xylene</i>	SAC	<i>Site Assessment Criteria</i>
COC	<i>Chain of Custody</i>	SVC	<i>Site Validation Criteria</i>
DA	<i>Development Approval</i>	TCLP	<i>Toxicity Characteristics Leaching Procedure</i>
DP	<i>Deposited Plan</i>	TPH	<i>Total Petroleum Hydrocarbons</i>
DQOs	<i>Data Quality Objectives</i>	UCL	<i>Upper Confidence Limit</i>
EPA	<i>Environment Protection Authority</i>	UST	<i>Underground Storage Tank</i>
ESA	<i>Environmental Site Assessment</i>	VHC	<i>Volatile Halogenated Compounds</i>
HIL	<i>Health-Based Soil Investigation Level</i>	VOC	<i>Volatile Organic Compounds</i>
LGA	<i>Local Government Area</i>	DPI	<i>Department of Primary Industries</i>
NEHF	<i>National Environmental Health Forum</i>		
NEPC	<i>National Environmental Protection Council</i>		
NHMRC	<i>National Health and Medical Research Council</i>		
OCP	<i>Organochlorine Pesticides</i>		
OPP	<i>Organophosphate Pesticides</i>		
PAH	<i>Polycyclic Aromatic Hydrocarbon</i>		
PCB	<i>Polychlorinated Biphenyl</i>		
PID	<i>Photo Ionisation Detector</i>		
PQL	<i>Practical Quantitation Limit</i>		

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1.0 INTRODUCTION

ARADA Pty Ltd appointed Foundation Earth Sciences to prepare a Dewatering Management Plan (DMP) for the property located at 16-20 Carrington Road, Castle Hill NSW 2154 (hereafter known as the “site”). The purpose of this assessment is to achieve compliance with local council and Water NSW requirements in relation to the proposed future dewatering activities within the site.

2.0 OBJECTIVE

The objective of this DMP is to provide management procedures and has been prepared to generally address the guidance provided in the Department of Planning, Industry and Environment (DPIE) (currently called the Department of Planning and Environment) document titled “*Minimum requirements for building site groundwater investigations and reporting*”, dated January 2021 (DPIE 2021), within the context of the groundwater related risks associated with the project site.

3.0 LEGISLATION REQUIREMENTS

The following NSW state legislation, policies, and guidelines are applicable to the planned development and have been considered during the preparation of this DMP.

- Water Management Act (2000) and Water Act (1912).
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources.
- NSW Aquifer Interference Policy (NOW, 2012).

- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012).
- NSW Wetlands Policy (2010).
- NSW State Groundwater Policy Framework Document (1997).
- NSW State Groundwater Quality Protection Policy (1998).
- NSW State Groundwater Dependent Ecosystems Policy (2002).
- NSW Water Extraction Monitoring Policy (2007).

4.0 PROPOSED DEVELOPMENT

The proposed development includes the demolition of the existing structures and the construction of a mixed use commercial and residential flat building with two level basement, lower ground floor and associated landscaping areas.

Refer to **Appendix B** – Proposed Development Plans.

5.0 SITE IDENTIFICATION AND HISTORICAL INFORMATION

5.1 Site identification

The site is identified as follows:

Table 1: Site Identification Review

Site	Details	
Location	16-20 Carrington Road, Castle Hill NSW 2154	
Lot/DP	Lot 2 in DP 1257535; Lot 26 in DP247890; lot 27 in DP247890; Lot 28 in DP253774; Lot 2 of DP253774; lot 19 in DP247890; lot 30 in DP247890; lot 31 in DP247890; lot 32 in DP247890; lot 20 in DP247890; Lot 21 in DP247890; lot 22 in DP247890; lot 23 in DP247890; lot 24 in DP247890; lot 1 in DP243774	
Local Council	The Hills Shire Council	
Site Area	Approximately 14,000m ²	
Shape & Slope	Irregular shape block of land sloping North West from South East	
Existing Structures	Multiple residential properties and buildings on the site	
Closest Watercourse	Cattai Creek approximately 250m distance to the west	
Neighbouring Properties	East	- Residential properties & Sexton Avenue
	West	- Residential properties & Middleton Avenue
	South	- Residential properties & Fishburn Crescent
	North	- Residential properties & Carrington Road
Geology Map	Penrith 1: 1:100,000 Geological Series Sheet 9030, Edition 1, 1991, from the Geological Survey of New South Wales	
Primary Geology	Rwa – Ashfield Shale, Wianamatta Group, Triassic Age, described as “Dark grey to black claystone-siltstone and fine sandstone-siltstone laminite” at the development site	

Secondary Geology	Rh- Hawkesbury Sandstone, Wianamatta Group, Triassic Age, described as “Medium to very coarse-grained quartz sandstone, minor laminated mudstone and siltstone lenses” 150m W of site
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5.2 Previous Reports

Two (2) previous investigation for the property is listed below:

- ACSES Engineers “Geotechnical Engineering Design Brief” prepared by ACSES for ARADA, Document Reference: 121527.GED01, dated 24th January 2024.
- Geotechnical Investigation Report, titled “16-20 Carrington Road, Castle Hill NSW 2154”, was prepared by FES, with reference to report No. G702-1, and dated May 2024

6.0 REVIEW OF GEOLOGICAL INFORMATION

FES installed three groundwater well, identified as GW201, as part of the hydrogeological assessment, identified as BH2/GW1, BH12/GW2 and BH13/GW3. Ground profiles encountered within the boreholes is summarised in the following table. However, reference should be made to the logs annexed in Appendix C for details.

Table 2: Summary of Ground Profile

Unit	Details	Depth (m)			
		BH1	BH2/GW1	BH3	BH4
Surface / Top of BH (RL m AHD)		96.6	100.7	103.0	101.9
DGB Roadbase	Gravel, 50mm thickness	-	-	-	-
Fill [Topsoil and Fill]	Clayey Silt/ Silty Clay, low to medium plasticity, brown/yellow, dry	0.0 – 0.4	0.0 – 0.5	0.0 – 0.2	0.0 – 0.8
Residual Soil	Silty CLAY, high plasticity, orange/grey and brown	0.4 – 1.0	0.5 – 2.4	0.2 – 1.4	0.8 – 1.0
Class V ¹ Sandstone	SANDSTONE, extremely weathered, interbedded with clay bands, very low to low strength, brown	-	2.4 – 6.0	1.4 – 6.2	-
Class IV ¹ Sandstone	SANDSTONE, with shale layers, highly weathered	-	6.0 – 7.1	6.2 – 8.2	-
Class III ¹ Sandstone	SANDSTONE, moderately weathered, grey/brown	-	-	8.2 – 10.2	-
Unit	Details	Depth (m)			
		BH5	BH6	BH7	BH8
Surface / Top of BH (RL m AHD)		105.6	105.3	98.5	101.1
DGB Roadbase	Gravel, 50mm thickness	-	-	-	-

Fill [Topsoil and Fill]	Clayey Silt/ Silty Clay, low to medium plasticity, brown/yellow, dry	0.0 – 0.4	0.0 – 0.4	0.0 – 0.4	0.0 – 0.4
Residual Soil	Silty CLAY, high plasticity, orange/grey and brown	0.4 – 1.0	0.4 – 1.0	0.4 – 1.0	0.4 – 1.0
Class V ¹ Sandstone	SANDSTONE, extremely weathered, interbedded with clay bands, very low to low strength, brown	-	-	-	-
Class IV ¹ Sandstone	SANDSTONE, with shale layers, highly weathered	-	-	-	-
Class III ¹ Sandstone	SANDSTONE, moderately weathered, grey/brown	-	-	-	-
Unit	Details	Depth (m)			
		BH9	BH10	BH11/GW3	BH12/GW2
Surface / Top of BH (RL m AHD)		105.2	101.7	101.9	105.0
DGB Roadbase	Gravel, 50mm thickness	-	-	-	0.0 – 0.05
Fill [Topsoil and Fill]	Clayey Silt/ Silty Clay, low to medium plasticity, brown/yellow, dry	0.0 – 0.4	0.0 – 0.4	0.0 – 0.7	0.05 – 0.5
Residual Soil	Silty CLAY, high plasticity, orange/grey and brown	0.4 – 1.0	0.4 – 1.0	0.7 – 2.0	0.5 – 2.2
Class V ¹ Sandstone	SANDSTONE, extremely weathered, interbedded with clay bands, very low to low strength, brown	-	-	2.0 – 5.6	2.2 – 6.0
Class IV ¹ Sandstone	SANDSTONE, with shale layers, highly weathered	-	-	5.6 – 6.0	6.0 – 8.7
Class III ¹ Sandstone	SANDSTONE, moderately weathered, grey/brown	-	-	6.0 – 11.9	8.7 – 11.7

Groundwater seepages were not originally observed during drilling works undertaken at the site.

Please refer to **Appendix C** – Borehole Logs

7.0 REVIEW OF HYDROGEOLOGICAL INFORMATION

Table 3: Site Condition and Surrounding Environment Review

Site Information	Descriptions
Sensitive Receivers	The nearest sensitive human receptors are the current and future users of the site, construction workers during the site redevelopment and the public. The nearest watercourse is Cattai Creek approximately 250m distance to the west.
Soil Landscape <i>Review of NSW Soil and Land Information website ESPADE.</i>	The Soil Landscape Map viewed on NSW ESPADE indicates that the site is located within the Glenorie landscape area. The Glenorie landscape area consists of undulating to rolling low hills on Wianamatta Group shales. Local relief 50–80 m, slopes 5–20%. Narrow ridges, hillcrests and valleys. Extensively cleared tall open-forest (wet sclerophyll forests).
Topography	The topography viewed on NSW ESPADE indicated the following for the Glenorie Landscape: Low rolling and steep hills. Local relief 50–120 m, slopes 5–20%. Convex narrow (20–300 m) ridges and hillcrests grade into moderately inclined sideslopes with narrow concave drainage lines. Moderately inclined slopes of 10–15% are the dominant landform elements.
Geological Profile	This soil landscape is underlain by Wianamatta Group Ashfield Shale and Bringelly Shale formations. The Ashfield Shale is comprised of laminite and dark grey shale. Bringelly Shale consists of shale, calcareous claystone, laminite, fine to medium grained lithic-quartz sandstone (Herbert, 1983).
Presence of Acid Sulphate Soils <i>Review of NSW Department of Land & Water Conservation (DLWC) Acid Sulphate Soil Risk Maps</i>	A review of the maps “eSPADE” indicated that there is a “no known occurrence” of acid sulphate soil materials within the soil profile.

Site Information	Descriptions					
(Edition Two, December 1997, Scale 1:250,000).						
Localised Hydrogeology Review of DPI (Office of Water) Database.	Number	Location from Site	Depth (m BGL)	SWL (m BGL)	Use	Water Bearing Zones
	GW107601	521m NW	35.34	-	Monitoring Bore	-
	GW100981	680m NE	102.00	8.00	Domestic	16.50-17.00, 79.50-80.00 & 94.50-85.00
	GW111751	1.6km SE	19.70	-	Monitoring Bore	-
Local Meteorology (Bureau of Meteorology BOM website)	The monthly rainfall of the local surrounding area is represented by the data collected from the BOM rainfall gauge located in Baulkham Hills Eucalyptus Ct, which is approximately km from the site. The records indicate that the mean rainfall recorded in February (date of fieldwork) was 117.7mm.					
Nearest Contaminated Sites (EPA Search)	Searches of EPA records confirmed there were no current properties within 1 km of the site which were the subject of: <ul style="list-style-type: none"> active notifications under Section 60 of the CLM Act orders made under Part 3 of the <i>Contaminated Land Management Act 1997</i> (the <i>CLM Act</i>), and/or the subject of penalty notices issued under the <i>Protection of the Environment Operations Act 1997</i> the (<i>POEO Act</i>). 					
Groundwater dependant Ecosystems (Review of the NSW GDE Atlas)	There are no aquatic GDEs within 2 km of the site. There are no terrestrial GDEs within 2 km of the site. There are no subterranean GDEs within 2 km of the site.					
Natural Springs	No natural springs have been identified at or within 500 m of the site					
Culturally Significant Groundwater Sites	No culturally significant sites were identified within the Greater Metropolitan Regional Groundwater Water Sharing Plan.					

Site Information	Descriptions
Regulated Groundwater Resources	The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources divides the east coast of NSW into 13 groundwater sources, of which the planned development is within the Sydney Basin Central Groundwater Source (SBCGS).
Regional Hydrogeology	The most extensive aquifer at the site is the Sandstone aquifer. The horizontal hydraulic conductivity of the Hawkesbury Sandstone is typically in the order of 5×10^{-7} m/sec to 5×10^{-8} m/sec.

8.0 HYDROGEOLOGICAL INVESTIGATION

To comply with DPIE's minimum requirements for groundwater investigations and reporting for building and construction sites, the following hydrogeological fieldwork was carried out to support those assessments presented in this DMP.

- Drilling of three hydrogeological investigation boreholes identified as BH2/GW1, BH12/GW2, and BH11/GW3 at a selected location on the site.
- Installation and development of groundwater monitoring wells in boreholes GW1, GW2, and GW3.
- Performance of raising head permeability ('slug') tests in the screened intervals of groundwater monitoring wells BH2/GW1, BH12/GW2, and BH11/GW3.

9.0 GROUNDWATER CONDITIONS

FES assessed the three groundwater wells that were installed during the hydrogeological investigation. The locations of the wells are labelled as BH2/GW1, BH12/GW2, and BH11/GW3. No samples were recovered from three (3) groundwater wells for this DMP as the wells were dry during the time of drilling and after 2 weeks of monitoring the GW wells.

Further to this follow up during a preliminary hydraulic (slug test) was performed at a later date. This was purged accordingly however water results did not return immediately and several interferences were noted during the slug testing. It was then decided that the wells would be purged completely again due to the potential from previous drilling water introduced could be skewing the data.

The wells were purged dry (<1L was taken from each well) on the and zero water was identified within the wells. The wells were then left for a period of 1 week however no water was identified upon return for assessment.

Follow up assessments over several weeks also noted the lack of groundwater detected within the wells even after significant periods of rainfall, with the exception of GW1 which had approximately <100ml within the base of the well.

Based on this assessment it was determined that the proposed basement is unlikely to be impacted by any significant groundwater flows. This was consistent with neighbouring sites in which groundwater was not detected during the site works and drilling.

The location of the groundwater wells is shown in **Figure 1** – Site Plan and details of the boreholes are presented in **Appendix C**– Borehole Logs.

9.1 Groundwater Sample Collection

Groundwater sampling for the DMP was attempted on the 19th of April 2024. Prior to sampling, the resting water level was recorded within the well while checking for the presence of phase separated hydrocarbon. The remainder of this report will be on a contingency only basis as no water was detected within the boreholes during this investigation and several follow up assessments.

10.0 DEWATERING (CONTINGENCY ONLY)

The remainder of this assessment serves as contingency only in the event that during construction significant groundwater is identified in areas that could not be previously addressed.

10.1 ADOPTED DISCHARGE CRITERIA

The NSW DECC has endorsed the use of the Groundwater Investigation Levels (GILs) given in the 1999 NEPM '*Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater*' (Amendment 2013) and the water quality trigger levels given in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018). These Guidelines provide criteria for:

- Aquatic ecosystems – both marine and fresh waters

The NEPM advises that 'when assessing groundwater contamination, the GILs are to be applied at the point of extraction and as response levels at the point of use, or where there is a likelihood of an adverse environmental effect at the point of discharge'.

For assessing groundwater quality, it is first necessary to assess the potential uses of groundwater downgradient of the site being assessed.

Potential uses of groundwater downgradient of the site include:

- Discharge to water bodies sustaining aquatic ecosystems particularly Fresh Water.
- Extraction of groundwater by local users.

The threshold concentrations presented in the ANZECC (2000) Fresh and Marine Waters Quality Guidelines are considered applicable for the protection of aquatic ecosystems of the receiving waters. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging to receiving waters. It is important to note that these are not threshold values at which an environmental problem is likely to occur if exceeded, rather, if the trigger values are exceeded, then further action is required which may include either further site-specific investigations to assess whether or not there is an actual problem or management / remedial action should be undertaken.

It is considered that **Marine Water Trigger** values are applicable for investigating chemical concentrations in groundwater at the site. Pacific Ocean, 1.66km east of the site. It is understood that the NSW EPA policy is that the trigger values for the protection of 95% of aquatic ecosystems should be used as groundwater assessment criteria when considering moderately or highly disturbed receiving environments. The receiving waters for groundwater at the site are considered to be moderately disturbed ecosystems and the ANZG (2018) 95% protection values are therefore considered appropriate groundwater assessment criteria for the site.

Guidelines from the Australian Drinking Water Criteria 2018 have also been included.

Refer to **Appendix A** – Adopted Discharge Criteria.

It is estimated that dewatering will be require for the period of 180 days for the construction of the basement. If construction takes longer than this period, then the dewatering should be continued and monitored accordingly.

In providing the above general estimates the following should be noted.

- An ‘instantaneous’ excavation below the water table has been modelled (i.e., excavation staging and the progressive lowering of groundwater levels and accompanying inflow rates has not been considered). As such groundwater inflow rates during construction are conservative, particularly those in the first six months of the modelled scenarios.
- The estimated highest groundwater level at the site was used to estimate both (i) groundwater inflows to the planned excavation / basement, and (ii) the extent of groundwater drawdown attributable to the planned development.
- As stated in above, groundwater levels at these elevations are likely to only occur sporadically during and after significant rainfall events (i.e., they are not typical at the site) hence their inclusion in these assessments is considered to be conservative and likely result in ‘worst-case scenario’ estimates of groundwater inflows and the extent of groundwater drawdown surrounding the planned development.
- Should joints, swarms, faults etc be encountered in the excavation that were not identified during borehole drilling – which is considered unlikely, then additional inflows to those presented may be experienced. Under these circumstances, excavation should be suspended, the inflows assessed by a hydrogeologist and consideration given to employing additional mitigation measures (including grouting).
- Should there be additional drained basements (either now or in the future) within the estimated zone of groundwater drawdown – which is considered likely, particularly at the mixed residential and commercial development to the east of the site.

- The site, then the passive take of groundwater by this planned development will be less (or reduce) than the modelled inflows.

10.2 Drawdown

Predictions of the maximum (i.e., long-term) extent of groundwater drawdown (cone of depression) in the shale/sandstone bedrock aquifer were generally estimated from the groundwater flow modelling. Drawdown will be greatest along the boundaries of the excavation, with groundwater ultimately draining to the same elevation as the sub-floor drains below the planned basement floors and decreasing with distance from the excavation.

Maximum distances behind each wall at which steady-state groundwater level drawdown is estimated based on a project-induced drawdown in groundwater wells (via downward drainage as opposed to increase in the regional bedrock aquifer beneath horizontal groundwater flow) and is expected to be much less than this and likely indistinguishable from natural variations of groundwater levels in response to groundwater recharge and discharge fluxes.

10.3 Settlement

The primary aquifer is most likely located deeper within the medium strength shale/sandstone rock, changes in the elevation of the water table due to dewatering and any depressurisation due to the proposed development will result in negligible consolidation and settlement as they are not expected to be impacted.

Groundwater may also occur in the residual soils across and surrounding the site. Drainage from these soils to the planned excavation is expected to result in lower

groundwater levels in the residual soils in these areas, possibly resulting in consolidation in the soils which have not previously been dewatered. In stating this, however, the residual clays at the site are over-consolidated (as they are derived from the weathering of the bedrock at and surrounding the site), hence any subsidence of these soils is likely to be insignificant and less than the ground disturbance that could reasonably be expected due to construction activities.

In light of the above, it is considered any change in groundwater levels as a result of either short or long-term drainage of groundwater due to the proposed basement excavation will have negligible impact to neighbouring developments and/or infrastructure (subject to suitable retaining infrastructure) including:

- those underground services along the southern boundary of the site, and
- existing neighbouring public and private assets.

10.4 Minimal Impact Considerations

The Aquifer Interference Policy (AIP) includes a set of minimal impact considerations for assessing the impacts of aquifer interference activities including those regulated under the WMA 2000, the Water Act 1912 and those decided under the terms and conditions of other legislation. It indicates the term 'aquifer' is commonly understood to mean a groundwater system of sufficient permeability to allow water to move in it, and which can yield productive volumes of groundwater, however, notes those criteria and considerations in the AIP are equally applicable to low-yielding and/or saline groundwater systems.

The site is underlain by soft to hard clays and varying strength sandstone. Both the soils and rocks are of relatively low yield (<5 L/s) and are a 'less productive groundwater source' as outlined in the AIP. Based on the outcomes of the hydrogeological assessment

impacts to the aquifer are considered to be minimal however, if large open water-bearing defects are encountered within the basement excavation, they can be controlled by grouting the defects.

11.0 CONSTRUCTION MONITORING AND REPORTING (CONTINGENCY)

11.1 Water Quality Treatment

During the construction process, water needs to be pumped into a holding tank and a monitoring program needs to be applied. Direct discharge of untreated groundwater may potentially cause unlawful environmental harm which is prohibited under the Environmental Protection Act 1994. To ensure that any potential environmental harm is managed correctly and to enable the proponent to demonstrate compliance, regular monitoring of water quality parameters must continue in a manner advised by professionals.

It is recommended that an appropriate filtration system is designed to allow the groundwater to pass through before entering the local system. In addition, the water quality should be sampled before the initial disposal occurs and at regular intervals during the disposal process. The samples should be analysed for Metals, TRH, BTEX, PAH, VOC, TSS, TDS, Turbidity, EC, Oil & Grease and pH as a minimum. Some examples of filtration systems include:

- Sediment Tanks;
- Sediment Tanks supplemented with chemical dosing units to enhance settling rates;
- Media Filtration Systems that can treat a range of recalcitrant contaminants.

It is our understanding that the water comes into the holding tank, the flocculant (eg aluminium sulphate) is added and left-over night to settle. The water quality is then tested and sent to NATA accredited laboratory to determine the suitability for disposal down stormwater. This process is repeated for the duration of the dewatering onsite. Any remaining sediment in the holding tank is to be collected and disposed offsite appropriately.

Foundation Earth Sciences recommends that 'tail' water from the dewatering operation be treated to the **extent practicable** prior to discharging, to meet the adopted discharge water quality criteria.

11.2 Groundwater Monitoring Frequency during Dewatering

A groundwater level, water quality and dewatering rate monitoring program must be implemented during constructions. The following program is tentatively proposed:

- Weekly monitoring of groundwater levels. The monitoring is to commence prior to dewatering commencing and to continue for a period of at least 2 months following cessation of dewatering.
- Monitoring of discharge water quality to be undertaken weekly, decreasing to monthly after the first four weeks, if groundwater quality is stable. The analytical suite should include as a minimum, Heavy Metals, BTEXN, TRH, PAH, VOC, turbidity, Ph, TDS /TSS, oil & grease and Electrical Conductivity (EC).
- The monitoring results must be provided weekly to the environmental engineer for review.

The final groundwater monitoring program should be developed following assessment of conditions by the authorities.

11.3 Groundwater Level Monitoring

The groundwater level during dewatering will require continuous monitoring, from the date of consent until two months after cessation of pumping and / or until groundwater level return to pre-dewatering levels.

Groundwater level monitoring is to be completed by either datum loggers, installed two weeks prior to start of dewatering or manually using a water level meter.

12.0 CONTINGENCY PLAN

12.1 Groundwater Level Drops 1m below baseline

Should the groundwater level monitoring indicate that the groundwater levels external to the basement are dropping or increasing more than those identified within the seasonal variations, the geotechnical engineer must be informed. Dewatering activities should be immediately reduced.

The cause is likely to be higher than estimated permeability or significant rainfall events. The above would be accompanied by a higher than estimated dewatering rate and the dewatering rate must be measured and provided to the geotechnical engineer.

The survey monitoring interval may need to be increased to assess whether the drawdown/surcharge is causing surrounding buildings and structures to settle.

With respect to pumping, a standby pump and hoses will be kept on site in the event that there is a failure with the installed pumps. If extra hoses and adaptors to suit the systems are required on site, turnaround time will be within 24 hours of notice.

12.2 Quality of water does not meet Discharge Criteria

Discharge to the stormwater system must be suspended. Tail water should be retained onsite and stored in appropriate bulk containers for further on-site treatment and sampling by environmental consultant.

Alternatively, should trade waste application be made, groundwater will be discharged under the licence agreement.

12.3 Power outages

Ensure a backup generator is readily available and the contractor has an electrician on stand-by.

12.4 Dewatering system failures

Ensure that spare equipment parts are on hand.

12.5 Visual and / or Olfactory anomalies

The onsite treatment system should be diagnosed and adjusted. The contractor is to seek advice from the engaged suitably qualified environmental consultant.

13.0 RECOMMENDATION AND CONCLUSIONS

FES carried out a number of assessments but did not encounter significant groundwater within any of the groundwater wells within the site. From a geotechnical perspective, the proposed development with a “Drained Basement” option is deemed feasible on the site using industry-standard design and construction techniques.

The analysis is based on the groundwater assessment and the likely hydraulic conductivity of the encountered subsurface conditions. There will certainly be variations in the adopted parameters and assumptions, and it is found that the results of the analysis can be within one order of the magnitude. Since the parameters are adopted with higher-end value, based on our experience, the actual groundwater inflow into the basement is more likely to be less than what is estimated in this report. However, if large open water-bearing defects are encountered within the basement excavation, they can be controlled by grouting the defects. The analysis indicates that a “Soldier Pile” wall with a shotcrete infill system is feasible for the encountered groundwater. This report does not justify that the adopted shoring wall system is adequate for the ground movement. It is recommended to assess and confirm the potential ground movement for the adopted shoring wall system before the construction stage.

During the construction process, if water needs to be pumped into a holding tank and a monitoring program needs to be applied. It is recommended that an appropriate filtration system is designed to allow the groundwater to pass through before entering the local system. It is our understanding that the water comes into the holding tank, the flocculant (eg aluminium sulphate) is added and left over-night to settle. The water quality is then tested and sent to NATA accredited laboratory to determine the suitability for disposal down stormwater. This process is repeated for the duration of the dewatering onsite. Any remaining sediment in the holding tank is to be collected and disposed offsite

appropriately. A final report detailing all the monitoring information should be provided at the end of the project.

Thank you for the opportunity of undertaking this work. We would be pleased to provide further information on any aspects of this report.

14.0 LIMITATIONS

To the best of our knowledge information contained in this report is accurate at the date of issue, however, subsurface conditions, including groundwater levels and contaminant concentrations, can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

There is always some disparity in subsurface conditions across a site that cannot be fully defined by investigation. Hence it is unlikely that measurements and values obtained from sampling and testing during environmental works carried out at a site will characterise the extremes of conditions that exist within the site.

There is no investigation that is thorough enough to preclude the presence of material that presently or in the future, may be considered hazardous at the site. Since regulatory criteria are constantly changing, concentrations of contaminants presently considered low may, in the future, fall under different regulatory standards that require remediation.

Opinions expressed herein are judgements and are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions.


REFERENCES

- ANZG (2018) “Australian and New Zealand Guidelines for Fresh and Marine Water Quality”, Australian and New Zealand Governments and Australian State and Territory Governments, Canberra ACT.
- Department of Urban Affairs and Planning – EPA (1998) “*Managing Land Contamination – Planning Guidelines – SEPP 55 – Remediation of Land*”.
- National Environmental Protection Council (NEPC) (1999) – *National Environmental Protection (Assessment of Site Contamination) Measure. Amendment 2013*
- National Health and Medical Research Council (NHMRC) & National Resource Management Ministerial Council (NRMCC) “National Water Quality Management Strategy, Australian Drinking Water Guidelines” (2011)
- NSW EPA (2014) “*Technical Note: Investigation of Service Station Sites*”.
- NSW EPA (2020), “Consultants Reporting on Contaminated Land”. NSW Environment Protection Authority, Parramatta
- NSW DEC “Guidelines for the NSW Site Auditor Scheme” (2017, 3rd edition). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) – “Waste Classification Guidelines, Part 1: Classifying Waste”;
- NSW EPA (2015) “Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997”;
- NSW EPA “Sampling Design Guidelines” (1995). NSW Environment Protection Authority, Sydney.
- US EPA “Regional Screening Level (RSL) Summary Tables” (2016). United States Environment Protection Authority.

FIGURE 1: SITE PLAN

APPENDIX A: ADOPTED DISCHARGE CRITERIA

Table A1

	Heavy Metals (Dissolved)								TRH		BTEX						PAH					Physicochemical						
	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC	F1 (C ₆ -C ₁₀)	F2 (>C ₁₀ -C ₁₆)	BENZENE	TOLUENE	ETHYL BENZENE	M/P-XYLENE	O-XYLENE	NAPHTHALENE	TOTAL-XYLENE	BENZO(A)PYRENE	ANTHRACENE	PHENANTHRENE	FLUORANTHENE	NAPHTHALENE	pH	EC(us/cm)	Turbidity	Oil & Grease (mg/L)	Total Dissolved Solids mg/L	Faecal Coliforms
Limit of Resolution (LOR)	1	0.1	1	1	1	0.05	1	1	10	50	1	1	1	2	1	1	-	1	1	1	1	1	-	1	0.1	5	5	5
Discharge Water Criteria																												
Based on ANZ (2018) + ANZECC 2000 + Drinking Water																												
Default Trigger Values South East Oz - Marine																												
Fresh Water Trigger Values (95%)	24/13	0.2	1	1.4	3.4	0.06	11	8	-	-	950	-	-	200	350	-	-	-	-	-	-	16	6.5-8.5	122-2200		ND		
Fresh Water Trigger Values (95%) -low reliability																												
Marine Water	0.7	4.4	1.3	4.4	0.1	7	15			500	180	80					0.1	0.01	0.6	1	50							
NHMRC 2018 Drinking Water																												
Default Trigger Values South East Oz - Marine																												

Notes: All units are in ug/L, unless otherwise stated

APPENDIX B: PROPOSED DEVELOPMENT PLANS

LEGEND

AC	Air Conditioning
ACU	Air Conditioning Condenser Unit
ACC	Accessible
ADP	Adaptable
AHD	Australian Height Datum
B	Bathroom
B1.2	Bedroom 1, Bedroom 2, etc.
BGS	Boom Gate System
BKR	Bicycle Rack
BKS	Bicycle Storage
BL	Bollard
BOH	Back of House
BY	Balcony
CLNR	Cleaner Store
COM	Commercial
COMS	Communications Services
CP	Carparking Space
CPO	Cupboard
CPE	Car Park Exhaust
CWB	Car Wash Bay
CWS	Cold Water Supply
CY	Courtyard
D	Dining
E	Entry
ELEC	Electrical Services
EN	Ensuite
(EX)	Existing
EXH	Exhaust
F	Fire Services
FCR	Fire Control Room
FE	Fire Extinguisher
FFL	Finished Floor Level
FGL	Finished Ground Level
FH	Fire Hydrant
FIP	Fire Indicator Panel
FS_01	Fire Stair No.1, 2, etc.
OZ	OZ
GA_01	Grease Arrestor No.01, 02, etc.
GBC	Garbage Chute
GBR	Garbage Room
GHR	Garbage Holding Room
GL	Ground Line
H	Hydraulic Services
HL	Hold Line
HWS	Hot Water Services
HWU	Hot Water Unit
IL	Invert Level
(INT)	Integrated Assembly
K	Kitchen
KB	Kerb
KE	Kitchen Exhaust
L_01	Lift No.1, 2, etc.
OZ...	OZ...
L	Living
LA	Landscape
LG	Lower Ground
LY	Laundry
M	Mechanical Services
MBP	Motor Bike Parking
MEX	Mail Box Assembly
MSB	Mobile Garbage Bin
MRV	Medium Rigid Vehicle
MSB	Main Switch Board Services incl. Main Distribution Board & Frame
MTR	Meter
MY	Mechanical Vent
NGL	Natural Ground Level
OSD	On Site Detention Tank
OSR	On Site Retention Tank
P	Pantry
PDR	Powder Room
R	Robe
RES	Residential
RF	Refrigerator
RL	Relative Level to AHD
RTL	Retail
S	Storage
SA	Supply Air
SCN	Screen
SHR	Shower
SKL	Skylight
SP	Stair Pressurisation
SRV	Small Rigid Vehicle
SSL	Structural Slab Level
ST_01,02	Stair No.1, 2, etc.
STY	Study
SWD	Stormwater Drain
SWP	Stormwater Pit
TCE	Terrace
TD	Timber Deck
TOW	Top of Wall
TRA	Tenant Return Air
TSA	Tenant Supply Air
TS	Traffic Signal
TYP	Typical
UG	Upper Ground
UNO	Unless Noted Otherwise
UT	Utility Space
V	Void
VIS	Visitor
WC	WC
WC_A	WC - Accessible
WC_F	WC - Female
WC_M	WC - Male
WC_P	WC - Parents
WC_U	WC - Unisex
WR	Walk in Robe
WM	Washing Machine
WS	Wheel Stop
End.	End.

---	Setback Line
---	Site Boundary
---	Liveable Apartment (above level)
---	Adaptable Apartment
---	Adaptable Parking Space
---	Accessible Parking Space
---	1 Bed Apartment
---	2 Bed Apartment
---	3 Bed Apartment
---	4 Bed Apartment

Rev	Date	Approved By	Revision Notes
A	20/02/2025	CM	For Coordination
B	20/02/2025	CM	For Coordination
C	20/02/2025	CM	For Coordination
D	20/02/2025	CM	For Coordination
E	04/02/2025	CM	For Coordination

CURT 17 Tenney Street Pyrmont Sydney NSW 2000 ARADA

Project File
16-20 Carrington Road
16-20 Carrington Road, 2-12 Middleton Avenue, 4-6 Fishburn Crescent & 25-31 Sexton Avenue Castle Hill NSW 2154

Drawing File
GA Plans
Basement 01

Scale	Project No.	23104	Client	WJTL AC JB BK	Name
1:200 @ A3	Drawn By	DA-110-006	Drawn By	DA-110-006	E
Status	For Coordination				

AVENUE



MIDDLETON AVENUE
MINOR COLLECTOR (24M) + CYCLE WAY



FISHBURN CRESCENT
LOCAL STREET (17M)

NEW SITE BOUNDARY 2M DEDICATION
EXISTING SITE BOUNDARY

SEXTON AVENUE
LOCAL STREET (17M)

NEW SITE BOUNDARY 2M DEDICATION
EXISTING SITE BOUNDARY

NEW SITE BOUNDARY 2M DEDICATION
EXISTING SITE BOUNDARY

EXISTING SITE BOUNDARY

EXISTING SITE BOUNDARY

NEW SP2 SITE BOUNDARY

METRO SECOND RESERVE

EXISTING SITE BOUNDARY

APPROX LOCATION OF SEWER RELOCATION

APPROX LOCATION OF SEWER RELOCATION

APPROX LOCATION OF SEWER RELOCATION

SUB ARTERIAL + CYCLE WAY

EXISTING SITE BOUNDARY

NEW SP2 SITE BOUNDARY

METRO SECOND RESERVE

EXISTING SITE BOUNDARY

NEW SITE BOUNDARY 2M DEDICATION
EXISTING SITE BOUNDARY

SEXTON AVENUE
LOCAL STREET (17M)

MIDDLETON AVENUE
MINOR COLLECTOR (24M) + CYCLE WAY

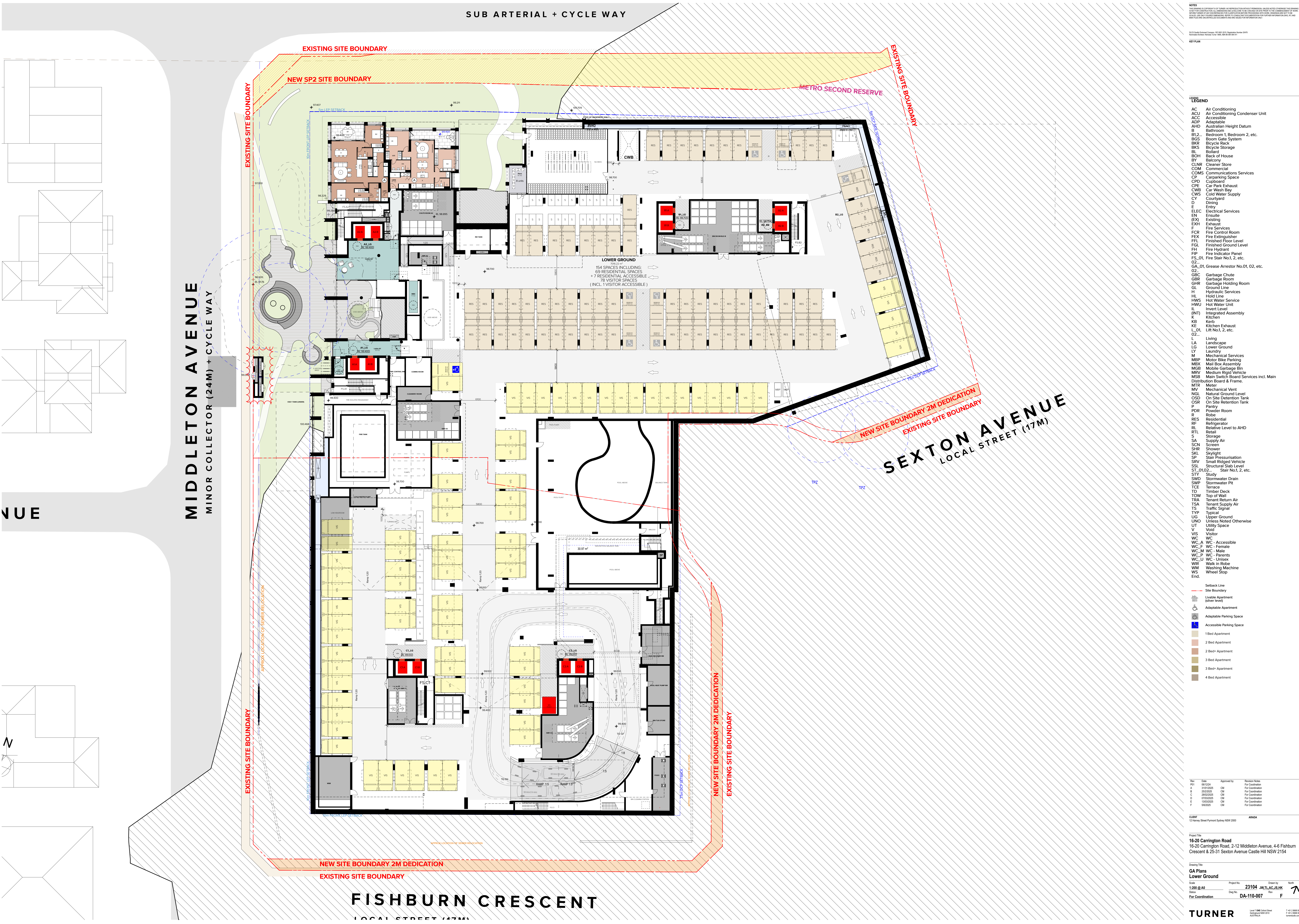
AVENUE

NEW SITE BOUNDARY 2M DEDICATION

EXISTING SITE BOUNDARY

FISHBURN CRESCENT
LOCAL STREET (17M)

N



NOTES

1. THIS DRAWING IS A PRELIMINARY DESIGN AND SHOULD NOT BE USED FOR CONSTRUCTION WITHOUT THE APPROVAL OF THE LOCAL COUNCIL. THE CLIENT IS RESPONSIBLE FOR OBTAINING ALL NECESSARY APPROVALS AND PERMITS FROM THE LOCAL COUNCIL AND OTHER RELEVANT AUTHORITIES. THE CLIENT IS ADVISED THAT THE LOCAL COUNCIL MAY REQUIRE MODIFICATIONS TO THIS DRAWING TO COMPLY WITH LOCAL COUNCIL REQUIREMENTS AND REGULATIONS. THE CLIENT IS ADVISED THAT THE LOCAL COUNCIL MAY REQUIRE MODIFICATIONS TO THIS DRAWING TO COMPLY WITH LOCAL COUNCIL REQUIREMENTS AND REGULATIONS.

KEY PLAN

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- LEGEND**
- AC Air Conditioning
 - ACU Air Conditioning Condenser Unit
 - ADP Adaptable
 - ACC Accessible
 - ADP Adaptable
 - AHD Australian Height Datum
 - B Bathroom
 - B1.2 Bedroom 1, Bedroom 2, etc.
 - BGS Boom Gate System
 - BKR Bicycle Rack
 - BKS Bicycle Storage
 - BL Bollard
 - BOH Back of House
 - BY Balcony
 - CLNR Cleaners Store
 - COM Commercial
 - COMS Communications Services
 - CP Carport
 - CPD Carparking Space
 - CPE Car Park Exhaust
 - CWB Car Wash Bay
 - CWS Cold Water Supply
 - CY Courtyard
 - D Dining
 - E Entry
 - ELEC Electrical Services
 - EN Ensuite
 - EXH Exhaust
 - F Fire Services
 - FCE Fire Control Room
 - FEX Fire Extinguisher
 - FFL Finished Floor Level
 - FGL Finished Ground Level
 - FH Fire Hydrant
 - FIP Fire Indicator Panel
 - FS_01 Fire Stair No.1, 2, etc.
 - GA_01 Grease Arrestor No.01, 02, etc.
 - OZ
 - GBC Garbage Chute
 - GBR Garbage Room
 - GHR Garbage Holding Room
 - GL Ground Line
 - H Hydraulic Services
 - HL Hold Line
 - HWS Hot Water Services
 - HU Hot Water Unit
 - IL Invert Level
 - (INT) Integrated Assembly
 - K Kitchen
 - KB Kerb
 - KE Kitchen Exhaust
 - L_01 Lift No.1, 2, etc.
 - OZ...
 - L Living
 - LA Landscape
 - LG Lower Ground
 - LY Laundry
 - M Mechanical Services
 - MBP Motor Bike Parking
 - MEX Mail Box Assembly
 - MSB Mobile Garbage Bin
 - MRV Medium Rigid Vehicle
 - MSB Main Switch Board Services incl. Main Distribution Board & Frame
 - MTR Meter
 - MY Mechanical Vent
 - NGL Natural Ground Level
 - OSD On Site Detention Tank
 - OSR On Site Retention Tank
 - P Pantry
 - PDR Powder Room
 - R Robe
 - RES Residential
 - REF Refrigerator
 - RL Relative Level to AHD
 - RTL Retail
 - S Storage
 - SA Supply Air
 - SCN Screen
 - SHR Shower
 - SKL Skylight
 - SP Stair Pressurisation
 - SRV Small Rigid Vehicle
 - SSL Structural Slab Level
 - ST_01 Stair No.1, 2, etc.
 - STY Study
 - SWD Stormwater Drain
 - SWP Stormwater Pit
 - TCE Terrace
 - TD Timber Deck
 - TOW Top of Wall
 - TRA Tenant Return Air
 - TSA Tenant Supply Air
 - TS Traffic Signal
 - TYP Typical
 - UG Upper Ground
 - UNO Unless Noted Otherwise
 - UT Utility Space
 - V Void
 - VIS Visitor
 - WC WC
 - WC_A WC - Accessible
 - WC_F WC - Female
 - WC_M WC - Male
 - WC_P WC - Parents
 - WC_U WC - Unisex
 - WR Walk in Robe
 - WM Washing Machine
 - WS Wheel Stop
 - End.

- Setback Line
- Site Boundary
- Livable Apartment (above level)
- Adaptable Apartment
- Adaptable Parking Space
- Accessible Parking Space
- 1 Bed Apartment
- 2 Bed Apartment
- 3 Bed Apartment
- 4 Bed Apartment

Rev	Date	Approved By	Revision Notes
A	09/02/24	CM	For Coordination
B	20/02/25	CM	For Coordination
C	07/03/25	CM	For Coordination
D	07/03/25	CM	For Coordination
E	07/03/25	CM	For Coordination
F	06/02/25	CM	For Coordination

CLIENT: University Street Pyramid Springs NSW 2020 ARADA

Project Title: 16-20 Carrington Road, 2-12 Middleton Avenue, 4-6 Fishburn Crescent & 25-31 Sexton Avenue Castle Hill NSW 2154

Drawing Title: GA Plans Lower Ground

Scale: 1:200 @ A3

Project No: 23104

Client: JH, TL, AC, JS, BK

Design: DA-110-007

Date: F

TURNER

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APPENDIX C: BOREHOLE LOGS




CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 7/03/2024 Completed : 7/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 96.6 Datum : m AHD

Equipment : Hand Auger + DCP Borehole Size : 75mm Slope : -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	96.2	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
		1.0			Borehole BH1 terminated at 1.00m						1.0
		95.6	1.5								1.5

Comments:

D - Dry VS - Very Soft VL - Very Loose
 M - Moist S - Soft L - Loose
 W - Wet F - Firm MD - Medium Dense
 St - Stiff D - Dense
 VSt - Very Stiff VD - Very Dense
 H - Hard

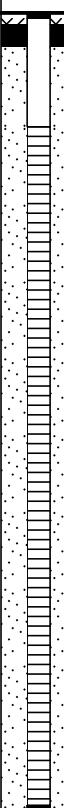





CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 6/03/2024 Completed : 6/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 100.7 Datum : m AHD

Equipment : FICO Drilling Rig Borehole Size : 100mm Slope : -90°

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
ADT	Water observed during augering at 7m		100.2	0.50			FILL, Silty Clay, medium plasticity, brown/orange	M	[S-F]		Fill	
			99.9	0.80		CL-CH	Silty CLAY, medium plasticity, orange, with some medium gravel	M	[S-F]	Aggressivity + Atterberg Sample	Residual Soil	
			99.5	1.20		CL-CH	Silty CLAY, medium to high plasticity, brown/orange	M	[F-St]			
				2.00		CL-CH	CLAY, medium plasticity, grey/orange, with some ironstone bands and extremely weathered sandstone layers	M	[St]			
			98.3	2.40			SANDSTONE, extremely weathered, fine grained, brown/orange, interbedded with clay and trace of ironstone bands				Sandstone	
			93.6	7.10			Borehole BH2 terminated at 7.10m					
				8								8
				10								10
				12								12

Comments:

D - Dry
M - Moist
W - Wet
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense






CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 6/03/2024 Completed : 6/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 103 Datum : m AHD

Equipment : FICO Drilling Rig Borehole Size : 100mm Slope : -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
ADT	Not Encountered	102.8	0.20		CL-CH	FILL, Silty Clay, medium plasticity, brown	M	[S]		Fill	
						CLAY, medium-high plasticity, light brown/grey, trace of medium gravel	M	[F-St]		Residual Soil	
		101.6	1.40			SANDSTONE, extremely weathered, fine grained, brown, interbedded with clay and trace of ironstone bands			Aggressivity + Atterberg Sample SPT 6, 21, 10/50mm	Sandstone	2
											4
											6
		96.8	6.20			Borehole BH3 continued as cored hole from 6.20m					8
											10
											12

Comments:

D - Dry VS - Very Soft VL - Very Loose
M - Moist S - Soft L - Loose
W - Wet F - Firm MD - Medium Dense
St - Stiff D - Dense
VSt - Very Stiff VD - Very Dense
H - Hard



CLIENT NAME: ARADA **JOB NUMBER:** G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation

Date Started : 6/03/2024 **Completed :** 6/03/2024 **Logged By :** KV/AB **Checked By :** LM

Borehole Location : Refer to Site Plan **Surface RL :** 103 **Datum :** m AHD

Equipment : FICO Drilling Rig **Borehole Size :** 100mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength					Is (50) (MPa)	RQD %	Defect Spacing (mm)	Defect Description	Depth (m)			
							EL	VL	J	M	H						VH	EH	
			2													2			
			4													4			
			6													6			
NMLC	Not Encountered	96.8	6.20		SHALE, highly weathered, brown/dark grey with light grey laminations, trace of ironstone staining	HW									6.26m J,P,S, 0-5° 6.35m J,P,S, 10-20° 6.40m J,P,S, 0-5° 6.41m J,P,S, 0-5° 6.43m J,P,S, 0-5° 6.46m J,P,S, 0-5° 6.51m J,P,S, 0-5° 6.57m, Clay Seam 6.66m J,P,S, 0-5° 6.68m, Clay Seam 6.73m J,P,S, 0-5° 6.78m J,P,S, 10-20° 6.81m J,Ir,S, 0-5° 6.84m J,Ir,S, 40-50° 6.90m J,P,S, 0-5° 6.93m, Fragment Zone, 100mm 7.05m, Fragment Zone, 50mm 7.13m J,Ir,S, 5-10° 7.14m J,Ir,S, 5-10° 7.17m J,Cu,S, 40-50° 7.25m, Barrell Lift 7.33m J,P,S, 0-5° 7.37m J,P,S, 0-5° 7.45m J,Ir,S, 0-5° 7.57m J,P,S, 0-5° 7.62m J,P,S, 0-5° 7.68m J,P,S, 5-10° 7.75m J,P,S, 0-5° 7.81m, Clay Seam 7.82m J,Ir,S, 40-50° 7.95m J,P,S, 0-5° 8.00m J,P,S, 0-5° 8.08m J,P,S, 5-10° 8.14m J,P,S, 0-5° 8.25m, Extremely Weathered Seam 8.36m J,P,S, 0-5° 8.45m J,P,S, 0-5° 8.58m, Fractured Zone, 30mm 8.78m, Barrell Lift 8.83m J,P,S, 0-5° 8.94m, Hand Break 8.96m, Fracture Zone, 40mm 9.00m J,Cu,S, 40-50° 9.10m J,P,S, 0-5° 9.32m J,P,S, 10-20° 9.44m, Extremely Weathered Seam 9.56m J,P,S, 10-20° 9.81m J,P,R, 40-50°	0.21 0.39	37		8
		94.8	8.24		SANDSTONE, highly to moderately weathered, fine grained, grey, with some ironstone staining	HW-MW											8		
			10													10			
		92.8	10.17		BH3 terminated at 10.17m											12			

Comments:

Weathering	EL - Extremely Low	D - Diametral	J - Joint	MB - Mechanical Break	S - Smooth
EW - Extremely	VL - Very Low	A - Axial	B - Bedding Plan	HB - Handling Break	R - Rough
HW - Highly	L - Low		C - Clay Seams		P - Polished
MW - Moderately	M - Medium		FZ - Fractured Zone	PI - Planar	
SW - Slightly	H - High		IS - Infill Seam	Ir - Irregular	Qz - Quartz
Fr - Fresh	VH - Very High		SS - Sheared Seam	Cu - Curved	Fe - Iron Stain
	EH - Extremely High		CZ - Crushed Zone	St - Stepped	



CLIENT NAME: ARADA **JOB NUMBER:** G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation

Date Started : 6/03/2024 **Completed :** 6/03/2024 **Logged By :** KV/AB **Checked By :** LM

Borehole Location : Refer to Site Plan **Surface RL :** 101.9 **Datum :** m AHD



Equipment : Hand Auger + DCP **Borehole Size :** 75mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered		0.5			FILL, Silty Clay, low to medium plasticity, dark brown	M	[S]		Fill	0.5
		101.1	0.80		CL-CH	Silty CLAY, medium to high plasticity, orange/brown	M	[F]		Residual Soil	1.0
		100.9	1.00			Borehole BH4 terminated at 1.00m					1.5

Comments:

D - Dry VS - Very Soft VL - Very Loose
 M - Moist S - Soft L - Loose
 W - Wet F - Firm MD - Medium Dense
 St - Stiff D - Dense
 VSt - Very Stiff VD - Very Dense
 H - Hard



CLIENT NAME: ARADA **JOB NUMBER:** G702
SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation
Date Started : 6/03/2024 **Completed :** 6/03/2024 **Logged By :** KV/AB **Checked By :** LM
Borehole Location : Refer to Site Plan **Surface RL :** 105.6 **Datum :** m AHD
Equipment : Hand Auger + DCP **Borehole Size :** 75mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	105.2	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
			1.0			Borehole BH5 terminated at 1.00m					1.0
		104.6	1.5								1.5

Comments:

D - Dry	VS - Very Soft	VL - Very Loose
M - Moist	S - Soft	L - Loose
W - Wet	F - Firm	MD - Medium Dense
	St - Stiff	D - Dense
	VSt - Very Stiff	VD - Very Dense
	H - Hard	



CLIENT NAME: ARADA **JOB NUMBER:** G702
SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation
Date Started : 7/03/2024 **Completed :** 7/03/2024 **Logged By :** KV/AB **Checked By :** LM
Borehole Location : Refer to Site Plan **Surface RL :** 105.3 **Datum :** m AHD
Equipment : Hand Auger + DCP **Borehole Size :** 75mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	104.9	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
		1.0					Borehole BH6 terminated at 1.00m				
		104.3	1.5								1.5

Comments:

D - Dry	VS - Very Soft	VL - Very Loose
M - Moist	S - Soft	L - Loose
W - Wet	F - Firm	MD - Medium Dense
	St - Stiff	D - Dense
	VSt - Very Stiff	VD - Very Dense
	H - Hard	



CLIENT NAME: ARADA **JOB NUMBER:** G702
SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation
Date Started : 6/03/2024 **Completed :** 6/03/2024 **Logged By :** KV/AB **Checked By :** LM
Borehole Location : Refer to Site Plan **Surface RL :** 98.5 **Datum :** m AHD
Equipment : Hand Auger + DCP **Borehole Size :** 75mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	98.1	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
		1.0					Borehole BH7 terminated at 1.00m				
		97.5	1.00								1.5

Comments:

D - Dry	VS - Very Soft	VL - Very Loose
M - Moist	S - Soft	L - Loose
W - Wet	F - Firm	MD - Medium Dense
	St - Stiff	D - Dense
	VSt - Very Stiff	VD - Very Dense
	H - Hard	

CLIENT NAME: ARADA **JOB NUMBER:** G702
SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation
Date Started : 6/03/2024 **Completed :** 6/03/2024 **Logged By :** KV/AB **Checked By :** LM
Borehole Location : Refer to Site Plan **Surface RL :** 101.1 **Datum :** m AHD
Equipment : Hand Auger + DCP **Borehole Size :** 75mm **Slope :** -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	100.7	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
		1.0				Borehole BH8 terminated at 1.00m					1.0
		100.1	1.00								1.5

Comments:

D - Dry	VS - Very Soft	VL - Very Loose
M - Moist	S - Soft	L - Loose
W - Wet	F - Firm	MD - Medium Dense
	St - Stiff	D - Dense
	VSt - Very Stiff	VD - Very Dense
	H - Hard	



CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 6/03/2024 Completed : 6/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 105.2 Datum : m AHD

Equipment : Hand Auger + DCP Borehole Size : 75mm Slope : -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	104.8	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	0.5
		1.0				Borehole BH9 terminated at 1.00m					1.0
		104.2	1.00								1.5

Comments:

D - Dry VS - Very Soft VL - Very Loose
 M - Moist S - Soft L - Loose
 W - Wet F - Firm MD - Medium Dense
 St - Stiff D - Dense
 VSt - Very Stiff VD - Very Dense
 H - Hard



CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 6/03/2024 Completed : 6/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 101.7 Datum : m AHD

Equipment : Hand Auger + DCP Borehole Size : 75mm Slope : -90°

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
HA	Not Encountered	101.3	0.40			FILL, Silty Clay, medium plasticity, brown	M	[S-F]		Fill	
			0.5		CH	CLAY, high plasticity, brown/orange	M	[F]		Residual Soil	
		100.7	1.00			Borehole BH10 terminated at 1.00m					1.0
			1.5								1.5

Comments:

D - Dry VS - Very Soft VL - Very Loose
 M - Moist S - Soft L - Loose
 W - Wet F - Firm MD - Medium Dense
 St - Stiff D - Dense
 VSt - Very Stiff VD - Very Dense
 H - Hard

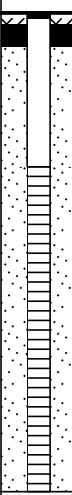



CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 7/03/2024 Completed : 7/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 101.9 Datum : m AHD

Equipment : Commachio 305 Borehole Size : 100mm Slope : -90°

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
ADT			101.2	0.70			FILL, Clayey Silt, low to medium plasticity, brown	M	[S]		Fill	
						CL-CH	Silty CLAY, medium plasticity, brown/orange	M	[St]	Aggressivity + Atterberg Sample	Residual Soil	
			99.9	2.00			SANDSTONE, extremely weathered, fine grained, brown/grey, with some clay and trace of ironstone bands			SPT 3, 8, 16 N=24	Sandstone	2
												4
			97.7	4.20			Borehole BH11 continued as cored hole from 4.20m					6
		Not Encountered										8
												10
												12

Comments:

D - Dry
M - Moist
W - Wet
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

CLIENT NAME: ARADA JOB NUMBER: G702

SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW PROJECT: Geotechnical Investigation

Date Started : 7/03/2024 Completed : 7/03/2024 Logged By : KV/AB Checked By : LM

Borehole Location : Refer to Site Plan Surface RL : 101.9 Datum : m AHD

Equipment : Commachio 305 Borehole Size : 100mm Slope : -90°

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength					Is (50) (MPa)	RQD %	Defect Spacing (mm)	Defect Description	Depth (m)
								EL	VL	J	M	H					
				2													
				4													
			97.7	4.20		SHALE, highly weathered, brown/dark grey	HW								4.20m Clay Band, 40mm		
			97.0	4.90		SANDSTONE, highly weathered, fine grained, brown/red, interbedded with shale and ironstone bands									4.29m J.P.S, 0-5°		
			96.3	5.59		SANDSTONE, highly to moderately weathered, fine grained, grey/light brown	HW-MW								4.34m J.P.S, 0-5°		
				6											4.38m Fragmented Zone, 30mm		
				8											4.47m J.P.S, 0-5°		
				10											4.50m J.P.S, 0-5°		
				12											4.58m J.P.S, 0-5°		
															4.63m Clay Band, 40mm		
															4.75m J.P.S, 0-5°		
															4.92m Clay Seam		
															5.00m J.P.S, 5-10°		
															5.09m Clay Band, 30mm		
															5.13m Barrell Lift		
															5.16m J.P.S, 0-5°		
															5.21m J.P.S, 0-5°		
															5.26m J.P.S, 0-5°		
															5.27m J.P.S, 0-5°		
															5.30m J.P.S, 0-5°		
															5.37m Extremely Weathered Seam		
															5.47m J.St.S, 10-20°		
															5.51m Clay Band, 50mm		
															5.58m J.P.S, 0-5°		
															5.70m J.P.S, 0-5°		
															6.00m Hand Break		
															6.72m J.P.S, 0-5°		
															6.80m Hand Break		
															7.00m Hand Break		
															7.23m Barrell Lift		
															7.42m J.P.S, 0-5°		
															7.54m J.P.S, 0-5°		
															7.77m J.P.S, 30-40°		
															8.00m Hand Break		
															8.79m Barrell Lift		
															9.00m Hand Break		
															9.41m J.P.S, 30-40°		
															9.67m J.P.S, 30-40°		
															10.00m Hand Break		
															10.86m J.P.S, 0-5°		
															11.00m Hand Break		
															11.24m J.P.S, 0-5°		
															11.35m J.P.S, 20-30°		
															11.39m J.P.S, 20-30°		
			90.1	11.85													
BH11 terminated at 11.85m																	

Comments:








Weathering	EL - Extremely Low	D - Diametral	J - Joint	MB - Mechanical Break	S - Smooth
EW - Extremely	VL - Very Low	A - Axial	B - Bedding Plan	HB - Handing Break	R - Rough
HW - Highly	L - Low		CS - Clay Seams		P - Polished
MW - Moderately	M - Medium		FZ - Fractured Zone	PI - Planar	
SW - Slightly	H - High		IS - Infill Seam	Ir - Irregular	Qz - Quartz
Fr - Fresh	VH - Very High		SS - Sheared Seam	Cu - Curved	Fe - Iron Stain
	EH - Extremely High		CZ - Crushed Zone	St - Stepped	

CLIENT NAME: ARADA **JOB NUMBER:** G702
SITE ADDRESS: Carrington Rd [Middleton/Fishburn/Sexton Ave], Castle Hill NSW **PROJECT:** Geotechnical Investigation
Date Started : 7/03/2024 **Completed :** 7/03/2024 **Logged By :** KV/AB **Checked By :** LM
Borehole Location : Refer to Site Plan **Surface RL :** 105 **Datum :** m AHD
Equipment : Commachio 305 **Borehole Size :** 100mm **Slope :** -90°

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture	Consistence	Samples Tests Remarks	Additional Observations	Depth (m)
ADT			105.0	0.05			DGB Road Base, 50mm FILL, Clayey Silt, low to medium plasticity, brown	M	[S-F]		Road Base Fill	
			104.5	0.50		CL-CH	Silty CLAY, medium plasticity, brown	M	[F-St]	SPT 7, 8, 11 N=19 Aggressivity + Atterberg Sample	Residual Soil	
			104.2	0.80		CL-CH	Silty CLAY, medium plasticity, grey, interbedded with extremely weathered sandstone	M	[VSt-H]			
			102.8	2.20			SANDSTONE, extremely weathered, fine grained, grey, with some clay and trace of ironstone bands				Sandstone	
			99.0	6.00			SHALE, extremely to highly weathered, dark grey, with some clay				Shale	
			98.0	7.00			Borehole BH12 continued as cored hole from 7.00m					

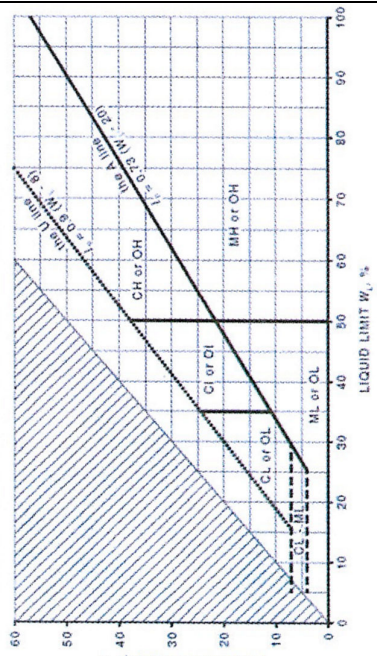
Comments:

D - Dry	VS - Very Soft	VL - Very Loose
M - Moist	S - Soft	L - Loose
W - Wet	F - Firm	MD - Medium Dense
	St - Stiff	D - Dense
	VSt - Very Stiff	VD - Very Dense
	H - Hard	

 FILL	 ORGANIC SOILS (OL, OH, Pt)	 CLAY (CL, CI, or CH)
 COUBLES or BOULDERS	 SILT (ML or MH)	 SAND (SP or SW)
 GRAVEL (GP or GW)	Combinations of these basic symbols may be used to indicate mixed materials	

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in borehole logs using the preferred method given in AS 1726:2017, section 6.1 soil descriptions and classification.

GROUP SYMBOLS			PARTICLE SIZE CHARACTERISTICS				
MAJOR DIVISIONS	SYMBOL	DESCRIPTION	Fraction	Components	Subdivision	Size mm	
COARSE GRAINED SOILS More than 65% of the soil excluding oversize fraction is greater than 0.075mm	GRAVEL More than 50% of the coarse fraction is >2.36mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines.	Over-size	BOULDERS	>200	
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines.		COBBLES	63-200	
		GM	Silty gravel, gravel-sand-clay mixtures.		GRAVEL	Coarse Medium Fine	19-63 6.7-19 2.36-6.7
		GC	Clayey gravel, gravel-sand-clay mixtures.		SAND	Coarse Medium Fine	0.6-2.36 0.21-0.6 0.075-0.21
	SAND More than 50% of the coarse fraction is <2.36mm	SW	Well graded sand and gravelly sand, little or no fines.		SILT		0.002-0.075
		SP	Poorly graded sand and gravelly sand, little or no fines.		CLAY		<0.002
		SM	Silty sand, sand-silt mixtures.		PLASTICITY PROPERTIES		
		SC	Clayey sand, sandy-clay mixtures.				
	FINE GRAINED SOILS More than 35% of the soil excluding oversize fraction is less than 0.075mm	Liquid limit less <50%	ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.			
			CL, CI	Inorganic silts of low to medium plasticity, gravelly clays, sandy clays, silty clays			
OL			Organic silts and organic silty clays of low plasticity.				
Liquid limit > 50%		MH	Inorganic silts of high plasticity.				
		CH	Inorganic clays of high plasticity.				
		OH	Organic clays of medium to high plasticity.				
Highly organic Soil	PT	Peat muck and other highly organic soils.					

ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Non-cohesive and free running
M	Moist	Soils feel cool, darkened in colour. Soil tends to stick together.
W	Wet	Soils feel cool, darkened in colour. Soil tends to stick together, free water forms when handling.

Moisture content of cohesive soils shall be described in relation to plastic limit (PL) or liquid limit (LL) for soils with higher moisture content as follows: Moist, dry of plastic limit ($w < PL$); Moist, near plastic limit ($w = PL$); Moist, wet of plastic limit ($w < PL$); Wet, near liquid limit ($w = LL$), Wet, wet of liquid limit ($w > LL$),

CONSISTENCY				DENSITY			
Symbol	Term	Undrained Shear Strength (kPa)	SPT "N" #	Symbol	Term	Density Index %	SPT "N" #
VS	Very Soft	< 12	< 2	VL	Very Loose	< 15	0 to 4
S	Soft	> 12 to < 25	> 2 to < 4	L	Loose	> 15 to < 35	4 to 10
F	Firm	> 25 to < 50	> 4 to < 8	MD	Medium Density	> 65 to < 85	10 to 30
St	Stiff	> 50 to < 100	> 8 to 15	D	Dense	> 65 to < 85	30 to 50
H	Hard	> 200	> 30				
Fr	Friable	-					

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material. #SPT correlations are not stated in AS1726:2017 and may be subject to corrections for overburden pressure and equipment type.

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION BY MASS
Trace	Presence just detectable by feel or eye but soil properties little or no difference to general properties of primary component	Coarse grained soils: $< 5\%$ Fine grained soils: $< 15\%$
With	Presence easily detectable by feel or eye but soil properties little or no difference to general properties of primary component	Coarse grained soils: 5-12% Fine grained soils: 15-30%
Prefix	Presence easily detectable by feel or eye in conjunction with the general properties of primary component	Coarse grained soils: $> 12\%$ Fine grained soils: $> 30\%$

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in borehole logs using the preferred method given in AS 1726:2017, section 6.2 Rock identification, descriptions, and classification.

ROCK MATERIAL DESCRIPTION

Layering		Structure	
Term	Description	Term	Spacing (mm)
Massive	No Layering apparent	Thinly Laminated	< 6
		Laminated	6-20
Poorly Developed	Layering just visible; little effect on properties	Very thinly bedded	20-60
		Thinly bedded	60-200
Well Developed	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering	Medium bedded	200-600
		Thickly bedded	600-2,000
		Very thickly bedded	$> 2,000$

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES		
Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water, soil, or rock substance, which acts as cement.
Bedded Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Foliation	FL	Repetitive planar structure parallel to the shear direction or perpendicular to the direction of higher pressure, especially in the metamorphic rock, e.g., schistosity (SH) and Gneissosity.
Contact	CO	The surface between two types or ages of rock.
Cleavage	CL	Cleavage planes appear as parallel, closely spaced, and planar surfaces resulting from mechanical fracturing of rock through deformation or metamorphism, independent of bedding.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with rough parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Decomposed seam/Zone	DS/DZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Schistosity	SH	The foliation in schist or other coarse grained crystalline rock due to the parallel arrangement of platy or prismatic mineral grains, such as mica.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS					
Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	PI	Consistent Orientation	Polished	Pol	Shiny smooth surface
Curved	Cu	Gradual change in orientation	Slickensided	SL	Grooved or stained surface, usually polished
Undulating	Un	Wavy surface	Smooth	S	Smooth to touch. Few or no surface irregularities
Stepped	St	One or more well defined steps	Rough	RF	Many small surface irregularities, amplitude generally <1mm. Feels like fine to coarse sandpaper
Irregular	Ir	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.

Orientation:
Vertical Boreholes- The dip (inclination from horizontal) of the defect.
Inclined Boreholes- The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING			DEFECT APERTURE		
Coating	Abbr.	Description	Aperture	Abbr.	Description
Clean	CN	No Visible coating or infilling	Closed	CL	Closed.
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)	Open	O	Without any infill material
Veneer	VNR	A visible coating of soil or mineral substances, usually too thin to measure (<1mm); may be patchy	Infilled	-	Soil or rock i.e., clay, talc, pyrite, quartz, etc.

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in borehole logs using the preferred method given in AS 1726:2017, section 6.2 Rock identification, descriptions, and classification.

ROCK MATERIAL STRENGTH CLASSIFICATION

Symbol	Term	Point Load Index Is (50) (MPa)#	Field Guide
VL	Very Low	0.03 To 0.01	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut triaxial sample by hand. Pieces up to 30mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with knife; indentations 1mm to 3mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 – 1	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
H	High	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken with a pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

#Rock Strength Test Results



Point Load Strength Index, Is (50) Axial Test (MPa)



Point Load Strength Index, Is (50), Diametral test (MPa)

Relationship between rock strength test result (Is (50)) and unconfined compressive strength (UCS) will vary with rock type and strength and should be determined on a site-specific basis. However, UCS is typically 20 x Is (50)

ROCK MATERIAL WEATHERING CLASSIFICATION

Symbol	Term	Field Guide
RS	Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric no longer evident; there is a large change in volume, but the soil has not been significantly transported.
XW	Extremely Weathered	Rock is weathered to such an extent that it has soil properties- i.e., it either disintegrates or can be remoulded, in water.
DW	HW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to decomposition of weathered product in pores. In some environments it is convenient to subdivide into highly weathered and moderately weathered, with the degree of alteration typically less for MW
	MW	
SW	Slightly Weathered	Rock slightly discoloured but shows little to no change of strength relative to fresh rock.
FR	Fresh	Rock shows no sign of decomposition or staining.