G3 56 Delhi Road
North Ryde NSW 2113
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E mailbox@psm.com.au
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Our Ref: PSM4669-017L

3 May 2024

Development Manager
Goodman
The Hayesbery
1-11 Hayes Road
Rosebery NSW 2018
Cameron.Rubenach@goodman.com

Attention: Cameron Rubenach

Dear Cameron

RE: LANCELEY PLACE DATA CENTRE, ARTARMON - PROJECT EOS - PRELIMINARY GROUNDWATER IMPACT ASSESSMENT

1. Introduction

A State Significant Development Application (SSDA) has been prepared in support of a proposed data centre at 2-8 Lanceley Place and 14 Campbell Street, Artarmon (Lanceley Place Data Centre, Artarmon). The site comprises 5 individual allotments totalling 14,024m2 in area, is zoned E4 General Industrial and has road frontages to both Lanceley Place and Campbell Street.

The proposal will include:

- Site preparation works including demolition, bulk excavation and removal of existing structures on the site, tree and vegetation clearing, and bulk earthworks;
- Construction, fit out and operation of a ten-storey, 80MVA data centre with a maximum building height of 51.479m (RL 124.5) ridge height (street wall height of 50m) and total gross floor area of 26,769m2 comprising:
  - At-grade parking for 39 car parking spaces and 2 accessible car parking spaces
  - Two (2) 12.5m long vehicle loading dock spaces
  - Five (5) levels of technical data hall floor space with four (4) data halls per floor
  - Ancillary office space
  - A lobby, offices and amenities located on the ground floor.
- Provision of required utilities, including:
- Eight (8) 95,000L above-ground diesel storage tanks
- Four (4) 1,100kL above-ground water tanks
  - Three (3) 33kV switch-rooms on site.
- Vehicle access provided via Campbell Street and Lanceley Place
- Pedestrian access provided via Campbell Street and Lanceley Place
- Associated landscaping and site servicing
- Installation of services and drainage infrastructure

- A floor space ratio of approximately of 1.91:1. Given this exceeds the Willoughby Local Environmental Plan 2012 (WLEP) control, a request to vary the control for the development under Clause 4.6 of the WLEP will be included with the SSDA.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) and accompanying cover letter issued for the Lanceley Place Data Centre project (SSD-66777221) dated 23 January 2024.

Item	Description	Section Reference
13. Ground and Water Conditions	Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on: • Groundwater resources in accordance with the *Groundwater Guidelines*.	Section 4 and 5

2. The Site

The site is located on Cammeraygal Land and is in the Artarmon industrial area within the Willoughby Local Government Area (LGA). It is bounded by Campbell Street to the north and Lanceley Place to the east and has immediate frontages with a concrete batching plant to the south-east, and several buildings including the NextDC Data Centre to the west.

Artarmon Industrial Precinct comprises relatively new commercial and industrial developments and has been subject to several separate DAs which have increased the densities in the area. Other notable nearby land uses include the Home HQ shopping centre, the Artarmon Bunnings Warehouse, the Royal North Shore Hospital and the North Shore Private Hospital.

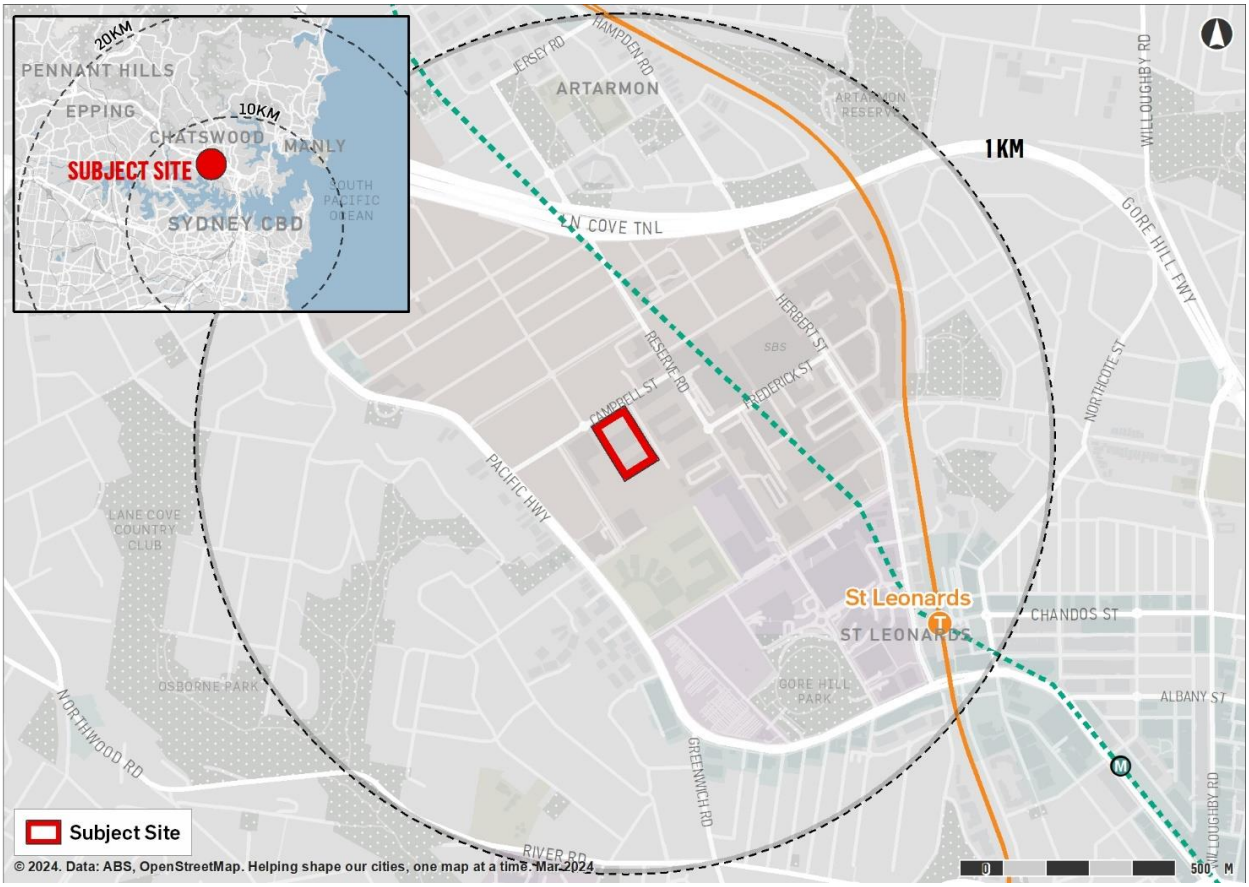
The site comprises 14,024m2 and consists of five separate lots. It was most recently occupied by film and television studios tenanted by the Australian Broadcasting Corporation (ABC) which sold the site in 2021. The site was subject to a SSDA application in 2023 which proposed an industrial warehouse and distribution centre (SSD-48478458). The site is currently vacant.

The closest residential uses include residential flat building on the western side of Pacific Highway (approximately 300m west from the site) and in Artarmon (approximately 500m north of the site).

The site is well serviced by transport, and is within close proximity of the Pacific Highway, M1, M2 and the Lane Cove tunnel with bus services linking the area with North Sydney and the Sydney CBD. St Leonards Station, which provides T9 Northern Line and T1 North Shore and Western Line train services, is within a 1km walk of the site.

The future Crows Nest Metro station is located approximately 1.4km from the site which will deliver high frequency metro services across Sydney and is expected to be opened in 2024.

Inset 1: Site Aerial



Inset 2: Local Context

3. Background

PSM have prepared the following documents for the site:

- Previous geotechnical investigations in December 2021 and May 2023 undertaken by PSM (ref. PSM4669-003L REVA dated 1 May 2024)
- PSM groundwater impact assessment for previous proposed development with basement excavation (ref. PSM4669-013L dated 21 August 2023).

To assist with our preliminary groundwater impact assessment for the latest proposed Project EOS development, PSM have been provided with the following documents:

- Civil Drawings by Taylor Thomson Whitting (TTW) (ref. 231976-TTW-00-DR-CI-00001 to 09211 dated 1 May 2024)
- Architectural Drawings by HDR Architects (ref. EOS-AR-11000 to 31000).

From the provided documents, PSM understands the following:

- The previously proposed development has been changed from a multi-level distribution centre to a multi-level data centre
- As part of the changes, the proposed data centre has a relatively small underground water tank instead of the basement across the majority of the site footprint as previously proposed
- The new proposed water tank will have a final floor level of RL 68.50 m AHD
- Previous groundwater measurements within the vicinity of the water tank by PSM on 26 July 2023 indicates a groundwater level of RL 71.51 m AHD hence it is likely that groundwater will be intercepted during excavation of the water tank. The water tank area will undergo up to approximately 5.0 m of cut.

4. Preliminary Groundwater Impact Assessment

4.1 Ground Conditions

During PSM's previous geotechnical investigation, one borehole, BH03 was undertaken in the vicinity of the water tank. Borehole logs from indicate that the ground conditions are likely to comprise the following:

- Approximately 0.3 m of FILL overlying
- Approximately 2.0 m of RESIDUAL SOIL overlying
- BEDROCK.

It is noted that the expected ground conditions for the water tank do not vary significantly from the previously expected ground conditions for the basement.

4.2 Geometric Differences of the proposed excavations

Previously the proposed basement for the multi-level distribution centre had the following geometry:

- A maximum excavation depth of 4.68 m
- Width and length of approximately 82.8 m by 137.4 m
- Area of approximately 11377 m^2.

PSM undertook the groundwater analysis and present the impact assessment in our letter PSM4669-013L.

The new proposed underground water tank excavation for the multi-level data centre has the following geometry:

- A maximum excavation depth of approximately 5.0 m
- Width and length of approximately 33 m by 33 m

- Area of approximately 1090 m^2.

Configuration of the previous basement is presented in Figure 1 and configuration of the water tank area is presented in Figure 2.

Table 1 below presents the comparison of the two proposed excavations.

Table 1 – Proposed excavations comparison

	PREVIOUS PROPOSED MULTI-LEVEL DISTRIBUTION CENTRE – BASEMENT EXCAVATION (AS ASSESSED IN PSM GROUNDWATER ANALYSIS – PSM4669-017L)	CURRENT PROPOSED MULTI LEVEL DATA CENTRE – WATER TANK EXCAVATION
Maximum Excavation Depth	4.68 m	4.71 m
Proposed Excavation Lowest FFL Level	RL 66.82 m	RL 68.50
Excavation Plan Dimensions	82.8 m x 137.4 m	33 m x 33 m
Excavation area	11,377 m^2 (the basement extended under footprint of the proposed structure)	1,090 m^2 (limited at one corner of the Site)

4.3 PSM Previous Impact Assessment (PSM4669-013L)

Previously, PSM undertook a groundwater impact assessment for the initial basement geometry for the multi-level distribution centre. A summary of our previously provided advice is summarised as follows:

- The predicted long term groundwater inflows into the basement are expected to be below 3 ML/year and is thus considered a 'minor aquifer interference activity,' exempt from the Water Management Act and may not require a license
- The proposed basement is expected to have impacts less than the Level 1 minimum impact considerations with regards to the Aquifer Interference Policy (AIP)
- Any groundwater drawdown is very unlikely to result in settlements that would damage neighbouring properties.

5. Discussion

Our previous groundwater analysis for the multi-level distribution centre indicated minimal inflows arising from the basement excavation which has a larger footprint and deeper excavation.

The proposed water tank excavation for the new multi-level data centre is:

- 1.7 m shallower than the previous assessed basement excavation
- Much smaller in area than the previous assessed basement excavation (i.e. one tenth of previously assessed basement excavation).

On this basis, we expect the groundwater impact due to the water tank excavation of the multi-level data centre is even much less than that discussed in our letter PSM4669-013L for the previously proposed basement excavation of the distribution centre.

We consider the previous advice and recommendations issued in the letter are still relevant.

Should there be any queries, please do not hesitate to contact the undersigned.

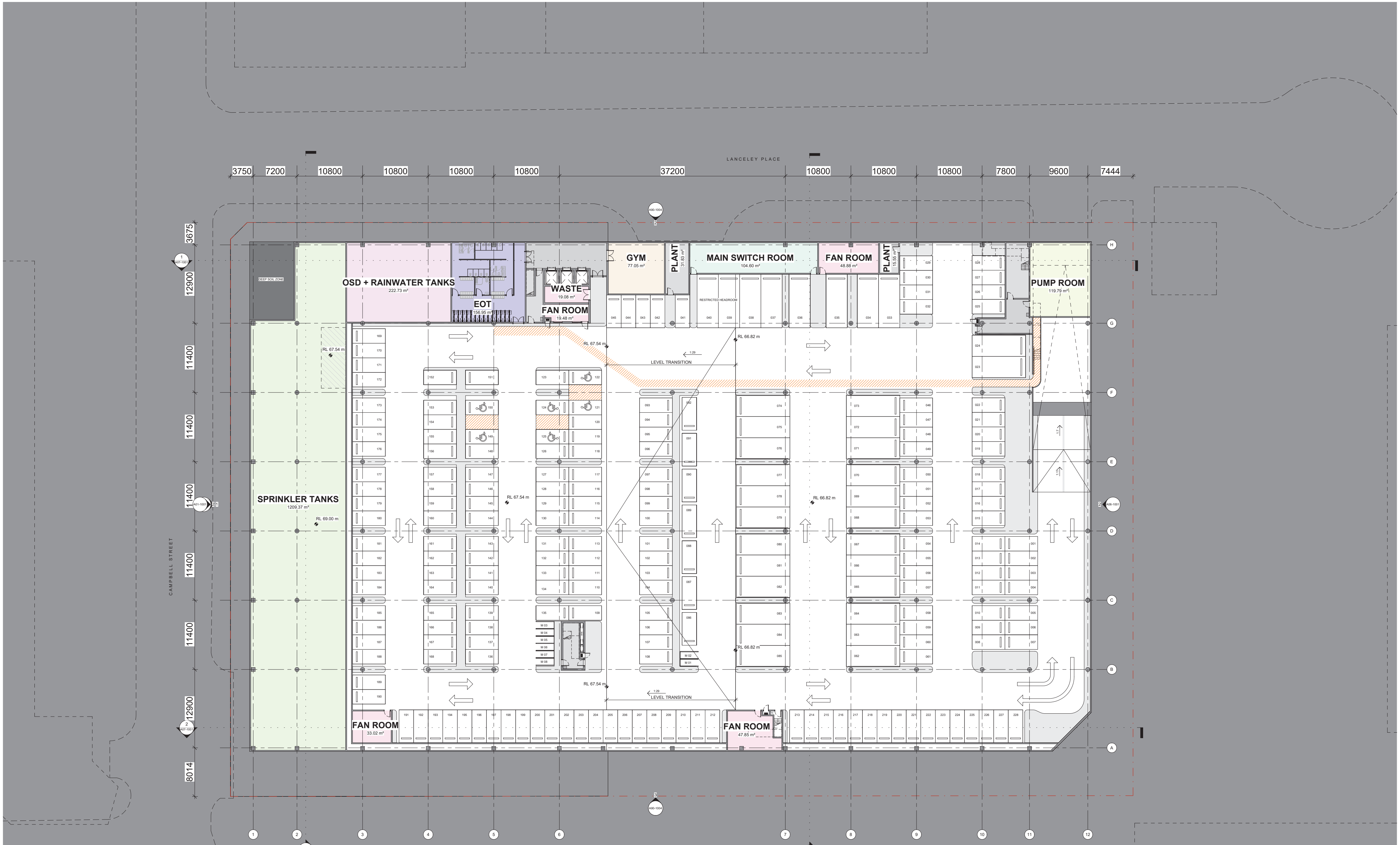
Yours Sincerely

KEN TONG LEE
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl.

Figure 1	Previous Basement Configuration – Multi–level Distribution Centre
Figure 2	New Water Tank Configuration – Multi-level Data Centre
Appendix A	PSM4669-003L REVA
Appendix B	PSM4669-013L



Parking Schedule	
Type	Count
ACCESSIBLE CAR PARKING	6
MOTORCYCLE PARKING	8
MRV PARKING	34
STANDARD CAR PARKING	188

ARCHITECT

GRIMSHAW

GRIMSHAW ARCHITECTS LLP

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www.grimshaw.global

Level 2, 333 George Street,
Sydney, NSW 2000, AUS

DRAWING NOTICES

Do not scale - all dimensions to be checked on site. Grimshaw drawings to be read in conjunction with grimshaw and specialist specifications. Drawings to be read in conjunction with m&e, structural, fire and acoustic information.

CLIENT
Goodman Property Services (Aust) Pty Ltd

CONSULTANTS

PROJECT NAME
2 LANCELEY PLACE

PROJECT NO.
22095

ADDRESS
2 LANCELEY PLACE, ARTARMON, NSW

REV	BY	DATE	DESCRIPTION
A	GAS	12.10.22	Post Meeting
B	GAS	02.11.22	Draft for Coordination
C	GAS	18.11.22	Draft for Coordination
D	GAS	02.12.22	Draft for Coordination
E	GAS	14.12.22	Pre DA Set for Client Review
F	GAS	22.12.22	Pre DA Issue 95%
G	GAS	19.01.23	Draft DA
H	GAS	30.01.23	SSDA

KEY PLAN

NORTH

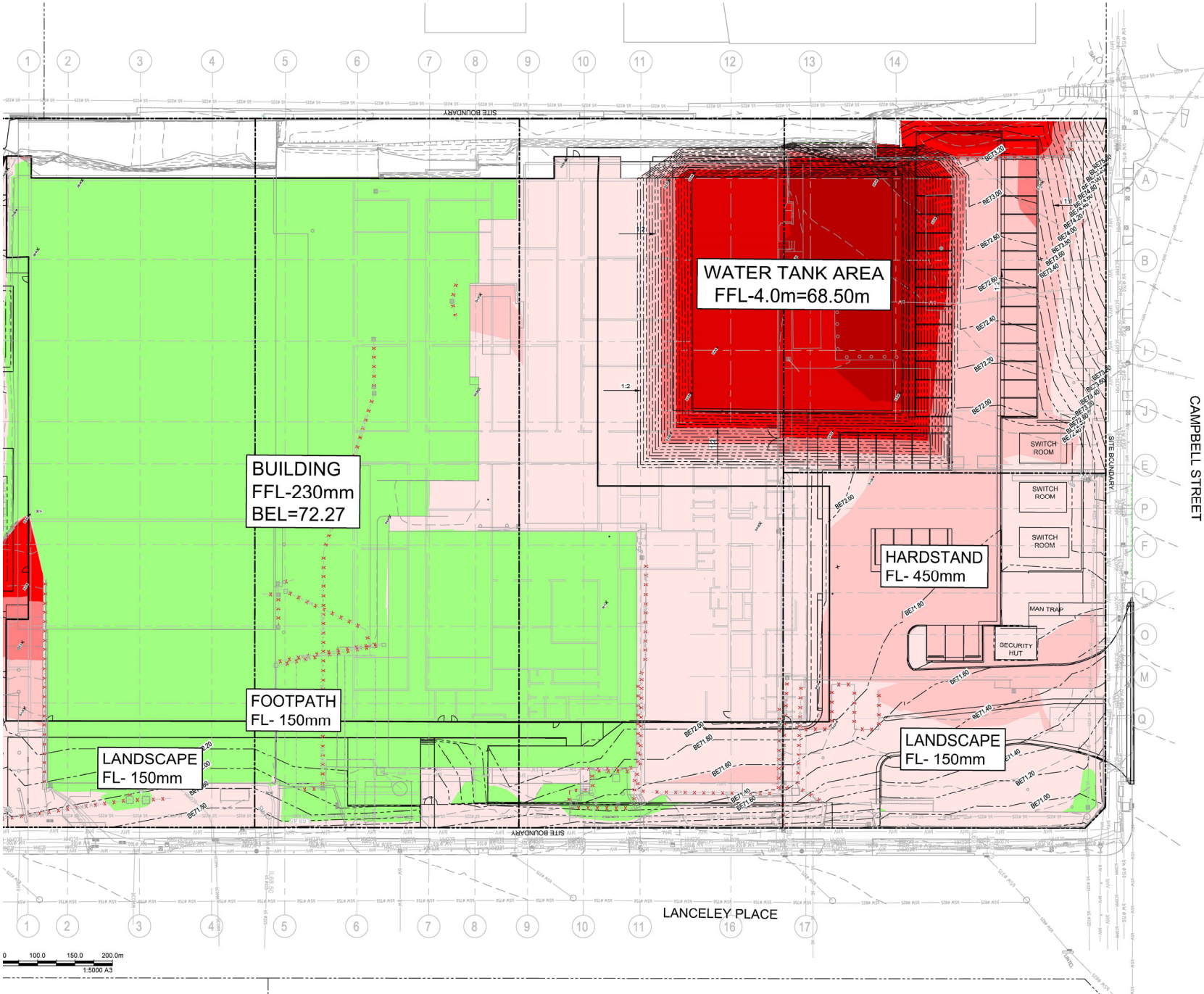
DRAWING TITLE
LEVEL B1

SCALE
1 : 200 @A0

STATUS
FOR INFORMATION

DRW	CH	APPR	DRW DATE	REV
AL/GA	EE	MJ	30.01.23	H

DRAWING NO.
A02-1001



Elevations Table

Number	Minimum Elevation	Maximum Elevation
1	-8.000	-7.000
2	-7.000	-6.000
3	-6.000	-5.000
4	-5.000	-4.000
5	-4.000	-3.000
6	-3.000	-2.000
7	-2.000	-1.000
8	-1.000	0.000
9	0.000	1.000
10	1.000	2.000
11	2.000	3.000
12	3.000	4.000

LOCATION	AREA (m^2)	BULK EARTHWOR		
		CUT (m^3)	FILL (m^3)	NE (m^3)
BULK CUT & FILL	13203	-11270	2710	-856
ROCK CUT & FILL	4511	-3815	3921	106

BULK EARTHWORKS NOTES

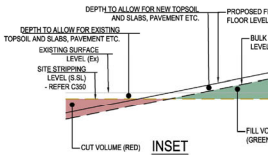
1. All bulk earthworks setout from grid lines U.N.O.
2. All batters at a slope of .2 (H) : 1 (V) U.N.O.
3. Excavated material may be used as structural fill provided
   (i) it complies with the specification requirements for fill n
   (ii) the placement moisture content complies with the Geo
   Consultants requirements, and allows filling to be place
   proofrolled in accordance with the specification. Where
   necessary the Contractor must moisture condition the
   excavated material to meet these requirements.
4. Compact fill areas and subgrade to not less than:

Location	Standard dry density (AS 1289 5.1.1.)	Moisture (OMC)
Under building slabs on ground:	98%	±2%
Under roads and carparks:	98%	±2%
Landscaped areas:	95%	±2%

5. Before placing fill, proof roll exposed subgrade with a 12 t minimum roller to test subgrade and then remove soft spo (areas with more than 3mm movement under roller). Soft spots to be replaced with granular fill U.N.O.
6. Contractor shall place safety barriers around excavations accordance with relevant safety regulations.
7. For interpretation of bulk earthworks foot print line shown bulk earthworks drawings refer to the bulk earthworks con legend.
8. Bulk earthwork drawings are not to be used for detailed e
9. Refer to Geotechnical Report prepared by PSM CONSUL -PSM4669-003L REV2. DATED- 16 June, 2023.
10. Detailed earthworks such as piling, pile caps, ground be service trenching & landscape mounding etc is excluded.

ASSUMPTIONS:

1. Bulk quantities represent difference betwe existing ground levels and proposed levels
2. Site strip has not been included.
3. Set down for Structural slab is 230mm as documentation.
4. Set down for hardstand(carpark and loadir pavement assumed to be 450mm and set footpaths and landscape areas assumed t based on 3% CBR.Further investigation is Geotechnical Engineer.
4. Bulk earthworks does not included detail e for lift pits, footings, services etc.
5. For Rock surface, Geotech report does no surface RLs at bore hole spots. Surface RL taken from survey.
6. Survey does not include existing buildings Floor levels have been assumed for bulk e
7. Shoring is considered, where existing reta for bulk excavation.



INSET
N.T.S.

NOT FOR CONSTRUC

SSION	VC	ES	01.05.2024						
	Eng Draft		Date	Rev	Description	Eng Draft	Date	Rev	Description	Eng Draft	Date

Client: Goodman

Engineer: TTW Structural Civil Traffic Façade
612 9439 7288 | Level 6, 73 Miller Street, North Sydney, NSW 2060

Project: LANCELEY PLACE DATA CENTRE, ARTARMON

Drawing Title: EARTHWORKS CUT AND FILL VOLUMES PLAN

Scale at A1	Drawn	Designed
1:250	SS	SH

Project No	Originator	Zone	Type	Role
231976	TTW	00	DR	CI

01.05.2024 8:54 AM

Appendix A
PSM4669-003L REVA

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North Ryde NSW 2113
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F +61-2 9812 5001
E mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM4669-003L REVA

1 May 2024

Goodman Property
The Hayesbery
1-11 Hayes Road
Rosebury NSW 2018
Cameron.Rubenach@goodman.com

Attention: Cameron Rubenach

Dear Cameron

RE: LANCELEY PLACE DATA CENTRE, ARTARMON
RESULTS OF GEOTECHNICAL INVESTIGATION

1. Introduction

A State Significant Development Application (**SSDA**) has been prepared in support of a proposed data centre at 2-8 Lanceley Place and 14 Campbell Street, Artarmon (Lanceley Place Data Centre, Artarmon). The site comprises 5 individual allotments totalling 14,024m^2 in area, is zoned E4 General Industrial and has road frontages to both Lanceley Place and Campbell Street.

The proposal will include:

- Site preparation works including demolition, bulk excavation and removal of existing structures on the site, tree and vegetation clearing, and bulk earthworks;
- Construction, fit out and operation of a ten-storey, 80MVA data centre with a maximum building height of 51.479m (RL 124.5) ridge height (street wall height of 50m) and total gross floor area of 26,769m^2 comprising:
  - At-grade parking for 39 car parking spaces and 2 accessible car parking spaces
  - Two (2) 12.5m long vehicle loading dock spaces
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- Vehicle access provided via Campbell Street and Lanceley Place
- Pedestrian access provided via Campbell Street and Lanceley Place
- Associated landscaping and site servicing
- Installation of services and drainage infrastructure

- A floor space ratio of approximately of 1.91:1. Given this exceeds the *Willoughby Local Environmental Plan 2012* (WLEP) control, a request to vary the control for the development under Clause 4.6 of the WLEP will be included with the SSDA.

This letter has been prepared to address the Secretary's Environmental Assessment Requirements (**SEARs**) and accompanying cover letter issued for the Lanceley Place Data Centre project (SSD-66777221) dated 23 January 2024.

Specifically, this report has been prepared to respond to the SEARs requirement issued below.

Item	Description of Requirement	Section reference (this report)
Ground and Water Conditions	Geotechnical Assessment	Section 8

This letter presents the results of PSM's geotechnical investigation for the proposed redevelopment of the ABC Site located at the corner of Lanceley and Campbell Street, Artarmon (the **Site**) for the following periods.

- December 2021
- May 2023

The work was undertaken in accordance with PSM proposals:

- PSM4669-001L dated 3 December 2021 (requested as part of due diligence study of the Site)
- PSM4669-009L dated 1 May 2023.

1.1 The Site

The site is located on Cammeraygal Land and is in the Artarmon industrial area within the Willoughby Local Government Area (LGA). It is bounded by Campbell Street to the north and Lanceley Place to the east and has immediate frontages with a concrete batching plant to the south-east, and several buildings including the NextDC Data Centre to the west.

Artarmon Industrial Precinct comprises relatively new commercial and industrial developments and has been subject to several separate DAs which have increased the densities in the area. Other notable nearby land uses include the Home HQ shopping centre, the Artarmon Bunnings Warehouse, the Royal North Shore Hospital and the North Shore Private Hospital.

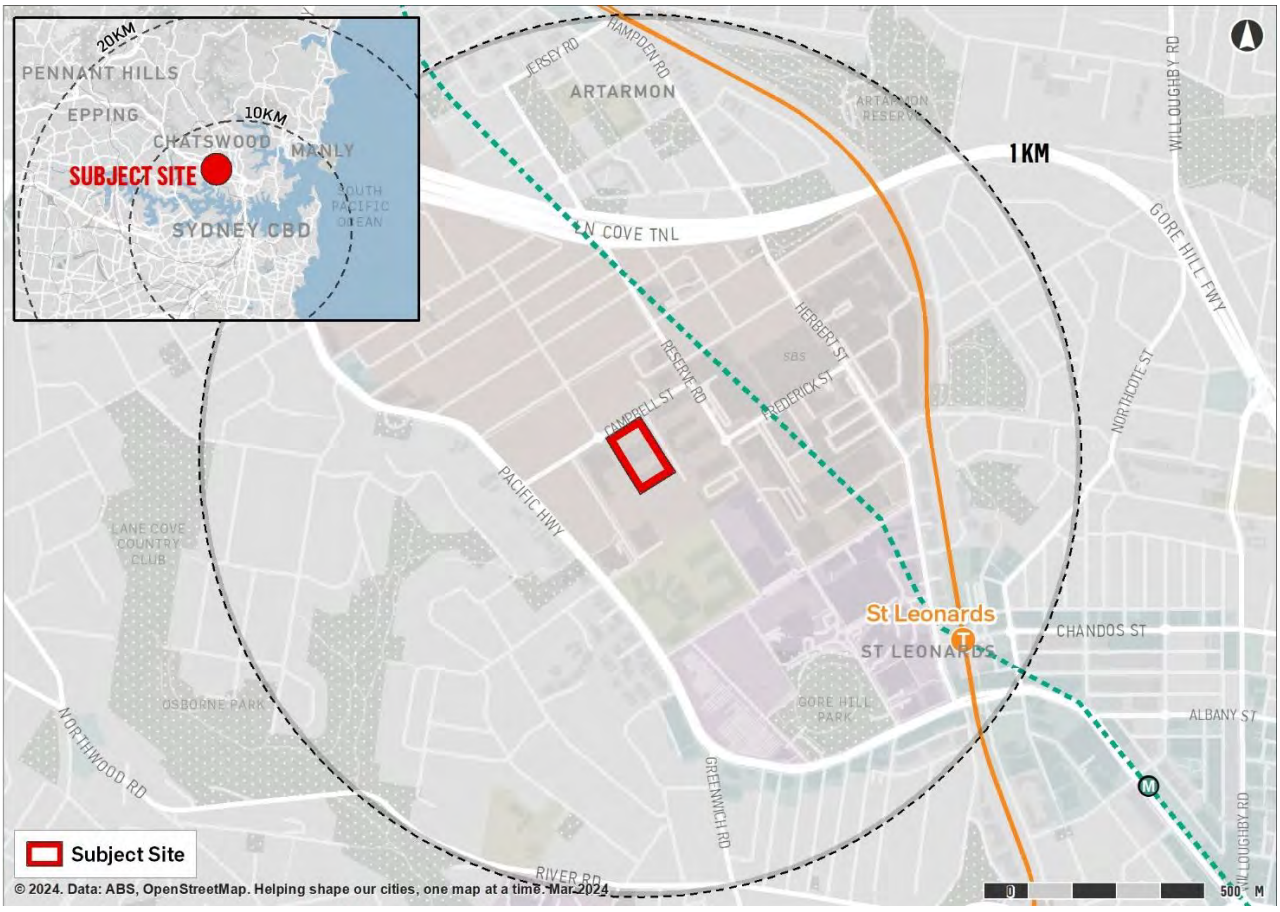
The site comprises 14,024m^2 and consists of five separate lots. It was most recently occupied by film and television studios tenanted by the Australian Broadcasting Corporation (ABC) which sold the site in 2021. The site was subject to a SSDA application in 2023 which proposed an industrial warehouse and distribution centre (SSD-48478458). The site is currently vacant.

The closest residential uses include residential flat building on the western side of Pacific Highway (approximately 300m west from the site) and in Artarmon (approximately 500m north of the site).

The site is well serviced by transport, and is within close proximity of the Pacific Highway, M1, M2 and the Lane Cove tunnel with bus services linking the area with North Sydney and the Sydney CBD. St Leonards Station, which provides T9 Northern Line and T1 North Shore and Western Line train services, is within a 1km walk of the site.

The future Crows Nest Metro station is located approximately 1.4km from the site which will deliver high frequency metro services across Sydney and is expected to be opened in 2024.

Inset 1: Site Aerial (Source: Urbis)



Inset 2: Local Context (Source: Urbis)

2. Geotechnical Investigation – December 2021

2.1 Fieldwork

Two days of fieldwork were undertaken on 20-21 December 2021, in which a total of eight (8) boreholes were drilled, as follows:

- Five (5) augered boreholes and two (2) cored boreholes using a track-mounted drill rig
- One (1) hand augered borehole.

The augered boreholes were drilled to maximum depths ranging between 1.5 m and 2.7 m below ground surface. The cored boreholes were drilled to depths of 5.5 m and 6.1 m below ground surface following augering.

Rotary augering techniques were employed in soil and some weathered rock units, and triple-tube coring was used in more competent rock.

Where a concrete slab was present at the ground surface concrete coring was undertaken prior to drilling the boreholes.

All borehole locations were scanned for underground services by a service locator prior to undertaking any ground-breaking investigations.

The investigation locations were recorded with a hand-held GPS unit with a horizontal accuracy of approximately +/- 5 m.

The fieldwork was undertaken under the fulltime supervision of a PSM Geotechnical Engineer, who undertook the following tasks:

- Preparing field logs of material encountered
- Collecting soil samples for laboratory testing
- Conducting field tests such as Standard Penetrometer Tests (SPTs) and Point Load Index (Iss) tests.

SPTs were undertaken in soil units within selected boreholes. Point Load Index (Iss) tests were undertaken at approximately 1 m intervals on recovered rock core.

At the completion of the fieldwork, the boreholes were backfilled with the borehole cuttings and topped off with a grout-secured concrete plug.

The locations of the boreholes are presented on Figure 1. Selected site photographs are presented in Figures 2 to 6.

Appendix A.1 presents the geotechnical borehole logs and photographs of the recovered rock core. Appendix B.1 contains the results of the point load index tests.

2.2 Laboratory testing

Soil samples were recovered and sent to a geotechnical laboratory for the following testing:

- 2 x CBR tests (BH02 and BH03) .

Soil samples were also recovered and sent to a NATA accredited laboratory for the following testing:

- 3 x Aggressivity and salinity tests (BH02, BH03, and BH05).

The results of the laboratory testing are presented in Section 5.

3. Geotechnical Investigation – May 2023

Two days of fieldwork were undertaken on 22-23 May 2023, in which a total of four (4) cored boreholes (i.e. BH09 to BH12) were drilled using a track-mounted drill rig.

The cored boreholes were drilled to depths of 5.4 m and 7.1 m below ground surface following augering.

Rotary augering techniques were employed in soil and some weathered rock units, and triple-tube coring was used in more competent rock.

Where a concrete slab was present at the ground surface concrete coring was undertaken prior to drilling the boreholes.

All borehole locations were scanned for underground services by a service locator prior to undertaking any ground-breaking investigations.

The investigation locations were recorded with a hand-held GPS unit with a horizontal and vertical accuracy of approximately +/- 30 mm.

The fieldwork was undertaken under the fulltime supervision of a PSM Geotechnical Engineer, who undertook the following tasks:

- Directing the service location and borehole
- Preparing field logs of material encountered
- Undertaking point load strength index tests on recovered rock core.

Point Load Index (*Iss*) tests were undertaken at approximately 1 m intervals on recovered rock core.

At the completion of the fieldwork, the boreholes were backfilled with the borehole cuttings and topped off with a grout-secured concrete plug.

The locations of the boreholes are presented on Figure 1. Selected site photographs are presented in Figures 7 to 9.

Appendix A.2 presents the geotechnical borehole logs and photographs of the recovered rock core. Appendix B.2 contains the results of the point load index tests.

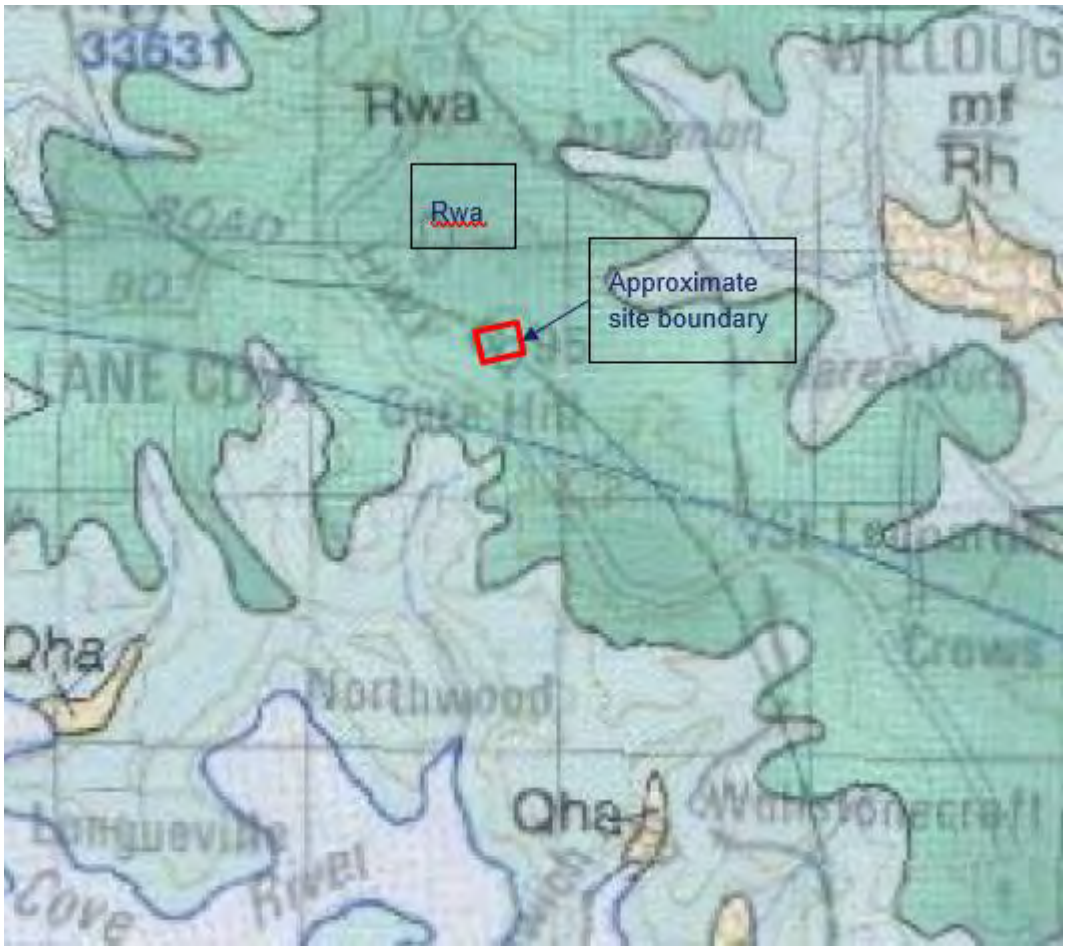
4. Site Conditions

4.1 Geological Setting

The 1:100,000 Sydney geological map (1983) indicates that the sjte is underlain by:

- (R_{wa}) Ashfield Shale of the Wianamatta Group comprising black to dark-grey shale and laminite.

Inset 3 presents the site location with regards to the geological setting.



Inset 3: Sydney 1:100,000 geological map (site marked in red)

4.2 Surface Conditions

The Site is bounded by Campbell St to the northwest, Lanceley Place to the northeast, Hanson concrete batch plant to the southeast, and an Ausgrid development to the southwest.

The Site is currently occupied by several single and multistorey buildings housing the ABC filming studios. The buildings are surrounded by asphalt carparking and concrete carparking / hardstand.

A retaining wall up to an estimated height of 10 m is located along the southwest boundary of the Site (retaining the adjacent Ausgrid site). The upper portion of the wall comprises a vertical shotcreted face while the lower portion comprises a sub-vertical rock cut. Part of the rock cut is shotcreted with weathered siltstone exposed in the remainder. Details of the retaining wall construction are unknown to PSM. Photo 3 on Figure 3 shows the retaining wall.

The northern end of the Site slopes down gently from the retaining wall in the northwest to Lanceley Place in the northeast.

During the investigation of the Site, we observed that most of the surface was paved (concrete).

4.3 Subsurface Conditions

The subsurface conditions encountered within the boreholes are summarised in Table 1. Geotechnical borehole logs are provided in Appendix A.1 and Appendix A.2.

Table 1 – Summary of Inferred Subsurface Conditions Encountered in PSM Boreholes

Inferred Unit	Depth to Top of Inferred Unit (m)	Material Description
PAVEMENT	0.0	CONCRETE; 100 mm to 170 mm thick ASPHALT; 50 mm thick ROADBASE; 10 mm to 50 mm thick.
EXISTING FILL	0.05	Sandy Gravelly CLAY to Sandy CLAY with Gravel; low to medium plasticity, dark brown to brown, firm to stiff consistency, sand fine to coarse grained, gravel fine to medium grained up to 30 mm, sub-angular, moist. Clayey GRAVEL with Sand to Sandy GRAVEL; fine to coarse grained up to 40 mm, sub-angular to angular, medium dense, dark brown to red-brown, sand fine to coarse grained, trace construction rubble (ceramic, tiles, bricks), dry to wet. SAND with Gravel trace Clay to SAND trace Gravel trace Clay; medium to coarse grained, medium dense, dark brown, gravel fine to medium grained up to 20 mm, sub-angular to angular, trace construction rubble (plastic, possible Asbestos containing materials), moist to wet.
RESIDUAL SOIL	0.01 to 0.4	Sandy Gravelly CLAY to CLAY; low to medium plasticity, brown to pale grey mottled orange-brown, stiff to hard, gravel fine to coarse up to 60 mm, sub-angular, dry to moist.
BEDROCK A	0.25 to 2.7	SILTSTONE; grey to dark grey, very low to low strength; extremely weathered to slightly weathered. SANDSTONE: medium grained, pale grey, very thinkly bedded, developed to well developed, fresh rock, low strength. INTERBEDDED SILTSTONE AND SANDSTONE; fine to medium grained, brown, orange, pale grey and dark grey, thinly bedded, well developed, extremely to slightly weathered, low strength, 60% siltstone and 40% sandstone, iron stained.
BEDROCK B	1.5 to 4.3	SANDSTONE; fine to medium grained, pale grey, laminated to very thinly bedded, poorly developed to well developed, slightly weathered to fresh, medium to high strength. INTERBEDDED SILTSTONE AND SANDSTONE; fine grained, brown, orange, pale grey and dark grey, thickly laminated, very well developed, fresh, medium to high strength, 60% to 70% siltstone and 30% to 40% sandstone. INTERBEDDED SILTSTONE AND SANDSTONE; fine grained, pale grey and dark grey, thickly laminated, very well developed, fresh, high strength, 60% to 70% sandstone and 30% to 40% siltstone.

The thickness of each geotechnical unit encountered in the boreholes are summarised in Table 2.

Table 2 – Reduced Level at Top of Inferred Geotechnical Units encountered in Boreholes

Period of Investigation	Borehole ID	Reduced Level at Top of Inferred Geotechnical Units (m AHD)					
		PAVEMENT	EXISTING FILL	RESIDUAL SOIL	BEDROCK A	BEDROCK B	EOH [1]
December 2021	BH01[5]	72.1	N/E	72.0	69.4	67.8	66.5
	BH02[5]	72.0	71.9	71.6	69.8	N/E	69.5
	BH03[5]	74.4	N/E	N/E	73.1	72.9*	72.9 (Ref)
	BH04[5]	73.9	N/E	73.9	72.5	N/E	71.4
	BH05[5]	71.7	71.6	N/E	71.4	69.4	65.6
	BH06[5]	71.8	71.8	N/E	N/E	N/E	69.6
	BH07[5]	71.8	71.6	N/E	71.6	70.3*	70.3 (Ref)
	BH08[5]	NE	73.1	N/E	N/E	N/E	72.5
May 2023	BH09[6]	71.9	71.9	N/E	70.8	69.2	66.5
	BH10[6]	72.5	72.3	70.5	N/E	68.3	65.4
	BH11[6]	72.1	72.0	71.4	69.3	67.9	65.2
	BH12[6]	74.1	74.1	73.6	72.6	68.1	67.4

(1) EOH = End of Hole
(2) N/E = Not encountered
(3) Ref = Refusal depth of drilling (Auger tip).
(4) * = TOP of BEDROCK B unit has been inferred based on auger refusal depth.
(5) RL's sourced from LTS Survey (ref: 51775 001DT)
(6) RL's recorded using a handheld GPS unit.

Our experience in Ashfield Shale indicates that the following joints may be present in BEDROCK A and BEDROCK B:

- Two steep (90° ± 20°) orthogonal joint sets striking general north-south and east-west. These are ubiquitous
- Disperse joint clusters with dips usually in the range of 30° to 70°. Their frequency is considered random. Joints with dips within this range encountered in BH01 and BH03 indicate that these joints are present at site
- Such joints are typically spaced between 0.3 m and 5 m
- The length of the joints is typically less than 5 m, but joints longer than 20 m have been known to occur.

Jointing observed in the rock cutting exposed along the southwest boundary of the Site were consistent with those described above. Photo 5 in Figure 4 contains a photo of one such joint.

4.4 Groundwater

Groundwater was encountered in

- BH06 during drilling at a depth of 1.2 m below ground surface (December 2021)
- BH10 during drilling at a depth of 2 m below ground surface (May 2023).

We note that we have previously issued a groundwater monitoring report (ref. PSM4669-006L REV1, dated 2 February 2023). The following was reported:

> *"Based on recent monitoring data, groundwater was observed to be between RL 70.84 m and RL 71.07 m; i.e. 0.75 m to 1.0 m below existing surface levels at Coffey_BH1 and BH12 (south boundary of the site). It is accessed to be very localised. We note that wells located on the north eastern boundary of the Site were dry."*

5. Laboratory Testing Results

5.1 California Bearing Ratio (CBR)

Table 3 presents a summary of the CBR test results. The test results are included in Appendix C.

Table 3 – CBR Test Results

Sample (Depth)	Material Description	Soaked CBR (%) [1]	Optimum Moisture Content (%)	Standard Maximum Dry Density (t/m^3)	Swell (%)
BH02 (0.2 – 1.0 m)	CLAY to Sandy CLAY with Gravel	11	16.4	1.81	0.5
BH03 (0.2 – 1.0 m)	SILTSTONE	3.5	15.2	1.80	1.0

(1) Soaked CBR value at 5 mm penetration

5.2 Aggressivity and Salinity Test Results

Table 4 presents a summary of the analytical laboratory testing results. Detailed results are provided in Appendix D.

Table 4 – Summary of Analytical Laboratory Test Results

Borehole ID – Depth	Material Description	pH	Moisture Content [%]	Chloride by Discrete Analyser [mg/kg]	Soluble Sulphate [mg/kg]	Electrical Conductivity [µS/cm]	Resistivity ohm.cm	Exchangeable Cations [meq/100g]					ESP [%]
								Ca	Mg	K	Na	CEC	
BH02 – 1.0 m	CLAY	7.4	12.6	<10	20	115	8700	4.9	<0.2	<0.2	<0.2	5.0	<0.2
BH03 – 0.5 m	SILTSTONE	5.5	9.7	30	30	51	19600	0.2	2.4	0.5	1.0	4.1	23.8
BH05 – 0.2 m	Clayey GRAVEL	8.7	9.7	<10	20	100	10000	4.2	<0.2	<0.2	<0.2	4.2	<0.2

6. Exposure Classification

6.1 Salinity Assessment

Site Investigations for Urban Salinity (DLWC 2002) classify soil salinity based on electrical conductivity (EC_e) as per Richards (1954). The method of conversion from $EC_{1:5}$ to EC_e (electrical conductivity of saturated extract) is based on DLWC (2002) and given by $EC_e = EC_{1:5} \times M$, where M is the multiplication factor based on "Soil Texture Group".

The "Soil Texture Group" of the samples tested has been assessed during our investigation. The salinity classification for the soil samples that were tested are presented in Table 5.

Table 5 – Salinity Classification

Sample ID (Depth)	EC1:5 (dS/m)	Soil Type	M	ECe (dS/m)	Salinity Class
BH02 – 1.0 m	0.115	Clay Loam	9	1.035	Non saline
BH03 – 0.5 m	0.051	Sandy Loam	14	0.714	Non saline
BH05 – 0.2 m	0.1	Sandy Loam	14	1.4	Non saline

Based on the results, the soils on Site are classified as "non saline".

We have referred to Clause 4.8.2 of Australian Standard AS3600-2018 "Concrete Structures" and note that the assessed soil electrical conductivity (EC_e) is less than the lower limit of the "A2" exposure classification.

6.2 Aggressivity / Corrosivity

Table 4.8.1 of Australian Standard AS 3600 (2018) "Concrete Structures" provides criteria for exposure classification for concrete in sulphate soils based on sulphate content and acidity in the soil and groundwater. Based on the laboratory results of the soil testing completed, we assess the exposure classification for concrete in the EXISTING FILL, RESIDUAL SOIL and BEDROCK units to be A1 where low permeability soil or rock is present (e.g. silts and clays) and A2 where high permeability soil is present (e.g. sands and gravels).

Table 6.4.2(C) of Australian Standard AS 2159 (2009) "Piling Design and Installation" provides criteria for exposure classification for concrete piles based on sulphates in the soil and groundwater, soil and groundwater pH, and chlorides in groundwater. Based on laboratory results of the soil testing completed, we assess the exposure classification for concrete piles in the EXISTING FILL, RESIDUAL SOIL and BEDROCK units to be "Mild" where high permeability soil is present, and "Non-aggressive" where low permeability soil and rock is present.

Table 6.5.2(C) of Australian Standard AS 2159 (2009) "Piling – Design and Installation" provides criteria for exposure classification for steel piles based on soil and groundwater pH, chlorides in soil and groundwater and resistivity. Based on laboratory results of the soil testing completed, we assess the exposure classification for steel piles in the EXISTING FILL, RESIDUAL SOIL and BEDROCK units to be "Non-aggressive".

6.3 Sodicity

Sodicity provides a measure of the likely dispersion on wetting and to shrink / swell properties of a soil. Soil sodicity is classified based on the Exchangeable Sodium Percentage (ESP) which is the amount of exchangeable sodium as a percentage of the Cation Exchange Capacity (DLWC, 2002).

The Exchangeable Sodium Percentages calculated from the laboratory results was compared to the criteria provided in "Site Investigations for Urban Salinity", DLWC (2002). In the EXISTING FILL and RESIDUAL SOIL units, the laboratory testing indicates that these units are classified as "non-sodic", as per DLWC (2002). In the BEDROCK units, the laboratory testing indicates that these units are classified as "highly sodic".

7. Earthworks

Details of any earthworks are not known at this stage.

We have prepared a bulk earthworks specification for the proposed development. Appendix E presents PSM bulk earthworks specification (Ref. PSM4669-004S REV0). The document provides subgrade preparation and filling requirements for development.

8. Discussion

8.1 General

The interim geotechnical design advice (IGDA) provided in the following sections has been prepared on the following basis:

- The investigation results presented in this letter
- The earthworks are to be completed in accordance with the PSM bulk earthworks specification PSM4669-004S REV0.

If any of the above is not applicable, PSM should be requested to confirm that the design advice below is still valid.

Any proposed excavation immediately adjacent to the existing retaining wall shall consider the impact and stability on the existing retaining wall. The shoring designer shall consider existing wall and structures in their design.

8.2 Site Classification

We note that the proposed development (i.e. multi storey commercial / industrial buildings) is outside the scope of AS2870-2011 “Residential slabs and footings”.

Based on the natural clay soil on Site, and for fill placed / prepared in accordance with the PSM bulk earthworks Specification, the characteristic surface movement, y_s, would be in the range 40 mm to 60 mm and thus would classify the Site as Class H1.

The civil and structural engineers should consider likely heave / settlement due to the effect of climatic factors in their designs.

We recommend that all structures and services be detailed such that they preclude any local wetting up or drying out of the subgrade after initial equilibrium is reached following construction of the slab and that the subgrade be within specification at the time of construction of the slab. We note that normal mounding or sagging away from the perimeter of covered areas will still occur and perimeters, or open joints, will still respond to environmental changes.

8.3 Earthquake site classification

For earthquake provisions, we assess the site as the following in accordance with AS1170.4-2007:

- The site is classified as Class B_e (Rock)
- The site has a Hazard Reduction Factor (Z) of 0.08.

8.4 Excavation

We understand that basements may be included as part of the development. The number of basement levels (i.e. excavation depth) is not known to PSM.

Excavation in Soil units and BEDROCK A should be achievable using conventional earth moving equipment (eg excavators and dozers). Excavation of BEDROCK B which comprises medium to high strength sandstone will require the use of hydraulic impact breakers, rock saws and/or rock grinders and must be undertaken by contractors with suitable experience in rock excavation close to existing structures.

Prospective contractors should make their own assessment of excavatability based on our logs and their site inspection and experience.

8.5 Temporary and Permanent Batters

Where site constraints permit, including for shallow excavations, batters could be considered to support the soil and weathered rock.

The batter angles in Table 6 are recommended for the design of batters up to 3 m height and above the groundwater table, subject to the following recommendations:

1. The batters shall be protected from erosion.
2. Permanent batters shall be drained.
3. Temporary batters shall not be left unsupported for more than 1 month without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events.
4. Where loads are imposed or structures / services are located within on batter height of the crest of the batter, further advice should be sought.

If the conditions above cannot be met, further advice should be sought.

Where Fill is not engineered/controlled fill, batter slope angles should be assessed by a suitable experienced geotechnical engineer.

Exposed rock faces should be inspected by a geotechnical engineer or engineering geologist to assess the need for localised rock bolting to control adverse jointing in the BEDROCK A and BEDROCK B units and shotcreting for overall face support and weather protection. The first inspection should be made when 1 m of the BEDROCK A and BEDROCK B units is excavated.

Table 6 – Design Batter Slope Angles

Unit	Temporary	Permanent
ENGINEERED FILL RESIDUAL SOIL	1.5H: 1V	2H: 1V
BEDROCK A	0.5H : 1V	1H : 1V
BEDROCK B	Vertical	Vertical*

Note: * - Subject to support design and inspections.

Proper and suitable safe work method statements and OHS documents need to be developed for works to be undertaken in the vicinity of the crest and toe of batters.

The batters should be inspected by an experienced geotechnical engineer or engineering geologist during excavation to confirm the batter advice provided.

8.6 Excavation Support

8.6.1 General

Permanent cuts in the RESIDUAL SOIL and BEDROCK A units steeper than the recommended permanent batter slopes in Table 7 will need to be supported by some form of retaining structure.

The selection of the appropriate retention system is a matter of design. The designer should consider the following factors in making its selection:

- Technical factors:
  - Performance, i.e., allowable deformations at the boundary and at adjacent buildings
  - Ground conditions (this is addressed below in Table 7 with the design parameters)
  - Surcharge loading and
  - Proximity of structures, buildings, roads etc.

- Non-technical factors:
  - Cost (to build and to maintain)
  - Other constraints such as real estate, neighbouring site/boundary, aesthetics, legislation, etc.

The design of these structures should be based on the following geotechnical properties:

- Effective strength parameters in Table 7 when assessing the earth pressure on retaining structures
- A lateral pressure of 10 kPa for vertical cuts in the BEDROCK A and BEDROCK B units. This is to allow for small blocks and rock wedges formed due to adverse defects that may exist within the unit
- Loading resulting from larger wedges resulting from interaction of the longer inclined joints within BEDROCK A and BEDROCK B units. For these purposes, the designer should consider the general defect descriptions presented in this report. Further geotechnical input with how to deal with this loading will be required at detailed design stage when the details of the excavation and proposed support system are better understood
- Water pressure (depending on the type of structure).

Note that design of retention systems may be based on either K_a or K_o earth pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires a wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

Where the design is based on K_o pressures, construction should be carefully controlled to avoid unwanted effects. It should be noted that designing for K_o pressures do not, of themselves, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drainage needs to be designed and constructed properly to prevent pore water pressures from building up behind the retaining walls and in the retained material. Otherwise, appropriate water pressures must be included in the design.

8.6.2 Vertical Excavation in BEDROCK B

For vertical excavations in BEDROCK B, exposed rock faces should be inspected by a geotechnical engineer to map the rock and assess the need for localised rock bolting to control risks associated with adverse jointing in the BEDROCK units and shotcreting for overall face support. The first inspection should be made when 1 m of BEDROCK is excavated or one month from commencement of the bulk excavation, whichever is earliest, with ongoing inspections at every 2 m lift.

Vertical cuts in BEDROCK B are likely to require localised support, such as rock bolting to control adverse jointing, and mesh and/or shotcrete for overall face support in locally lower quality rock.

Durability of the rock bolts are to be considered by the designer in accordance with their temporary versus permanent design life requirements.

8.7 Foundations

8.7.1 Preamble

In general, the designer should note the following with regards to foundation design:

- The bearing capacities provided are contingent on piles or footings being vertically and centrally loaded. Further advice should be sought if the footings are not vertically centrically loaded
- Where adjacent foundation details differ (e.g., pile and pad, differing loads or ground conditions) differential settlement will need to be assessed
- Deflections should be checked using the recommended elastic parameters in Table 7.

8.7.2 Shallow Foundations

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 7.

We note that an allowable bearing pressure (ABP) is not a soil property. It depends on many factors such as the size of the footings, the embedment depth, the load direction and eccentricity, the stiffness of the footing, the adopted factor of safety (FOS), as well as the soil properties. As footings get bigger or deeper the capacity increases rapidly, as the load gains eccentricity or becomes inclined, the capacity reduces rapidly.

Settlements can be estimated using the elastic parameters provided in Table 7. When assessing the settlement of the shallow footings, the designer needs to consider the additional ground settlement due to the total building load on both shallow and deeper units. The differential settlement due to the building load shall also be assessed.

Foundation conditions at the proposed shallow pad locations should be inspected by a suitable qualified geotechnical engineer prior to the pouring of concrete.

8.7.3 Piles

Piles should be designed in accordance with the requirements in AS 2159 (2009), *Piling – Design and Installation*. Selection of the pile system depends on many considerations and should be undertaken by the designer in conjunction with the Principal and contractor / builder. The parameters provided in Table 7 may be adopted in the design of piles founded in the BEDROCK A and BEDROCK B units.

The designer should note the following with regards to the pile design:

- The ABP needs to be confirmed by a geotechnical engineer through pile inspections prior to pouring concrete
- Under permanent load, the contribution of side adhesion for soils including the RESIDUAL SOIL unit should be ignored
- Pile settlement can be checked using the recommended elastic parameters in Table 7
- Where adjacent foundation details differ (e.g. pile and pad, differing loads or ground conditions), differential settlement should also be assessed.

Should higher bearing capacities be required of the BEDROCK A or BEDROCK B units, this may be available subject to further advice.

With regards to the pile design, we recommend that:

- A basic geotechnical strength reduction factor, $\Phi gb = 0.60$ (AS2159 CL. 4.3.2) be adopted for a high redundancy system for an assessed average risk rating (ARR) between 2.5 and 3.0. This should be reviewed to suit the specific design and appropriate pile testing proposed by the structural / pile designers in accordance with the requirements of AS2159
- It may be possible to increase the pile reduction factors, if the details of the proposed pile installation procedures indicate a high level of quality control with regards to concrete placement, base cleanliness, etc
- If a geotechnical strength reduction factor, $\Phi g = 0.40$ is adopted then no pile testing will be required (AS2159 Clause 8.2.4 (b)).

Where the pile is sized using the allowable bearing capacity in Table 7 (i.e., assuming all serviceability load is carried by the base), the settlement would be expected to be less than 1% of the pile diameter plus elastic shortening of the pile itself.

Table 7 – Engineering Parameters of Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m3)	Soil Effective Strength Parameters		Ultimate Bearing Pressure under Vertical Centric Loading (kPa)	Allowable Bearing Pressure (ABP) under Vertical Centric Loading (kPa) [3]	Ultimate Shaft Adhesion [4] (kPa)	Elastic Parameters	
		c' (kPa)	φ' (deg)				Long Term Youngs Modulus (MPa)	Poisson's Ratio
ENGINEERED FILL[1]	18	0	30	420	150	N/A	10	0.3
RESIDUAL SOIL [1]	18	0	30	420	150	N/A	10	0.3
BEDROCK A	22	10	30	3,000*	1,000**	150	100	0.25
BEDROCK B	24	150	30	6,000*	2,500**	400	500	0.25

(1) Pad footings in SOIL units (for ABP of 150 kPa) should have a minimum horizontal dimension of 1.0 m and a minimum embedment depth of 0.5 m.
(2) * - Ultimate values occur at large settlement (>5% of minimum footing / pile dimensions).
(3) ** - ABP is an end bearing pressure to cause settlement of <1% of minimum footing / pile dimensions.
(4) Clean socket of roughness category R2 or better.

8.8 Slabs

The design of slabs on RESIDUAL SOIL can be based on a subgrade with the following Young's moduli:

- Long term Young's modulus (E_{LT}) of 10 MPa
- Short term Young's modulus (E_{ST}) of 15 MPa.

We note that the environmental effects (e.g., drying or wetting up of the finished surface) affecting the land prior to development should be taken into account by the various designers of the proposed development.

We note that the final bulk earthworks subgrade will require proof rolling and plate load testing to confirm the properties provided and may require some boxing out and refilling, etc.

8.9 Pavements

Two (2) CBR tests were undertaken on samples of the existing fill. The results (refer to Table 3) contained CBR values of 3.5% and 11%.

Subgrade CBR for pavement design depends on the material at the finished subgrade levels.

We recommend that specific CBR testing be undertaken at subgrade level when pavement layouts are finalised. CBR testing shall be undertaken for any new imported material within the pavement subgrade (e.g., within 1 m below pavement).

9. General

If at any time, the conditions are found to vary from those described in this report, further advice should be sought.

Should there be any queries, please no not hesitate to contact the undersigned.

For and on behalf of
PELLS SULLIVAN MEYNINK

HUGO THANG
GEOTECHNICAL ENGINEER

GREG FAZZONE
SENIOR GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl.	Figure 1	Site Locality Plan
	Figure 2	Selected Site Photographs (1 of 8)
	Figure 3	Selected Site Photographs (2 of 8)
	Figure 4	Selected Site Photographs (3 of 8)
	Figure 5	Selected Site Photographs (4 of 8)
	Figure 6	Selected Site Photographs (5 of 8)
	Figure 7	Selected Site Photographs (6 of 8)
	Figure 8	Selected Site Photographs (7 of 8)
	Figure 9	Selected Site Photographs (8 of 8)
	Appendix A.1	Geotechnical Borehole Logs – December 2021
	Appendix A.2	Geotechnical Borehole Logs – May 2023
	Appendix B.1	Point Load Test Results – December 2021
	Appendix B.2	Point Load Test Results – May 2023
	Appendix C	CBR Test Results
	Appendix D	Salinity and Aggressivity Laboratory Test Results
	Appendix E	Earthworks Specification PSM4669-004S REV A
	Appendix F	Architectural Plan

Legend

- Monitoring Wells (Coffey)
- Augered Boreholes (PSM) - December 2021
- Hand Augered Boreholes (PSM) - December 2021
- Cored Boreholes (PSM) - December 2021
- Cored Boreholes (PSM) - May 2023
- Site Boundary

Notes:
1. Image taken from Nearmap, dated 12 September 2022.

Scale 1:500

0 10 20 m

Map Projection: GDA2020 / MGA zone 56
Grid: EPSG:7856

P S M

Created By:	Revision:
PSM	A
Date: 30 Apr 2024	Paper Size: A3

Goodman Property
Corner Lanceley St and Campbell St
Lanceley Place Data Centre, Artarmon

Site Locality Plan

PSM4669-003L | FIGURE 1

N:\PSM4669\GIS\02_WorkSpace\01_MXDs\PSM4669.qgz Layout: PSM4669-003L REV 2 Figure 1

Photo 1 - Typical site conditions comprising buildings and hardstand - near BH01 and BH02

Photo 2 - Typical rig setup - BH06

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

DECEMBER 2021
SELECTED SITE PHOTOGRAPHS (1 of 8)

PSM4669-003L	Figure 2

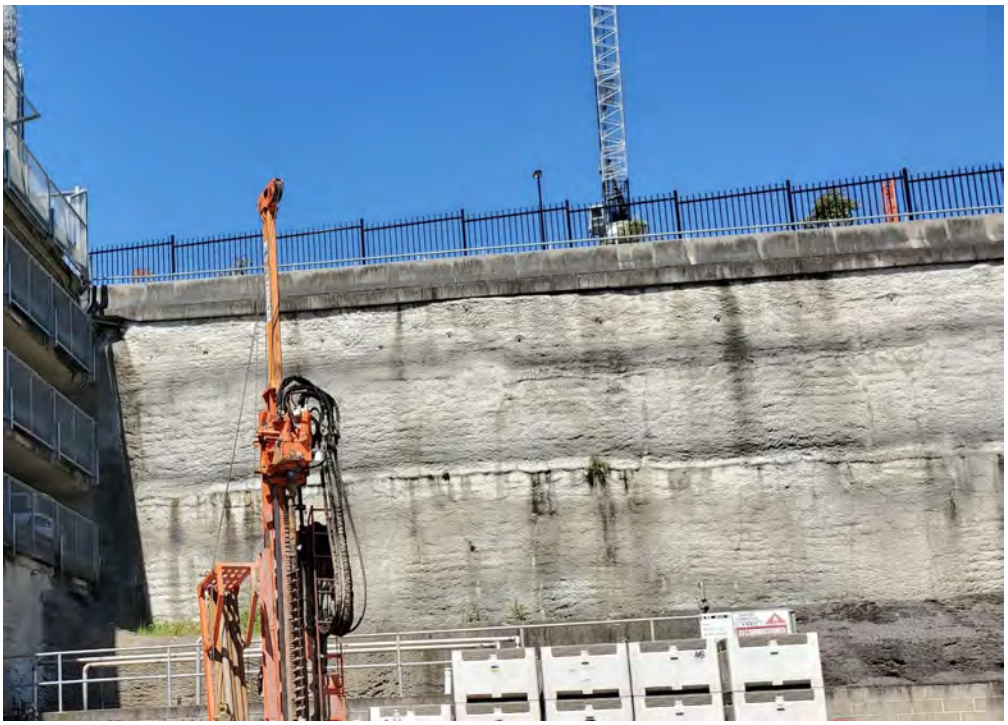


Photo 3 - Retaining wall along the southwest boundary of the Site

Photo 4 - Sandy Gravelly CLAY (NATURAL SOIL) observed in BH01

Goodman Property Corner Lanceley St and Campbell St, Artarmon Lanceley Place Data Centre DECEMBER 2021 SELECTED SITE PHOTOGRAPHS (2 of 8)	
PSM4669-003L	Figure 3

Photo 5 - Joint observed in rock cutting along south-west boundary of the site

Photo 6 - Soil profile at BH04

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Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

DECEMBER 2021

SELECTED SITE PHOTOGRAPHS (3 of 8)

PSM4669-003L	Figure 4

Photo 7 - SILTSTONE encountered near surface at BH05

Photo 8 - Sandy GRAVEL with Clay (FILL) observed in BH06

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Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

DECEMBER 2021

SELECTED SITE PHOTOGRAPHS (4 of 8)

P S M	PSM4669-003L	Figure 5

Photo 9 - Excavating the surface of BH08 prior to using the hand auger

Photo 10 - Reinstated hole at BH07

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Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

DECEMBER 2021

SELECTED SITE PHOTOGRAPHS (5 of 8)

P S M	PSM4669-003L	Figure 6

Photo 11 - General Site Photo facing South-West from BH09

Photo 12 - Typical Drill Rig Set-Up Overlaying a Tarp

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

MAY 2023

SELECTED SITE PHOTOGRAPHS (6 of 8)

P S M	PSM4669-003L	Figure 7

Photo 13 - Drilling Conditions on a Ramp for BH10

Photo 14 - Measurement of the Depth of Concrete Core at BH10

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

MAY 2023

SELECTED SITE PHOTOGRAPHS (7 of 8)

PSM4669-003L	Figure 8

Photo 15 - Soil Profile at BH11

Photo 16 - Reinstated hole at BH10

Goodman Property Corner Lanceley St and Campbell St, Artarmon Lanceley Place Data Centre MAY 2023 SELECTED SITE PHOTOGRAPHS (8 of 8)	
PSM4669-003L	Figure 9

Appendix A.1
Geotechnical Borehole Logs – December 2021

Borehole ID

BH01

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332140.0 m E 6256579.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT										CONCRETE; 100 mm				
										ROADBASE; 50 mm	D			
									CL	Sandy Gravelly CLAY: low plasticity, brown; gravel sub-angular, to 10 mm; sand fine grained.		St		0.15: NATURAL SOIL.
				SPT 0.50 m 4,7,12 N = 19					CL-Cl	CLAY trace gravel: low to medium plasticity, pale grey mottled brown; gravel sub-angular, to 20 mm.				
AD/T			Not Encountered				1					St to VSt		
										Shale fragment	D			
									CL	CLAY trace gravel: low plasticity, pale grey; gravel sub-angular, to 60 mm (shale); relic rock fabric.				1.80: Material recovered as powder.
							2					H		
										Continued on cored borehole sheet				
							3							
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332140.0 m E 6256579.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information							***Rock Substance***				***Rock Mass Defects***	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
						1						
						2		Continued from non-cored borehole sheet				
NMLC	Not Encountered	95	Is(50) d=0.1 a=0.3 MPa			3		INTERBEDDED SILTSTONE AND SANDSTONE: fine to medium grained, brown, orange, and dark grey, thinly bedded, well developed, 60% siltstone, 40% sandstone, iron stained. Becomes orange, pale grey, and dark grey.				SM, 0°, CL, PR, S, 8 mm FZ, RF & CL, 100 mm BP, 0°, CL, PR, S, 4 mm BP, 0°, CL, PR, RF
			Is(50) d=1.1 a=0.4 MPa			4		SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.				SM, 0°, CL, PR, S, 12 mm CO, 0°, CL, PR, S, 2 mm BP, 20°, S, PR, RF, 1 mm SM, 0°, CL, PR, S, 15 mm BP, 0°, CL, PR, S, 2 mm SM, 0°, CL, PR, S, 30 mm

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332140.0 m E 6256579.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information							***Rock Substance***						***Rock Mass Defects***	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Encountered	95						SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.*(continued)*				BP, 45°, CN, PR, S BP, 5°, CN, PR, RF JT, 70°, CN, IR, RF BP, 10°, X, CU, RF, 1 mm
						6		Hole Terminated at 5.60 m Target depth				
						7						
						8						
						9						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669

PROJECT: Lanceley Place Data Centre

LOCATION: Cnr Lanceley St and Campbell St, Artarmon

DATE: 20/12/2021

BH ID: BH01

FROM: 2.7 m

TO: 5.6 m

Notes:

1. Crosses on either side of a feature indicates drilling breaks, lines across features indicates defects.

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH01

(Core Photo 1 OF 1)

PSM4669-003L	Appendix A

Borehole ID

BH02

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332154.0 m E 6256553.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT										CONCRETE; 120 mm				0.00: PAVEMENT
				CBR 0.20-1.00 m					CL	Sandy CLAY with gravel: low plasticity, brown; sand medium to coarse grained; gravel sub-angular, fine to medium, to 20 mm.	M	F		0.12: FILL
AD/T			Not Encountered	SPT 0.50 m 7,11,10 N=21			1		CL-CI	CLAY: low to medium plasticity, pale grey mottled orange-brown; layers with relic rock structure and iron staining.	D	St to H		0.40: RESIDUAL SOIL
							2			SILTSTONE; grey, extremely weathered, very low to low strength, recovered as clay and rock fragments up to 20 mm.				2.20: BEDROCK
										Hole Terminated at 2.50 m Refusal				
							3							
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Borehole ID

BH03

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332091.0 m E 6256519.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T			Not Encountered	ES 0.50 m			1			ROADBASE; on surface. SILTSTONE; dark grey, extremely weathered, recovered as sand to gravel sized pieces.	D	VSt		0.00: BH03 adjacent to 1.5m Siltstone cutting, moderately to slightly weathered, medium strength, 1 x JT 89/90 degrees. 0.01: BEDROCK
										SILTSTONE; dark grey, highly weathered, low strength.				
							2			Hole Terminated at 1.50 m Refusal				
							3							
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Borehole ID

BH04

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	20/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	20/12/2021
Hole Location:	Refer to Figure 1	Logged By:	RS
Hole Position:	332095.0 m E 6256560.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T			Not Encountered				1		CL-CI	ROADBASE; at surface. CLAY trace gravel: low to medium plasticity, pale grey mottled orange-red; gravel sub-angular, to 30 mm; gravel is siltstone fragments.	D	St to VSt		0.01: NATURAL SOIL 1.00: Material recovered becoming more fine grained.
							2			SILTSTONE; grey, highly weathered, very low to low strength.				
							3			Hole Terminated at 2.50 m Target depth				
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Borehole ID

BH05

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332131.0 m E 6256468.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT										CONCRETE; 150 mm				0.00: CONCRETE slab
AD/T			Not Encountered	ES 0.20 m			1		GC	Clayey GRAVEL with sand: fine to coarse grained, to 40 mm, sub-angular, dark brown to red-brown; sand medium to coarse grained.	W	MD		0.15: FILL 0.30: BEDROCK
										SILTSTONE; dark grey, highly weathered, very low to low strength.	D			
				D 1.50 m			2		CL-CI	Gravelly CLAY: black; gravel fine to coarse grained, to 30 mm.	W	F		1.50: Possible weathered seam.
										SILTSTONE; dark grey, highly weathered, low strength.	D			
							3			Continued on cored borehole sheet				
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332131.0 m E 6256468.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Barrel Type and Length:	3 m	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
						1						
						2		Continued from non-cored borehole sheet				
NMLC	Not Encountered	91	Is(50) d=0.3 a=0.6 MPa					SILTSTONE: dark grey, massive.				BP, 0°, CL, PL, S, 2 mm
								INTERBEDDED SILTSTONE AND SANDSTONE: fine grained, pale grey and dark grey, thickly laminated, very well developed, 60% siltstone, 40% sandstone.				BP, 4°, CN, PL, RF JT, 90°, CN, PL, RF BP, 0°, CN, PL, RF BP, 0°, CN, PL, RF
			Is(50) d=1 a=3 MPa			3						BP, 5°, CN, PL, RF BP, 5°, CN, PL, RF
								SANDSTONE: fine grained, pale grey, very thinly bedded, poorly developed to developed.				SM, 3°, SHALE, PL, RF, >=5 mm
												SM, 0°, SHALE, PL, RF, >=30 mm BP, 0°, CN, PL, RF
			Is(50) d=1 a=0.9 MPa			4						SM, 5°, SHALE, PL, RF, 30 mm
		99										FZ, 3°, RF, PL, RF, 10 mm

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332131.0 m E 6256468.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Hanjin 8D | Inclination: -90° | RL Surface: No survey
Barrel Type and Length: 3 m | Bearing: | Datum: AHD | Operator: BG Drilling

Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Material Description (ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration)	Weathering	Strength Is(50) (● - Axial, ○ - Diametral)	Defect Spacing (mm)	Defect Descriptions / Comments
NMLC	Not Encountered	99	Is(50) d=0.6 a=1.7 MPa				SANDSTONE: fine grained, pale grey, very thinly bedded, poorly developed to developed.*(continued)* Becoming thinly laminated, well developed.	FR	H	200–600	BP, 5°, CN, PL, RF
								SW		60–200	BP, 3°, CN, PL, RF; BP, 0°, CN, PL, RF
			Is(50) d=1 a=1 MPa			6	Becoming laminated, poorly developed.	SW	H	200–600	
						7, 8, 9	Hole Terminated at 6.10 m Target depth				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

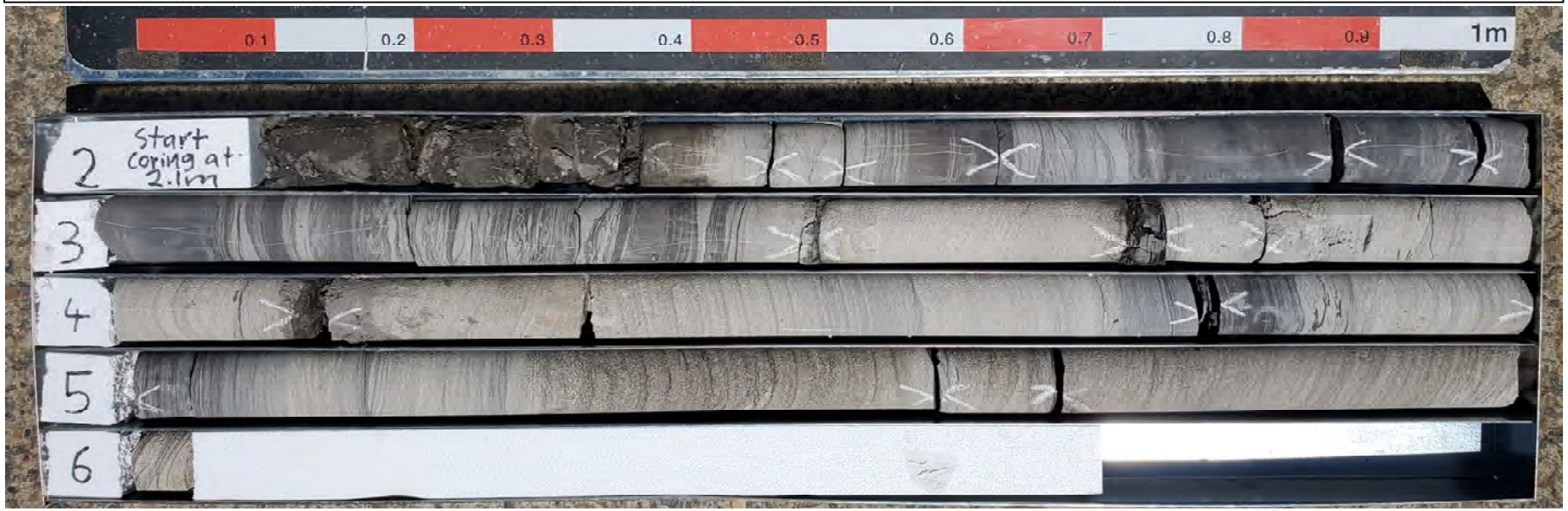
Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669 BH ID: BH05

PROJECT: Lanceley Place Data Centre FROM: 2.1 m

LOCATION: Cnr Lanceley St and Campbell St, Artarmon TO: 6.1 m

DATE: 21/12/2021



Notes:

1. Crosses through features indicates defects.

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH05

(Core Photo 1 OF 1)

PSM4669-003L	**Appendix A**

Borehole ID

BH06

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332177.0 m E 6256499.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T			Not Encountered	SPT 0.50 m 8,8,6 N=14					GW	ASPHALT; 50 mm	D			0.00: ASPHALT 0.05: FILL
										Sandy GRAVEL: fine to coarse grained, to 30 mm, sub-angular to angular, dark brown; sand fine to coarse grained; construction rubble (ceramic, tiles, bricks).		MD		0.50: Ceramic (?) observed in SPT, possibly explaining high SPT value.
				SPT 1.00 m 2,2,2 N=4			1		GC	Sandy GRAVEL with clay: fine to coarse grained, to 30 mm, sub-angular to angular, brown-red; sand fine to coarse grained; construction rubble (ceramic, tiles, bricks).	M			
				SPT 1.50 m 3,2,5 N=7							W	L		
				SPT 2.00 m N=R (hammer bouncing)			2							2.00: Siltstone (possibly from floating boulder) observed in end of SPT
										CONCRETE; brick aggregate observed Hole Terminated at 2.20 m Refusal				
							3							
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Borehole ID

BH07

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332116.0 m E 6256484.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	125 mm	Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT							0			CONCRETE; 160 mm.				0.00: Concrete slab
AD/T			▽						SP	SAND with gravel trace clay: coarse grained, dark brown; gravel sub-angular, to 20 mm.	M	MD		0.16: FILL 0.25: BEDROCK
										SILTSTONE; dark grey, highly to moderately weathered, very low to low strength.	D			
							1							
										Hole Terminated at 1.50 m Refusal				
							2							
							3							
							4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
▽ Inflow
◁ Partial Loss
◀ Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Borehole ID

BH08

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	21/12/2021
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	21/12/2021
Hole Location:	Refer to Figure 1	Logged By:	GF
Hole Position:	332124.0 m E 6256531.0 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin 8D	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	BG Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
HA			Not Encountered				0		SW	SAND trace gravel trace clay: medium to coarse grained, dark brown; gravel fine to medium grained, to 20 mm, sub-angular to angular; trace construction material (plastic).	M	MD	0.00: FILL; possible ACM observed
									CI	CONCRETE; 50 mm thick		St	
										Sandy Gravelly CLAY: medium plasticity, dark brown; gravel fine to medium grained, to 15 mm, sub-angular; sand fine grained.			
							1			Hole Terminated at 0.65 m Refusal			
							2						
							3						
							4						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Appendix A.2
Geotechnical Borehole Logs – May 2023

Borehole ID

BH09

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332166.5 m E 6256493.4 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Comacchio Geo 205	Inclination:	-90°	RL Surface:	71.94 m		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	Rockwell Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T			Not Encountered			70.9	1			ASPHALT; 50 mm thick				0.00: PAVEMENT. 0.05: FILL.
										SAND with gravel: fine to coarse grained, brown; gravel sub-angular, to 15mm.	D	MD		
										SAND trace gravel: fine to coarse grained, black; gravel sub-angular, to 40mm	D	MD		
						69.9	2			SILTSTONE; grey, extremely weathered, very low to low strength, recovered as sand and rock fragments up to 40mm	D			1.10: BEDROCK.
										becomes pale grey				
										Continued on cored borehole sheet				
						68.9	3							
						67.9	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger screwing
CT - Continuous push tube 1.5m long 76mm diameter

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332166.5 m E 6256493.4 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 | Inclination: -90° | RL Surface: 71.94 m
Barrel Type and Length: | Bearing: | Datum: AHD | Operator: Rockwell Drilling

Drilling Information							Rock Substance																Rock Mass Defects		
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					70.9	1						
					69.9	2		Continued from non-cored borehole sheet				
NMLC	Not Encountered	68	Is(50) d=1.54 a=2.87 MPa		68.9	3		SILTSTONE: black, massive. INTERBEDDED SILTSTONE AND SANDSTONE: fine grained, pale grey and dark grey, thickly laminated, very well developed, 60% sandstone, 40% siltstone.				CZ, 0°, CL & RF, IR, =40 mm BP, 5°, CL, PR, RF BP, 0°, CL, PR, RF
		68	Is(50) d=1.53 a=1.3 MPa					SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.				BP, 30°, CN, PR, S BP, 0°, CL, PR, RF BP, 0°, CL, PR, RF BP, 5°, CL, PR, RF BP, 5°, CN, CU, S BP, 0°, RF, PR, S
		100	Is(50) d=1.74 a=2.22 MPa		67.9	4						CZ, 0°, CL & RF, IR, =20 mm

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332166.5 m E 6256493.4 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 | Inclination: -90° | RL Surface: 71.94 m

Barrel Type and Length: | Bearing: | Datum: AHD | Operator: Rockwell Drilling

Drilling Information							Rock Substance																Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW	HW	MW	SW	FR	Strength Is(50) ●-Axial ○-Diametral VL 0.1	L	0.3	M	1	H	3	VH	10	EH	Defect Spacing (mm) <20	60	200	600	1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		100	Is(50) d=1.4 a=1.78 MPa					SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.									●										BP, 0°, CL, PR, RF
					65.9	6		Hole Terminated at 5.40 m Target depth																			
					64.9	7																					
					63.9	8																					
					62.9	9																					

Method
- AD/T - Auger drilling TC bit
- AD/V - Auger drilling V bit
- WB - Washbore
- HQ3- Wireline core (63.5 mm)
- PQ3- Wireline core (85.0 mm)
- SPT- Standard penetration test
- PT - Push tube
- WPT - Water pressure test

Water
- Inflow
- Partial Loss
- Complete Loss

Graphic Log/Core Loss
- Core recovered (hatching indicates material)
- No core recovery

Weathering
- XW - Extremely Weathered
- HW - Highly Weathered
- MW - Moderately Weathered
- SW - Slightly Weathered
- FR - Fresh

Strength
- VL - Very Low
- L - Low
- M - Medium
- H - High
- VH - Very High
- EH - Extremely High

Defect Type
- FT - Fault
- SS - Shear Surface
- SZ - Shear Zone
- BP - Bedding parting
- SM - Seam
- IS - Infilled Seam
- JT - Joint
- CO - Contact
- CZ - Crushed Zone
- VN - Vein
- FZ - Fracture Zone
- BSH - Bedding Shear
- DB - Drilling Break

Infilling/Coating
- CN - Clean
- SN - Stain
- VN - Veneer
- CO - Coating
- RF - Rock fragments
- G - Gravel
- S - Sand
- Z - Silt
- CA - Calcite
- CL - Clay
- FE - Iron
- QZ - Quartz
- X - Carbonaceous

Roughness
- SL - Slickensided
- POL - Polished
- S - Smooth
- RF - Rough
- VR - Very Rough

Shape
- PR - Planar
- CU - Curved
- UN - Undulating
- ST - Stepped
- IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669 BH ID: BH09

PROJECT: Lanceley Place Data Centre FROM: 2.6 m

LOCATION: Cnr Lanceley St and Campbell St, Artarmon TO: 5.4 m

DATE: 22/05/2023

Notes:

1. Crosses through features indicates defects.

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH09

(Core Photo 1 OF 1)

PSM4669-003L	**Appendix A**

Borehole ID

BH10

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332211.3 m E 6256471.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting:	Comacchio Geo 205	Inclination:	-90°	RL Surface:	72.48 m		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	Rockwell Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT										CONCRETE; 170 mm				0.00: CONCRETE slab.
AD/T										CLAY trace sand: low to medium plasticity, dark brown to red-brown; sand fine to coarse grained.	M	F		0.17: FILL.
						71.5	1			SAND with gravel: fine to coarse grained, brown; gravel sub-angular, to 10mm.	D	D		
										Gravelly SAND with clay: fine to coarse grained, grey to black; gravel sub-angular, to 10mm.	M	D		
						70.5	2			Sandy CLAY: low to medium plasticity, pale grey to dark grey; sand fine to coarse grained.				2.00: RESIDUAL SOIL.
						69.5	3				W	St		
						68.5	4							
										Continued on cored borehole sheet				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger screwing
CT - Continuous push tube 1.5m long 76mm diameter

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332211.3 m E 6256471.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 Inclination: -90° RL Surface: 72.48 m
Barrel Type and Length: Bearing: Datum: AHD Operator: Rockwell Drilling

Drilling Information							Rock Substance						Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					71.5	1						
					70.5	2						
					69.5	3						
					68.5	4		Continued from non-cored borehole sheet				
NMLC		67	Is(50) d=1.76 a=1.4 MPa					INTERBEDDED SILTSTONE AND SANDSTONE: fine grained, pale grey and dark grey, thickly laminated, very well developed, 70% sandstone, 30% siltstone.				BP, 0°, S, UN, RF BP, 0°, S, PR, RF BP, 3°, CN, UN, RF BP, 5°, CN, PR, RF BP, 2°, CN, PR, RF

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	22/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	22/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332211.3 m E 6256471.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 | Inclination: -90° | RL Surface: 72.48 m
Barrel Type and Length: | Bearing: | Datum: AHD | Operator: Rockwell Drilling

Drilling Information							Rock Substance																Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW	HW	MW	SW	FR	Strength Is(50) ● - Axial ○ - Diametral VL	0.1	L	0.3	M	1	H	3	VH	10	EH	Defect Spacing (mm) <20	60	200	600	1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		67						INTERBEDDED SILTSTONE AND SANDSTONE: fine grained, pale grey and dark grey, thickly laminated, very well developed, 70% sandstone, 30% siltstone.																					BP, 0°, CN, PR, RF
								SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.																				
			Is(50) d=1.03 a=1.46 MPa																										
		100			66.5	6																						BP, 0°, CN, UN, RF
			Is(50) d=1.17 a=1.36 MPa																										
					65.5	7																							
								Hole Terminated at 7.10 m Target depth																				
					64.5	8																							
					63.5	9																							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

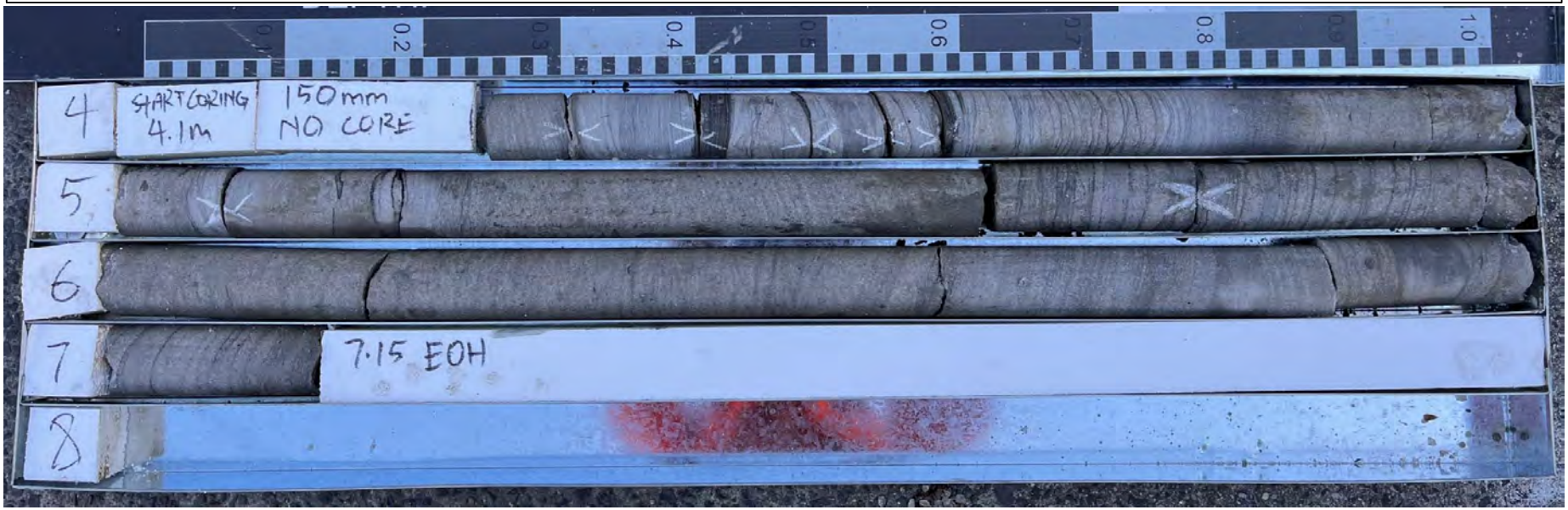
Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669 BH ID: BH10

PROJECT: Lanceley Place Data Centre FROM: 4.1 m

LOCATION: Cnr Lanceley St and Campbell St, Artarmon TO: 7.15 m

DATE: 22/05/2023



Notes:

1. Crosses through features indicates defects.

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH10

(Core Photo 1 OF 1)

PSM4669-003L	**Appendix A**

Borehole ID

BH11

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332149.1 m E 6256565.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 Inclination: -90° RL Surface: 72.07 m

Hole Diameter: Bearing: Datum: AHD Operator: Rockwell Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT										CONCRETE; 100mm				0.00: CONCRETE slab.
										SAND trace gravel: fine to medium grained, black; gravel sub-angular, to 10mm.	D	MD		0.10: FILL.
										SAND trace clay trace gravel: fine to medium grained, brown; gravel sub-angular, to 7mm.	D	MD		
AD/T			Not Encountered			71.1	1			CLAY with sand: medium plasticity, dark brown; sand fine to coarse grained.				0.70: RESIDUAL SOIL.
										becomes grey to red-brown.	D	St		
						70.1	2			becomes brown to grey.				
										becomes brown.				
						69.1	3			Continued on cored borehole sheet				
						68.1	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger screwing
CT - Continuous push tube 1.5m long 76mm diameter

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332149.1 m E 6256565.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 | Inclination: -90° | RL Surface: 72.07 m
Barrel Type and Length: | Bearing: | Datum: AHD | Operator: Rockwell Drilling

Drilling Information							Rock Substance					Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					71.1	1						
					70.1	2		Continued from non-cored borehole sheet				
NMLC	Not Encountered	58	Is(50) d=0.06 a=0.18 MPa		69.1	3		INTERBEDDED SILTSTONE AND SANDSTONE: fine to medium grained, brown, orange, and dark grey, thinly bedded, well developed, 70% siltstone, 40% sandstone, iron stained.		○●		BP, 0°, CL, PR, RF BP, 0°, CL, CU, RF BP, 5°, CL, PR, RF BP, 0°, CL, PR, RF BP, 0°, CL, PR, RF
					68.1	4		becomes orange, pale grey and dark grey.				CZ, CL & RF, IR, 10 mm BP, 0°, CL, PR, RF
		24	Is(50) d=0.88 a=1.41 MPa					SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.		●		BP, 0°, CL, PR, RF CZ, CL & RF, IR, 3 mm BP, 0°, CL, CU, RF BP, 0°, RF, PR, RF CZ, CL & RF, IR, 5 mm CZ, CL & RF, IR, 4 mm BP, 0°, CL, PR, S

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332149.1 m E 6256565.5 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 | Inclination: -90° | RL Surface: 72.07 m
Barrel Type and Length: | Bearing: | Datum: AHD | Operator: Rockwell Drilling

Drilling Information							Rock Substance															Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH 0.1 0.3 1 3 10	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Encountered	24						SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.				CZ, S & RF & CL, IR, 5 mm
												BP, 0°, CN, PR, RF
												BP, 0°, CN, PR, RF
		63	Is(50) d=0.11 a=0.26 MPa									
					66.1	6						CZ, RF & CL, IR, 20 mm
			Is(50) d=1.75 a=2.02 MPa									BP, 0°, CL, PR, RF
												BP, 0°, CL, PR, RF
												BP, 0°, CN, PR, RF
					65.1	7		Hole Terminated at 6.90 m Target depth				
					64.1	8						
					63.1	9						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669

PROJECT: Lanceley Place Data Centre, Artarmon

LOCATION: Cnr Lanceley St and Campbell St, Artarmon

DATE: 23/05/2023

BH ID: BH11

FROM: 2.8 m

TO: 6.9 m

Notes:

1. Crosses through features indicates defects.

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH11

(Core Photo 1 OF 1)

PSM4669-003L	**Appendix A**

Borehole ID

BH12

Engineering Log - Non Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332091.0 m E 6256555.9 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 Inclination: -90° RL Surface: 74.15 m

Hole Diameter: Bearing: Datum: AHD Operator: Rockwell Drilling

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T			Not Encountered			74.15	0			ASPHALT; 50 mm thick				0.00: PAVEMENT. 0.05: FILL.
										GRAVEL with sand: fine to medium grained, to 15mm, sub-rounded, brown to red-brown; sand medium to coarse grained.	D	MD		
										CLAY with sand: medium plasticity, pale grey to brown; sand fine to medium grained.				0.50: RESIDUAL SOIL.
						73.1	1				D	St		
										SILTSTONE; pale brown, extremely weathered, very low to low strength, recovered as sand and rock fragments up to 20mm				1.50: BEDROCK.
						72.1	2				D	D		
										Continued on cored borehole sheet				
						71.1	3							
						70.1	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger screwing
CT - Continuous push tube 1.5m long 76mm diameter

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
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
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332091.0 m E 6256555.9 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 Inclination: -90° RL Surface: 74.15 m
Barrel Type and Length: Bearing: Datum: AHD Operator: Rockwell Drilling

Drilling Information							Rock Substance					Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH 0.1 0.3 1 3 10	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					73.1	1						
					72.1	2		Continued from non-cored borehole sheet				
NMLC	Not Encountered	34	Is(50) d=0.05 a=0.02 MPa		71.1	3		INTERBEDDED SILTSTONE AND SANDSTONE: fine to medium grained, brown, orange, and dark grey, thinly bedded, well developed, 70% siltstone, 40% sandstone, iron stained.				BP, 0°, CL, PR, S BP, 0°, CL, PR, S CZ, RF & CL, IR, 10 mm BP, 5°, RF & CL, PR, RF CZ, RF & CL, IR, 30 mm
												BP, 5°, CL, PR, RF BP, 3°, CL, PR, RF BP, 0°, CL, PR, RF BP, 10°, CL & RF, PR, RF CZ, CL & RF, IR, 50 mm BP, 0°, CL, PR, RF BP, 0°, CL, PR, RF CZ, CL & RF, IR, 40 mm CZ, CL & RF, IR, 40 mm BP, 0°, CL, PR, RF CZ, CL & RF, IR, 20 mm BP, 0°, CL, PR, RF JT, 30°, CL, PR, RF CZ, CL & RF, IR, 30 mm BP, CL & RF, IR, RF BP, 0°, CL, PR, RF BP, 0°, CL, PR, S BP, 0°, CL, PR, S, 5 mm CZ, CL & RF, IR, 50 mm BP, 0°, CL, PR, S
		12	Is(50) d=0.35 a=0.55 MPa		70.1	4		becomes orange, pale grey and dark grey.				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4669

Client:	Goodman	Commenced:	23/05/2023
Project Name:	Lanceley Place Data Centre, Artarmon	Completed:	23/05/2023
Hole Location:	Refer to Figure 1	Logged By:	HT
Hole Position:	332091.0 m E 6256555.9 m N MGA2020 Zone 56	Checked By:	AS

Drill Model and Mounting: Comacchio Geo 205 Inclination: -90° RL Surface: 74.15 m
Barrel Type and Length: Bearing: Datum: AHD Operator: Rockwell Drilling

Drilling Information							Rock Substance								Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Encountered	12	Is(50) d=1.1 a=0.48 MPa					INTERBEDDED SILTSTONE AND SANDSTONE: fine to medium grained, orange, pale grey and dark grey, thinly bedded, well developed, 70% siltstone, 40% sandstone, iron stained.				CZ, CL & RF, IR, 50 mm CZ, CL & RF, IR, 20 mm BP, 0°, CN, PR, S BP, 0°, CN, PR, S CZ, CL & RF, IR, 50 mm BP, 0°, CL & RF, PR, RF BP, 0°, CL, PR, RF
		53	Is(50) d=0.4 a=0.95 MPa		68.1	6		SANDSTONE: medium grained, pale grey, very thinly bedded, developed to well developed.				BP, 0°, S, PR, RF JT, 45°, S, PR, RF
			Is(50) d=0.96 a=1.39 MPa		67.1	7		Hole Terminated at 6.70 m Target depth				
					66.1	8						
					65.1	9						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube
WPT - Water pressure test

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Logged in accordance with AS 1726:2017 Geotechnical site investigations

JOB NO: PSM4669 BH ID: BH12

PROJECT: Lanceley Place Data Centre FROM: 2.6 m

LOCATION: Cnr Lanceley St and Campbell St, Artarmon TO: 6.7 m

DATE: 23/05/2023

Goodman Property

Corner Lanceley St and Campbell St, Artarmon

Lanceley Place Data Centre

CORE PHOTOS BH12

(Core Photo 1 OF 1)

PSM4669-003L	Appendix A

Appendix B

Appendix B.1
Point Load Test Results – December 2021

Pells Sullivan Meynink

POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM4669*** **Sheet 1 of 1**

Project ***Lanceley Place Data Centre, Artarmon***

Test Method	*AS 4133.4.1-2007 Methods of testing rocks for engineering purposes - Determination of point load strength index*	Sampling Technique	*NLMC*	Sampling Date	
		Storage History	*North Ryde office storage*	Testing Date	*21/12/2021*
Test Machine	*GSA 6510-0304*	Moisture Condition	*Natural*	Tested By	*GF*
Calibration Date	*25/11/2021*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial Tests						AS 1726:2017 Strength Class
		(m)	D (mm)	L (mm)	P (kN)	$I_{s(50)}$ (MPa)	Failure Mode	W (mm)	D (mm)	P (kN)	I_s (MPa)	$I_{s(50)}$ (MPa)	Failure Mode	
Interbedded SS & SST	***BH01***	***3.70***	*50*	*150*	*0.3*	***0.1***	*Parallel to bedding*	*50*	*30*	*0.5*	*0.3*	***0.3***	*Through substance*	***VL***
Sandstone	***BH01***	***4.60***	*50*	*40*	*2.7*	***1.1***	*Parallel to bedding*	*50*	*40*	*1.1*	*0.4*	***0.4***	*Through substance*	***M / H***
Sandstone	***BH01***	***5.60***	*50*	*40*	*3.1*	***1.2***	*Parallel to bedding*	*50*	*40*	*3.0*	*1.2*	***1.2***	*Through substance*	***H***
Interbedded SS & SST	***BH05***	***2.41***	*50*	*90*	*0.7*	***0.3***	*Parallel to bedding*	*50*	*40*	*1.5*	*0.6*	***0.6***	*Through substance*	***L / M***
Interbedded SS & SST	***BH05***	***3.21***	*50*	*115*	*2.4*	***1.0***	*Parallel to bedding*	*50*	*45*	*8.3*	*2.9*	***3.0***	*Through substance*	***M / H***
Siltstone	***BH05***	***4.00***	*50*	*140*	*2.6*	***1.0***	*Parallel to bedding*	*50*	*20*	*1.3*	*1.0*	***0.9***	*Through substance*	***M / H***
Siltstone	***BH05***	***5.04***	*50*	*125*	*1.4*	***0.6***	*Parallel to bedding*	*50*	*30*	*3.5*	*1.8*	***1.7***	*Through substance*	***M / H***
Siltstone	***BH05***	***5.90***	*50*	*95*	*2.4*	***1.0***	*Parallel to bedding*	*50*	*30*	*2.0*	*1.0*	***1.0***	*Through substance*	***M***
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								
						0								

By: GF **Checked: AS** **Date:** ***17/1/2021***

Appendix B.2
Point Load Test Results –May 2023

Pells Sullivan Meynink

POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM4669*** **Sheet 1 of 1**

Project ***Lanceley Place Data Centre, Artarmon***

Test Method	*AS 4133.4.1-2007 Methods of testing rocks for engineering purposes - Determination of point load strength index*	Sampling Technique	*NLMC*	Sampling Date	
		Storage History	*North Ryde office storage*	Testing Date	*31/05/2023*
Test Machine	*GSA 6510-0304*	Moisture Condition	*Natural*	Tested By	*HT*
Calibration Date	*25/11/2021*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial Tests						AS 1726:2017 Strength Class
		(m)	D (mm)	L (mm)	P (kN)	$I_{s(50)}$ (MPa)	Failure Mode	W (mm)	D (mm)	P (kN)	I_s (MPa)	$I_{s(50)}$ (MPa)	Failure Mode	
Interbedded SS & SST	***BH09***	***2.90***	*50*	*30*	*3.9*	***1.5***	*Parallel to bedding*	*50*	*30*	*5.8*	*3.0*	***2.9***	*Through substance*	***VL***
Sandstone	***BH09***	***3.45***	*50*	*30*	*3.8*	***1.5***	*Parallel to bedding*	*50*	*30*	*2.6*	*1.4*	***1.3***	*Through substance*	***H***
Sandstone	***BH09***	***4.37***	*50*	*30*	*4.3*	***1.7***	*Parallel to bedding*	*50*	*30*	*4.5*	*2.4*	***2.2***	*Through substance*	***H***
Sandstone	***BH09***	***5.20***	*50*	*30*	*3.5*	***1.4***	*Parallel to bedding*	*50*	*30*	*3.6*	*1.9*	***1.8***	*Through substance*	***H***
Interbedded SS & SST	***BH10***	***4.62***	*50*	*30*	*4.4*	***1.8***	*Parallel to bedding*	*50*	*30*	*2.9*	*1.5*	***1.4***	*Through substance*	***H***
Sandstone	***BH10***	***5.64***	*50*	*30*	*2.6*	***1.0***	*Parallel to bedding*	*50*	*30*	*3.0*	*1.6*	***1.5***	*Through substance*	***H***
Sandstone	***BH10***	***6.60***	*50*	*30*	*2.9*	***1.2***	*Parallel to bedding*	*50*	*30*	*2.8*	*1.4*	***1.4***	*Through substance*	***H***
Interbedded SS & SST	***BH11***	***3.57***	*50*	*26*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*35*	*0.4*	*0.2*	***0.2***	*Through substance*	***VL / L***
Sandstone	***BH11***	***4.60***	*50*	*35*	*2.2*	***0.9***	*Parallel to bedding*	*50*	*35*	*3.2*	*1.4*	***1.4***	*Through substance*	***M / H***
Sandstone	***BH11***	***5.50***	*50*	*30*	*0.3*	***0.1***	*Parallel to bedding*	*50*	*45*	*0.7*	*0.3*	***0.3***	*Through substance*	***L***
Sandstone	***BH11***	***6.50***	*50*	*40*	*4.4*	***1.8***	*Parallel to bedding*	*50*	*40*	*5.1*	*2.0*	***2.0***	*Through substance*	***H***
Interbedded SS & SST	***BH12***	***3.25***	*50*	*30*	*0.1*	***0.0***	*Parallel to bedding*	*50*	*30*	*0.1*	*0.0*	***0.0***	*Through substance*	***#N/A***
Interbedded SS & SST	***BH12***	***4.50***	*50*	*40*	*0.9*	***0.3***	*Parallel to bedding*	*50*	*40*	*1.4*	*0.5*	***0.5***	*Through substance*	***M***
Interbedded SS & SST	***BH12***	***5.10***	*50*	*30*	*2.8*	***1.1***	*Parallel to bedding*	*50*	*30*	*1.0*	*0.5*	***0.5***	*Through substance*	***M / H***
Sandstone	***BH12***	***6.06***	*50*	*45*	*1.0*	***0.4***	*Parallel to bedding*	*50*	*45*	*2.6*	*0.9*	***0.9***	*Through substance*	***M***
Sandstone	***BH12***	***6.60***	*50*	*30*	*2.4*	***1.0***	*Parallel to bedding*	*50*	*30*	*2.8*	*1.5*	***1.4***	*Through substance*	***M / H***

By: HT **Checked: AS** **Date:** ***2/6/2023***

Appendix C
CBR Test Results

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink
PSM Job No.: PSM4669

Report No.: L4729E - 1
Report Date: 11/01/2022
Page 1 of 1

BOREHOLE NUMBER	BH 2	BH 3
DEPTH (m)	0.20 - 1.00	0.20 - 1.00
Surcharge (kg)	4.5	4.5
Maximum Dry Density (t/m^3)	1.81 STD	1.80 STD
Optimum Moisture Content (%)	16.4	15.2
Moulded Dry Density (t/m^3)	1.77	1.76
Sample Density Ratio (%)	98	98
Sample Moisture Ratio (%)	100	99
Moisture Contents		
Insitu (%)	16.7	10.8
Moulded (%)	16.4	15.1
After soaking and		
After Test, Top 30mm(%)	19.5	19.7
Remaining Depth (%)	18.2	19.2
Material Retained on 19mm Sieve (%)	1*	1*
Swell (%)	0.5	1.0
C.B.R. value:		
@5.0mm penetration	11	3.5

NOTES: Sampled and supplied by client. Samples tested as received.

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 21/12/2021.
- * Denotes not used in test sample.

NATA

NATA Accredited Laboratory Number:1327

11/01/2022
Authorised Signature / Date
(D. Treweek)

Appendix D
Salinity and Aggressivity Laboratory Test Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2146968**	Page	: 1 of 3
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROHAN STOCKER	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: PSM 4669	Date Samples Received	: 22-Dec-2021 14:00
Order number	: ----	Date Analysis Commenced	: 23-Dec-2021
C-O-C number	: ----	Issue Date	: 06-Jan-2022 16:23
Sampler	: Greg Fazzone		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 3		
No. of samples analysed	: 3		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH02 1m	BH03 0.5m	BH05 0.2m	----	----
			Sampling date / time	20-Dec-2021 00:00	20-Dec-2021 00:00	21-Dec-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2146968-001	ES2146968-002	ES2146968-003	--------	--------
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**7.4**	**5.5**	**8.7**	**----**	**----**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**115**	**51**	**100**	**----**	**----**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**12.6**	**9.7**	**9.7**	**----**	**----**
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**8700**	**19600**	**10000**	**----**	**----**
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	**4.9**	**----**	**4.2**	**----**	**----**
Exchangeable Magnesium	----	0.2	meq/100g	<0.2	**----**	<0.2	**----**	**----**
Exchangeable Potassium	----	0.2	meq/100g	<0.2	**----**	<0.2	**----**	**----**
Exchangeable Sodium	----	0.2	meq/100g	<0.2	**----**	<0.2	**----**	**----**
Cation Exchange Capacity	----	0.2	meq/100g	**5.0**	**----**	**4.2**	**----**	**----**
Exchangeable Sodium Percent	----	0.2	%	<0.2	**----**	<0.2	**----**	**----**
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**----**	**0.2**	**----**	**----**	**----**
Exchangeable Magnesium	----	0.1	meq/100g	**----**	**2.4**	**----**	**----**	**----**
Exchangeable Potassium	----	0.1	meq/100g	**----**	**0.5**	**----**	**----**	**----**
Exchangeable Sodium	----	0.1	meq/100g	**----**	**1.0**	**----**	**----**	**----**
Cation Exchange Capacity	----	0.1	meq/100g	**----**	**4.1**	**----**	**----**	**----**
Exchangeable Sodium Percent	----	0.1	%	**----**	**23.8**	**----**	**----**	**----**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**20**	**30**	**20**	**----**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	**30**	<10	**----**	**----**

Appendix E
Bulk Earthworks Specification PSM4669-004S REV A

Goodman Property

Lanceley St and Campbell St, Artarmon NSW

BULK EARTHWORKS SPECIFICATION

PSM4669-004S 1 May 2024

Table of Contents

List of Figures

List of Appendices

1. Scope

This specification details the requirements for the bulk earthworks to be undertaken at the ABC Site, corner of Lanceley St and Campbell St, Artarmon. The area where this specification is applicable is shown in Figure 1. This includes areas where material is filled or cut to bulk earthworks level (BEL) within the site.

Fill placed in accordance with this specification is denoted as Engineered Fill.

This specification does not address any environmental, contamination or erosion issues with respect to the fill material.

There is a HOLD POINT on placing fill in Section 2 of this Specification.

2. Hold Point

Process Held	Placing of Fill
Submission detail	The Contractor/GITA submit to PSM a Weekly Certificate as defined in Clause 6.2.1 of this specification for the earthworks completed to the previous Saturday no later than 5 pm of the subsequent Wednesday.
Release of Hold Point	PSM to confirm receipt of Weekly Certificate and recommend release of Hold Point if initial assessment of the Weekly Certificate indicates it complies with requirements of this specification. The contract superintendent should then release the Hold Point if it considers appropriate.

3. Earthworks

3.1 Subgrade Preparation

The condition of the subgrade should be assessed immediately prior to the commencement of filling.

The topsoil and any vegetation must be stripped.

All Engineered Fill is to be placed on one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Engineered compacted fill placed in accordance with this or approved specifications for which the Geotechnical Inspection and Testing and Authority (GITA) has a Level 1 certificate certifying compliance with that approved specification AND of at least stiff consistency.
4. Existing fill and other materials as approved by PSM.

It is likely sediment within existing dams will be required to be removed for the subgrade to meet the above requirement.

Proof rolling shall only be undertaken under the direction of PSM. PSM may also direct a bridging layer of Engineered Fill be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) of between 98% and 102%. Any such layer shall be a Lot under Clause 5.3.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be moisture conditioned and compacted to be in accordance with Clauses 3.5 and 3.6 of this specification.

3.2 Base Geometry and Permanent Batters

The slope of any buried batter shall be less than 2H:1V unless otherwise directed by PSM.

The contractor shall remove or flatten any geometrical obstructions (e.g. protrusions or holes) such that subsequent Engineered Fill can be placed to achieve the requirements of this specification.

Engineered Fill shall be placed only on areas where the base geometry has been approved by the GITA.

3.3 Material

3.3.1 Imported Fill

Imported Engineered Fill is to conform to one of the following definitions:

1. "Virgin excavated natural material" (**VENM**) as defined b the Protection of the Environment Operations Act 1997 No 156, Schedule 1, on Page 209:
   "Virgin excavated natural material (e.g. clay, gravel, sand, soil and rock) that is not mixed with any other waste and that:

   a) has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphide ores or soils, or

   b) consists of excavated natural materials that meet such criteria as may be approved by the EPA."

2. "Excavated natural material" (**ENM**) as defined by the Protection of the Environment Operations (Waste) Regulation 2014 – General Exemption Under Part 9, Clause 91 and 92, the excavated natural material exemption 2014"

   "Excavated natural material is naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

   a) been excavated from the ground
   b) contains at least 98% (by weight) natural material, and
   c) does not meet the definition of Virgin Excavated Natural Material (VENM) in the Act.
   d) Excavated Natural Material does not include material that has been in a hotspot; that has been processed or that contains asbestos, Acid Sulphate Soils (ASS), Potential Acid Sulphate Soil (PASS) or sulfidic ores."

   and which meets the requirements of this exemption.

3.3.2 Unsuitable Material

For the purpose of this Specification, unsuitable material shall be as defined by Clause 4.3 of AS3798-2007 "Guidelines on earthworks for commercial and residential developments" as:

a) "organic soils, such as many topsoils, severely root-affected subsoils and peat
b) materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture
c) materials containing substances which can be dissolved or leached out in the presence of moisture (e.g., gypsum), or which undergo volume change or loss of strength when disturbed and exposed to moisture (e.g., some shales and sandstones), unless these matters are specifically addressed in the design
d) silts, or materials that have the deleterious engineering properties of silt
e) other materials with properties that are unsuitable for the forming of structural fill; and
f) fill that contains wood, metal, plastic, boulders or other deleterious material, in sufficient proportions to affect the required performance of the fill."

3.3.3 Engineered Fill

Engineered Fill shall not comprise unsuitable material as defined in Clause 3.3.2 of this Specification.

The GITA shall assess that the proportion of deleterious material in each Lot is not greater than 1% by weight. Deleterious material is defined by Table 3015.3 of the RTA QA Specification 3051 (Edition 5 June 1998) as:

"Type III: Rubber, Plastic, Bitumen, Paper, Cloth, Paint, Wood and Other Vegetable Matter"

If the GITA is not able to visually assess the above criterion, the GITA shall arrange appropriate testing.

All Engineered Fill particles shall be able to be incorporated within a single layer. Further, less than 40% of particles shall be retained on the 37.5 mm sieve.

Engineered Fill shall; be able to be tested in accordance with the Standard Compaction method (AS1289.5.4.1) or Hilf test method (AS1289.5.7.1). These methods require less than 20% retained on the 37.5 mm sieve. Where between 20% and 30% of particles are retained on the 37.5 mm sieve the above test methods shall still be adopted and test reports annotated appropriately.

These requirements should be met by the material after placement and compaction.

Only material approved by the GITA as meeting the requirements in this clause of the Specification shall be placed as Engineered Fill.

3.4 Fill Zonation and Placement

Fill shall be placed in near horizontal, laterally extensive layers of uniform material and thickness, deposited systemically across the work area.

The compacted thickness of each layer of Fill shall as per the requirements in Table 3.1.

Engineered Fill shall only be placed on subgrade in accordance with this specification and approved by the GITA.

3.5 Compaction

Fill shall be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) within the range defined in Table 3.1.

The insitu density shall be measured over the full depth of each layer placed.

3.6 Moisture Control

The placement moisture variation or Hilf moisture variation shall be controlled to be within the range specified in Table 3.1.

The moisture content shall be uniform throughout the layer.

Placement moisture content of the Fill shall be measured for each field density test.

Table 3.1 – Requirements for Layer Thickness, Compaction and Moisture Variation

Fill Type	Compacted Layer Thickness (mm) – Equal to or less than	Compaction Ratio	Moisture Variation
	Visual Assessment	AS1289.5.1.1 and AS1289.5.4.1 or AS1289.5.7.1	AS1289.5.1.1 and AS1289.5.4.1 or AS1289.5.7.1
Engineered Fill	300	Between 98% and 102% Std Comp.	Between 2% Dry and 2% Wet Std Comp.

4. Survey

The survey requirements are as follows:

1. Any approved subgrade shall be surveyed prior to first filling and for cut areas such that subgrade levels are established to within ± 0.1 m. The area subject to approval shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
2. The Lot boundaries shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
3. The location of the field density tests shall be assessed and shown on the Lot boundary plan drawing to an accuracy of at least +/-5 m in plan.
4. The elevation of the field density tests shall be surveyed to an accuracy of +/-0.05 m.

The plan drawing shall show at the boundaries of the site and other identifiable site features, so as to allow the location of the lots and the test to be recoverable.

5. Inspection and Testing

5.1 Role of the GITA

The Geotechnical Inspection and Testing Authority (GITA) shall be contracted to document and certify that the works undertaken by the contractor has been completed in accordance with the relevant design and specifications.

5.2 Level 1 Control

The GITA shall adopt Level 1 responsibility as described in Section 8.2 of AS3798-2007 “Guidelines on earthworks for commercial and residential developments”:

“The primary objective of Level 1 inspection and Testing is for the geotechnical inspection and testing authority (GITA) to be able to express an opinion on the compliance of the work. The GITA is responsible for ensuring that the inspection and testing are sufficient for this purpose.

The geotechnical inspection and testing authority need to have competent personnel on site at all times while earthwork operations are undertaken. Such operations include:

- *Completion of removal of topsoil*
- *Placing of imported or cut material*
- *Compaction and adding/removal of moisture*
- *Trenching and backfilling*
- *Test rolling*
- *Testing.*

The superintendent should agree a suitable inspection and testing plan prior to commencement of the works.

On completion of the earthworks, the GITA will usually be required to provide a report setting out the inspections, sampling and testing it has carried out, and the locations and results thereof. Unless very unusual conditions apply, the GITA should also be able to express an opinion that the works (as far as it has been able to determine) comply with the requirements of the specification and drawings.”

For this particular contract, Level 1 responsibility includes:

1. Lot testing as per Clause 5.3 of this specification.
2. A frequency of compaction testing not less than that specified in Clause 5.4 of this specification.
3. The GITA documenting and reporting its activity in the terms required by Clause 6 of this specification.
4. The GITA undertaking adequate inspections and testing to comply with the above requirements and to be able to certify the fill in the terms required by Clause 6 of this specification.

5.3 Lot Testing

This specification requires lot testing to be undertaken.

A Lot is defined as a single layer of Engineered Fill consisting of uniform material which has undergone similar treatment.

Lot testing comprises the following:

1. A Lot shall be identified by the Contractor or the GITA with a Lot Number and presented for testing.
2. A Lot shall be deemed to be in accordance with the specification if all the tests undertaken within the Lot are in accordance with the specification, i.e. “a none to fail basis.
3. If any one test undertaken within a Lot fails, the whole of the Lot shall be reworked and retested.

Any portion of the placed Engineered Fill must be part of a single lot and all Lots will require approval by the GITA.

5.4 Testing Frequency (Compaction Testing)

The frequency of compaction testing for each lot shall not be less than the greater of:

1. For lot less than 50 m^3
   a) 1 test per lot.
2. For lot between 50 m^3 and 100 m^3
   a) 2 tests per lot.
3. For lot greater than 100 m^3
   a) 1 test per 500 m^3 of material placed.
   b) 3 tests per lot.

A laboratory moisture content test shall be undertaken for each field density test.

5.5 Proof Rolling and Plate Load Testing

Proof rolling, together with minor boxing out and refilling, of the upper surface of the bulk earthworks will be undertaken as directed by PSM. The plant to be adopted depends upon the design loads adopted by the structural engineers for each section of the site.

Plate load testing shall be undertaken at the direction of PSM at the following stages:

1. At final bulk earthworks level (BEL).

The contractor is to make a suitable reaction (e.g. 20 tonne excavator) available for the tests.

5.6 Inspection, Testing and Survey

The GITA shall at least undertake the following tasks:

1. Identify the subgrade as one of the four (4) subgrade types listed in Clause 3.1 of this specification and assess that the subgrade condition of any area prior to placement of fill material is in accordance with the subgrade preparation requirements of Clause 3.1 of this specification.
2. Should Engineered Fill be required to fill overcut areas, assess that filling has been placed in accordance with this specification.
3. Assess that the base geometry of any area prior to placement of fill material is in accordance with the base geometry requirements of Clause 3.2 of this specification.
4. Assess that the material placed is in accordance with the fill material requirements of Clause 3.3 of this specification.
5. Assess that the fill has been placed in accordance with the requirements for fill zonation and placement of Clause 3.4 of this specification.
6. Assess that each Lot as presented for approval by the contractor is in accordance with the requirements for Lot definition of Clause 5.3 of this specification.
7. Ensure that the survey requirements in Clause 4 of this specification have been completed.
8. Estimate the approximate volume of Engineered Fill placed in each Lot presented for approval.

9. Conduct Lot testing in accordance with the construction control testing requirements of Clauses 5.3 and 5.4 of this specification.
10. Assess that the compaction of each Lot is in accordance with the requirements of Clause 3.5 of this specification. The GITA shall select a depth of insitu density tests that allows the density of the full layer to be assessed.
11. Assess that the moisture variation of each Lot is in accordance with the requirements for moisture control in Clause 3.6 of this specification.
12. Conduct material property testing in accordance with the material testing requirements in this specification.

6. Reporting and Certification

6.1 Reporting

The GITA shall produce at least the following reports:

1. *Subgrade Approval Reports* (a sample is attached in Appendix A). Such a report shall:

- Document assessments undertaken for tasks 1 and task 3 of Clause 5.6 including reporting the subgrade type
- Document the subgrade survey that has been undertaken
- Approve or reject the subgrade condition and base geometry for filling, based on tasks 1 and 2 of Clause 5.6
- Approve or reject the subgrade condition for cut areas based on task 1.

2. *Lot Approval Reports* (a sample is attached in Appendix B). Such a report shall:

- Document assessments, testing and survey undertaken for tasks 4 to 12 of Clause 5.6
- Approve or reject the results of testing undertaken for task 10 of Clause 5.6
- Approve or reject lots based on tasks 10 and 12 of Clause 5.6
- Where applicable, records of the compaction plant detail.

3. Material Testing Reports. Such a report shall:

- Report the results of material property testing undertaken for task 12 of Clause 5.6.

4. *Daily Reports* (a sample is attached in Appendix C). Such a report shall be completed daily and shall:

- Document time spent on site by the GITA personnel
- List subgrade assessments and approvals undertaken each day with reference to relevant Subgrade Approval Report(s)
- List Lots presented, accepted, and approved or rejected each day, with reference to relevant Lot Approval Report(s)
- List survey undertaken each day as for task 9 of Clause 5.6 and not already document ted in the Subgrade or Lot Approval Reports
- Document other relevant activities undertaken on site that day (site instructions, breakdowns, compaction equipment used, etc.)
- Where applicable, records of the compaction plant used for each lot.

6.2 Certification

6.2.1 Weekly Certificates

The GITA shall produce a Weekly Certificate for any month in which earthworks are undertaken in accordance with this specification. The Weekly Certificate will cover all works from the previous Weekly Certificate until the end of work on a Saturday.

The Weekly Certificate shall transmit the following:

- Copy or reference to the complete specification document(s)

- Subgrade Approval Reports
- Lot Approval Reports
- Material property testing reports
- Daily Reports
- Survey of subgrade geometry prior to filling or in cut areas
- Plan survey drawing showing lot boundaries and location of density tests
- Survey documenting filling undertaken to date and showing location of testing
- Provide an Excel spreadsheet presenting the results of the month's acceptance testing completed by the GITA.

And certify that:

"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4669-004S REV0 dated xxx)."

6.2.2 Interim or Final Filling Certificate

At the completion of the bulk earthworks, or as requested by the Client, the GITA shall provide an Interim or Final Filling Certificate which shall:

1. Transmit a reference list of the Weekly Certificates.
2. Provide an Excel spreadsheet presenting the results of all the acceptance testing completed by the GITA.
3. Certify that *"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4669-004S REV0 dated xxx)."*

Legend

Approximate Site Boundary

Notes:

1. Image taken from Nearmap, dated 21 December 2021.

N

5 0 5 10 15 20m

1 : 1000 FULL SIZE A3

Goodman Property
Corner Lanceley St and Campbell St
Lanceley Place Data Centre, Artarmon

LOCALITY PLAN

PSM4669-004S	Figure 1

Appendix A
Subgrade Approval Report (Sample Only)

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

SUBGRADE APPROVAL REPORT

Client:	Contractor:
Job number:	Report number:
Project:	Technician:

Subgrade areas assessed:

Area ID	Date	Approximate extent	Subgrade description	Geometry summary	Specification reference	Compliance (Pass/Fail)	Survey reference	Approved (Yes/No)

COMMENTS:

Signed: Date:

Appendix B
Lot Approval Report (Sample Only)

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

LOT APPROVAL REPORT

Client:	Report number:
Job number:	Report date:
Project:	Technician:
Contractor:	Test methods:

LOT ID:	**Sheet of**
Retest (Yes/No)	Original test report number:
Specification reference	
Location:	
Lot boundary survey reference/location:	
Materials description:	*(MATERIAL TYPE, colour, minor components, maximum particle size)*
Material identification:	*(Identify the material as defined in Clause 2.3.1, Clause 2.3.2 or Clause 2.3.3 of the Specification)*
Deleterious material assessment:	*(Report proportion of deleterious material)*
Layer thickness:	
Accepted as Lot: (Yes/No)	Date:
Approximate volume (m3)	Number of tests required:

Test ID No.				
Test soil description				
Date tested:				
Grid reference				
Surveyed test locations (RL,E,N)				
Test depth (mm)				
Max size (mm)				
% Oversize material (wet)				
Field wet density (t/m^3)				
Field moisture content (%)				
PWCD (t/m^3)				
Compactive effort				
Moisture variation (%)				
HILF density ratio (%)				
TEST (Pass/Fail)				

LOT APPROVAL	(Pass/Fail)	Signed:	Date:

Appendix C
Daily Report (Sample Only)

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

DAILY REPORT

Client:	Report number:
Job number:	Report date:
Project:	
Location:	Level of testing: Level 1
Contractor	Technician:
Time on site:	
Time off site:	

1. Subgrade Approval

Areas ID	Subgrade Approval Report No:	Comments

2. Lot Approval

Lot ID	Lot Approval Report No:	Comments

3. Survey

Type of survey	Survey undertaken by:	Reference

4. Instructions received on site

5. Instructions given on site

COMMENTS:

Signed:	Date:

Appendix D
Sample Interim Letter (Sample Only)

Our Ref:

Date:

Addressed to: Earthwork Contractor

Attention: Earthwork Contractor Representative

Dear

RE: SAMPLE INTERIM (OR FINAL) FILLING CERTIFICATE
INDUSTRIAL DEVELOPMENT, BULK EARTHWORKS
CERTIFICATION OF EARTHWORKS
BETWEEN [DATE OF COMMENCEMENT] AND [DATE OF COMPLETION]

In the period between [date start] and [date finish] the contractor has undertaken earthworks in areas XXX and XXX.

During the above period:

- The GITA has prepared the following Subgrade Approval Reports:

1. Subgrade Approval Report No 1
2. ……

- The GITA has prepared the following Lot Approval Reports:

1. Lot Approval Report No 1
2. ……

- The GITA has prepared the following Daily Reports:

1. Daily Report No 1……
2. ……

- The following subgrade survey was undertaken:

1. Subgrade Survey reference……
2. ……

- The following weekly survey was undertaken:

1. Weekly survey of week ending …….reference……..
2. ……

Copies of all the above documents are attached.

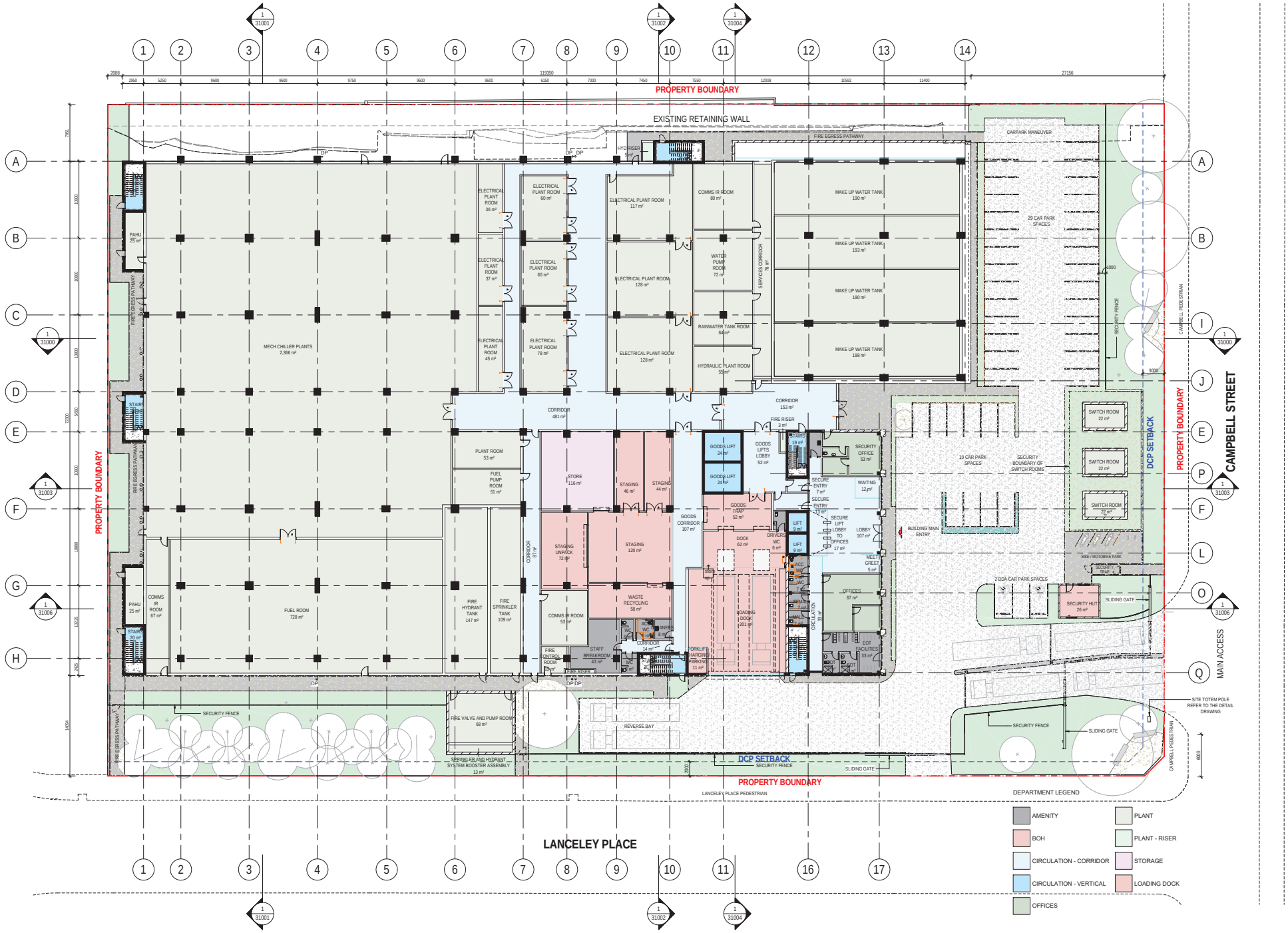
The GITA certifies that all the earthworks undertaken in the above stated period are documented in the above reports and have been undertaken in accordance with the Specifications (ref. PSM4130-007S, dated XXX) a copy of which is attached, with the exception of:

1. List outstanding issues (not approved subgrade, lots, unsuitable material, failed tests etc.)
2. ……..

Signed

GITA

Appendix F
Architectural Plan



Level 24, 25 Martin Place, Sydney NSW, 2000, Australia
+61 2 9956 2666 | hdrinc.com
HDR Pty. Limited ABN 76 158 075 220 trading as HDR
NOMINATED ARCHITECT: Cate Cowlishaw 10786 (NSW)

NORTH POINT

KEY PLAN

REV	DESCRIPTION OF CHANGE	DATE	CHECKED	ISSUED
A	SSD SUBMISSION	01/05/2024	HDR	

CLIENT
Goodman

PROJECT
LANCELEY PLACE DATA CENTRE
ARTARMON

DRAWING TITLE
SITE PLAN - EXTERNAL ARCHITECTURAL WORKS

SCALE
1 : 250 @ A1

PROJECT NUMBER
10384537

DRAWING NUMBER
EOS-AR-DRG-11003

ISSUE
A

PROJECT STATUS
PRELIMINARY

30/04/2024 11:45:45 AM

Appendix B
PSM4669-013L

G3 56 Delhi Road
North Ryde NSW 2113
P +61-2 9812 5000
E mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM4669-013L

21 August 2023

Senior Development Manager
Goodman
The Hayesbery
1-11 Hayes Road
Rosebery NSW 2018
Cameron.Rubenach@goodman.com

Attention: Cameron Rubenach

Dear Cameron

RE: ABC SITE ARTARMON - CORNER OF LANCELEY AND CAMPBELL STREET, ARTARMON - RESULTS OF GROUNDWATER ASSESSMENT REPORT

1. Introduction

This letter presents PSM's assessment of the groundwater conditions at and within the vicinity of the proposed development at the previous studios operated by ABC located on the Corner of Lanceley and Campbell Street (the Site). Additionally, the letter presents an assessment of the impact of the proposed basement on the groundwater at the site and its surrounds.

This letter has been prepared to address the comments in NSW Department of Planning and Environment EIS letter (Ref. OUT23/7611 dated 23 May 2023). A copy of the letter is attached in Appendix C.

The work was undertaken in accordance with our proposal PSM4669-012L dated 5 July 2023 and revised via email on 24 July 2023 to Cameron Rubenach.

2. The Site

2.1 Location

The Site is located within the Artarmon industrial area and is surrounded by other industrial developments. Lanceley Place and Campbell Street border the site on its northeastern and northwestern boundaries respectively.

The proposed development seeks to facilitate the construction of a multi-level warehouse and distribution centre, incorporating onsite car parking and ancillary offices. Specifically, the proposed development comprises the following works:

- Demolition of existing structures and bulk excavation of the Site
- Detailed earthworks and infrastructure construction, including vegetation clearing, installation of services and drainage infrastructure
- Construction, fit out and use of a three-storey warehouse and distribution centre, comprising 12 warehouse units with ancillary offices, including:
  - 25,538 m^2 of total Gross Floor Area (GFA)

- Approximately 21,534 m^2 of warehouse GFA
- Approximately 2,716 m^2 of office GFA
- Maximum building height of 33.46 m (RL 104.56).

- Provision of 188 car parking spaces, 34 medium rigid vehicle parking spaces, 6 accessible places and 8 motorbike parking spaces
- Site landscaping
- Business identification signage.

The warehouse is understood to comprise two (2) separate buildings with a combined basement carpark that extends across nearly the full footprint of the Site. The basement is understood to have a finished floor level (FFL) at RL66.820 m AHD at the carparking area and a FFL at RL69.00 m AHD within the proposed sprinkler tank footprint. Inset 1 presents a locality plan of the Site.

Inset 1: Site locality plan (aerial image from Nearmap, dated 20 June 2023)

2.2 Topography

The Site is noted to have an existing topography consisting of a fall of approximately 5m across the site. The fall is in a generally easterly direction towards Lanceley place. It is noted that the site has a highpoint at approximately RL 85 m AHD located at the southern corner of the site. The Site RL ranges from 85 m to RL 71 m AHD. There is a significant drop in elevation located on the western border of the site consisting of a shotcrete retaining wall.

2.3 Geological Setting

The 1:100,000 Sydney Geological map (1983) indicates that the site is underlain by:

- Rwa - Black to dark-grey shale and laminite

Inset 2 below presents the site location with regards to the geological setting.

Inset 2: Sydney 1:100,000 geological map (site marked in red)

3. Regulatory considerations

3.1 General

Constructing buildings with basements that require excavation which intercepts an aquifer is an aquifer interference activity. Therefore, it is subject to the Water Management Act 2000, relevant water sharing plans, and the NSW Aquifer Interference Policy.

3.2 Water licencing

Applicants must seek appropriate licences and approvals for a building project before construction starts.

Where predicted maximum long term groundwater inflows into a planned drained basement during operation of the development are expected to be less than 3 ML/year, such developments could be considered as a 'minor aquifer interference activity' which are generally exempt from the full extent of the Water Management Act and therefore may not require a licence.

This is discussed in the WaterNSW Fact Sheet titled *Water access licence exemption for aquifer interference activities taking 3ML or less of groundwater per year*.

This fact sheet includes a list of common aquifer interference activities to which the exemption may apply, one of which is the 'ongoing dewatering of basements'.

Ultimately the decision as to whether a licence will be required for the long-term passive collection of groundwater inflows into a planned basement will be at the discretion of WaterNSW.

3.3 NSW Aquifer Interference Policy (NOW, 2012)

The purpose of this Aquifer Interference Policy ("this Policy") is to explain the role and requirements of the Minister administering the Water Management Act 2000 ("the Minister") in the water licensing and assessment processes for aquifer interference activities under the Water Management Act 2000 and other relevant legislative frameworks.

The policy sets out Minimal Impact Considerations to be applied to assess the impact of the proposed aquifer interference activity, in this case the construction and ongoing dewatering of a basement.

3.4 Minimum Requirements for Building Site Groundwater Investigations and Reporting (January 2021)

The document indicates that a tanked basement construction which results in no ongoing dewatering is preferable as such construction reduces/eliminates:

- Energy demand from the continual operation of the pump-out system
- The required maintenance demand to keep the pumps operating and drainage lines free of clogging from the aeration of mineral-rich groundwater
- The water demand on the surrounding groundwater system and optimise the availability of groundwater for all users
- The additional administrative demand to retain records and maintain valid approvals, licences, or both, that would otherwise be imposed on the future managers of the property.

Drained basements can be considered where the ongoing water take is minimal, i.e., within the volumes that would typically be exempted from licencing, as discussed in Section 3.2.

Where a drained basement is proposed:

- A groundwater assessment shall be undertaken to appropriately predict the likely inflow volumes and drawdown and its effect on neighbouring structures, ecosystems, and groundwater users
- Engineering measures should be designed and constructed to meet as far as practical the aims listed in the dot points above with respect to ongoing energy, maintenance and administrative requirements on future managers of the property.

3.5 Disposal/reuse of groundwater

Should a drained basement be adopted, groundwater flowing into the basement during construction and in perpetuity will need to be either re-used on site as grey water or for irrigation purposes or be disposed of either in the stormwater or sewer systems.

Where disposal is proposed this will need to be agreed with the appropriate authorities, i.e., Local Council for stormwater and Sydney Water for sewer. Each authority will have their requirements with regards to peak and average flows and water quality.

4. Proposed Basement Configuration

4.1 Geometry

PSM has been provided with the following documentation to assist in our understanding of the basement geometry:

- Basement Plan by Grimshaw Architects (ref. Project 22095, Drawing A02-1001 REV H dated 30 January 2023)
- Sections of the proposed development by Grimshaw Architects (ref. Project 22095, Drawing A01-1001 dated 30 January 2023).

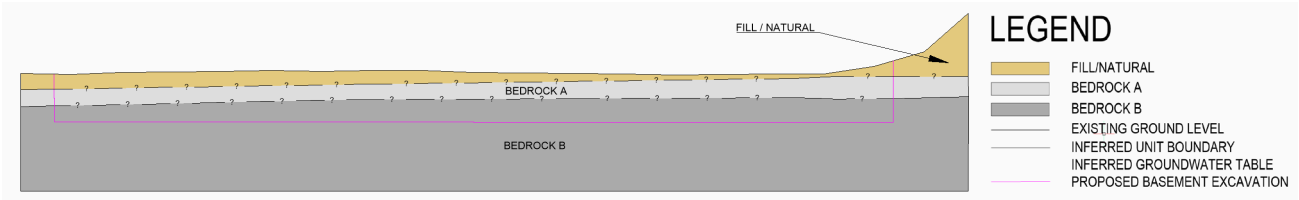
From the provided documents, we understand the basement has the following geometry:

- Base of the basement to be at a maximum excavation depth of 4.68 m at RL 66.820 m AHD
- Roof of the basement is at RL 71.500 m AHD. The current surface level is between 69.5 m AHD and 71.5 m AHD
- The basement is to extend under the footprint of the proposed development
- The basement will serve a variety of functions such as:
  - Pump room
  - Parking
  - Gym

- Lobby
- EOT
- OSD + Rainwater Tanks
- Sprinkler Tanks.

- It is noted that the basement is at different depths depending on the usage requirement. The model adopts the entire basement to be at a maximum depth of RL 66.820 m AHD. This is considered to be a conservative approach
- It is unclear how excavation for the basement will be conducted and the proposed length of time the excavation is to be left exposed
- The design of the basement (i.e, drained or tanked) is not known to PSM at this stage.

A long section of the Site presented in Inset 3 detailing the inferred ground conditions and proposed excavation level.



Inset 3: Long section with inferred ground conditions

PSM has previously completed site investigations including the drilling of (11) boreholes extending below the proposed basement elevation. The results of the geotechnical investigation and the inferred subsurface conditions at the Site are presented in PSM4669-003L REV2 dated 16 June 2023.

The attached Figure 1 shows the approximate location of the completed boreholes relative to the approximate site boundaries.

5. Groundwater monitoring data

5.1 Piezometers

Tetra Tech Coffey (Coffey) previously conducted a detailed environmental site investigation in 2021 including the installation of seven (7) piezometers as part of their environmental works.

PSM received approval from Goodman to utilise the existing piezometers in the hydrogeological investigation.

Construction records of the piezometers are presented in Appendix A.

Approximate locations of the piezometers are shown in Figure 1.

5.2 Groundwater level monitoring

Since the installation of the piezometers the groundwater has been measured during some site visits. Groundwater has been measured on the following dates:

- 18 August 2021 (Coffey) – (Ref. Coffey environmental report SYDEN288946-R02 dated 1 Oct 2021)
- 18 November 2022 (PSM)
- 1 December 2022 (PSM)
- 26 July 2023 (PSM).

Table 1 presents the results of the groundwater monitoring.

Table 1 - Results of Groundwater Monitoring

BH ID	Top of Casing (RL mAHD) *	Base of Piezometer (RL m AHD)*	Measurements *** (RL m AHD)			
			18 August 2021*	18 November 2022	1 December 2022	26 July 2023
Coffey_BH1	71.560	69.39	70.486	71.69 ** (water observed above the well casing)	70.94	71.14
Coffey_BH4	73.731	68.86	71.737	NA	NA	71.51
Coffey_BH7	69.718	64.97	66.755	NW (dry)	NW (dry)	66.92
Coffey_BH8	69.591	65.55	67.396	NW (dry)	NW (dry)	NW (dry)
Coffey_BH9	71.378	67.47	68.746	68.27	NW (dry)	68.77
Coffey_BH10	67.147	63.65	64.273	NW (dry)	NW (dry)	64.35
Coffey_BH12	71.593	67.25	70.959	70.75	70.70	71.68** (water observed above the well casing)

(1) NA = Not Accessible
(2) NW = No Water
(3) AHD = Australian height datum
(4) * - Top of Casing, base of piezometers levels, and measurement on 18 Aug 2021 are taken from Coffey report SYDEN288946-R02 dated 1 Oct 2021
(5) ** - water was observed above the well casing. Figure 2 and Figure 3 present some selected site photos of the observation
(6) *** - Measurement relative to the RL of the Coffey's borehole collar levels.

It is noted in two separate occasions (Coffey_BH01 on 18 Nov 2022 and BH_12 on 26 July 2023), water was observed to be above the well casing (eg. the gatic was "flooded"). It is possible that this was due to external factors such as surface water flowing into the monitoring pit.

6. PSM infiltration / hydraulic tests – 26 July 2023

A total of three (3) "slug" tests were performed on 26 July 2023 in three of the piezometers on site. The tests were undertaken in BH1, BH4 and BH12.

"Slug" tests refer to falling or rising head tests. All tests undertaken were rising head tests, in which groundwater was bailed out of the piezometers, and the water recharge was monitored using the HOBO water level loggers.

The results of the rising head tests are presented in Appendix B.

Based on the results of the "slug" tests, Table 2 presents the estimated hydraulic conductivities for the unit:

Table 2 - Results of Slug Tests

Unit	Assessed Hydraulic Conductivity (m/s)
NATURAL (CLAY)	8×10^{-8} m/s to 1×10^{-7} m/s
BEDROCK	2.2×10^{-7} m/s

7. Groundwater inflow assessment - Numerical Modelling (Seepage Analysis)

7.1 Methodology

Details of the basements (eg. if it is tanked or drained basements) are not known to PSM.

In order to estimate the inflows during excavation, we have undertaken a series of seepage analyses using the finite element seepage package SEEP/W, produced by GEO-SLOPE International Ltd. The following section presents details of the modelling.

7.2 Model Geometries

We have adopted the following for the geometry of the seepage analysis:

- An excavation depth of approximately 4.7 m on the eastern boundary of the site and 6.4 m on the western boundary of the site to RL 66.82 m
- Future ground surface obtained from A07 GA SCN CC of architectural drawings by Grimshaw Architects
- The excavation plan dimensions are approximately 82.8 m by 137.4 m.

7.3 Model Inputs

When assessing the hydraulic conductivity of these two units we have considered:

- The geotechnical characteristics of the units
- Typical conductivities adopted for these units in projects across Sydney both published in the literature and that we are aware of from our involvement in many hydrogeological models for Sydney Tunnels
- Results of localised slug tests:

The following hydraulic soil parameters were adopted:

UNIT	k_h BEST ESTIMATE	LOWER BOUND	Upper Bound	k_h/k_v
FILL/ NATURAL (CLAY)	1 x 10^{-7} m/s	1 x 10^{-8} m/s	1.0 x 10^{-7} m/s	5
BEDROCK	1 x 10^{-8} m/s	1 x 10^{-8} m/s	2.2 x 10^{-7} m/s	5

We have developed the following RUNs:

- RUN 1 – Calibration mode (prior to excavation) & k_h Best estimate
- RUN 2 – Basement excavation & k_h Best estimate
- RUN 3 – Basement excavation & k_h Lower Bound
- RUN 4 – Basement excavation & k_h Upper Bound.

The boundary conditions have been obtained utilising a calibration model consisting of the existing ground surface. Existing ground surface profile was obtained using data sourced from Elvis - Elevation and Depth - Foundation Spatial Data.

7.4 Results

Appendix D presents the geometry and results of the models respectively.

Based on the SEEP/W analysis, the estimated inflows into the excavation are as presented in Table 3.

Based on the estimated groundwater inflows the estimated groundwater volumes for different construction periods are presented in Table 3.

Table 3 - Summary of Estimate Inflows

	BEST ESTIMATE	LONG TERM – LOWER BOUND	LONG TERM – UPPER BOUND
Estimated Inflow (L/S)	0.005	0.004	0.084
Total Estimated Inflow (ML/year)	0.14	0.12	2.65

Note: Values presented are over the entire excavation width 137.4 m.

The estimated inflows are minor and below the 3 ML/yr limit that is typically adopted as the upper limit to minimal impact on the existing groundwater conditions.

8. DPE Comments - (Ref. OUT23/7611 dated 23 May 2023)

The following sections presents PSM clarification on DPE comments on items raised in their letter OUT23/7611 dated 23 May 2023.

8.1 Inconsistent Current Site elevations, groundwater level measured on 18 Aug 2021 (Coffey data), inconsistent site groundwater level trends.

Attachment A of DPE letter states the following:

> The prediction of water take and licensing requirements and the assessment of aquifer interference will require the clarification of some site details:
>
> - inconsistent current site elevations have been reported – ranging from 70.7 to 73.2 mAHD (Appendix 21 Section 2.2) or, as inferred from groundwater-level measurements given in both mbgl and mAHD (Appendix 18A Table 5.2), 67.1 to 73.7 mAHD.
> - inconsistent groundwater levels measured on 18 August 2021 have been reported for each monitoring bore – the difference per bore ranging from 0.2 to 4.6 mAHD (cf. Appendix 15 Table 1 and Appendix 18A Table 5.2)
> - inconsistent site groundwater-level trends are evident – rising at borehole BH1 and falling at BH12 by comparable amounts from 18 August 2021 to 1 December 2022

PSM Clarification:

At the time the previous groundwater monitoring level was prepared (Ref. PSM4669-006L Rev 1 dated 2 February 2023), PSM did not obtain full copy of Tetra Tech Coffey Detailed Site Investigation (Ref. SYDEN288946-R02 dated 1 October 2021). The survey Coffey borehole collar levels were not known to PSM.

PSM estimated the borehole elevations and the observed water levels from the site survey contour plan prepared by LTS Surveys (Ref. 51775 001DT). This was described in the letter PSM4669-006L Rev 1.

In this letter, we have provided updated borehole elevations and groundwater level based on the Coffey's borehole collar levels. Table 1 presents updated results with previous groundwater measurements updated to match the top of collar readings provided in Table 5.2 of the previous site investigation report by Tetra Tech Coffey (ref. Detailed Site Investigation by Tetra Tech Coffey, SYDEN288946-R02 dated 1 October 2021).

As described in Section 5.2 of the letter, it is noted at two separate occasions (Coffey_BH01 on 18 Nov 2022 and BH_12 on 26 July 2023) water was observed to be above the well casing (eg. the gatic was "flooded"). It is possible that this is due to external factors such as surface water flowing into the monitoring pit.

8.2 Groundwater levels have not been presented with respect to the proposed bulk excavation levels.

Attachment A of DPE letter also states the following:

- groundwater levels have not been presented with respect to the proposed bulk excavation level

PSM Clarification:

This information is now presented in this letter (in particular Appendix D – inflow assessment).

8.3 Basement Details

Attachment A of DPE letter also states the following:

- the duration and details (e.g. shoring, drained/tanked basement, etc) of the excavation and construction works are unclear.

PSM Clarification:

At the time this assessment letter is prepared, the details of the proposed basement are not known to PSM.

However, the estimated groundwater inflow presented in this letter could assist the Designer in their basement details.

9. Groundwater impact assessment

9.1 Licensing requirements

The predicted maximum long term groundwater inflows into the proposed drained basement are expected to be below 3 ML/year.

The proposed basement can thus be considered as a 'minor aquifer interference activity' which are generally exempt from the full extent of the Water Management Act and therefore may not require a licence. This is discussed in the WaterNSW Fact Sheet titled *Water access licence exemption for aquifer interference activities taking 3ML or less of groundwater per year*.

Ultimately however, the decision as to whether a licence will be required for the long-term passive collection of groundwater inflows into a planned basement will be at the discretion of WaterNSW.

9.2 Minimum Requirements for Building Site Groundwater investigations and Reporting (January 2021)

This Department of Planning document indicates that drained basements can be considered where the ongoing water take is minimal i.e. within the volumes that would typically be exempted from licencing.

As discussed in previous sections, the work completed and presented in this report indicates minimal water intake and thus we consider that this document would contemplate adopting a drained basement at this Site.

The document further requires that where a drained basement is proposed:

- A groundwater assessment shall be undertaken to appropriately predict:
  - The likely inflow volumes and drawdown. This is presented in Section 8 of this report
  - The effect of the drawdown on neighbouring ecosystems and groundwater users. This is discussed in Section 9.3
  - The effect on neighbouring structures. This is discussed in Section 9.4.
- Engineering measures should be designed and constructed to meet as far as practical the aims listed in the dot points above with respect to ongoing energy, maintenance, and administrative requirements on future managers of the property. These measures are discussed in Sections 9.5, 9.6 and 9.7 respectively.

9.3 AIP 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.

Both the soils and rocks at the site are of relatively low yield (<5 L/s) and are a *"less productive groundwater source"* and *"Fractured Rock Water Source"* as defined in the AIP.

The proposed development is expected to have impacts that are less than the Level 1 minimum impact considerations, which according to the AIP minimal consideration requirements, would be considered as acceptable.

9.4 Effect on neighbouring structures

The aquifers are contained within the shale bedrock and the overlying weathered rock units. On this basis, we consider that any minor drawdown resulting from a drained basement at the Site would be very unlikely to result in settlements that would damage neighbouring properties.

9.5 Long term energy demand

Given the estimated long-term inflows associated with a drained basement a sump and pump drainage system with a pump out drainage system would be considered appropriate. Assuming steady state inflows of 3 ML/yr (this is more than our upper estimate and is thus a conservative assumption), this is equivalent to 8.5 m^3/day.

Assuming a pump (or two pumps) capable of pumping at 20 L/s, this would result in the pump being in operation for approximately 42 hrs throughout the year. Assuming a 20 m^3 sump, this would result in the pump operating for around 16 minutes every 2 days.

Compared to other energy demands on the owners, such as air conditioning/heating or lights the use of pump can be considered a minimal long-term imposition on the owners.

9.6 Maintenance requirements

Adopting a drained basement can result in additional long term maintenance impositions on the owners of the property. These can however be minimised by appropriate design and construction.

Additional maintenance can result from:

1) Deterioration of exposed weak rock batters subject to ongoing seepage

   We note that the bedrock units present at the site may degrade with time if left exposed with ongoing groundwater seepage. It is thus recommended that shotcrete facing be provided to protect against degradation. Alternatively, a plenum space between the rock face and an internal dry-wall can be adopted. This should be wide enough to allow maintenance access.

2) Maintaining of the permanent drainage system. Where a drained basement is adopted, provision will need to be made for permanent and effective drainage. Such permanent drainage systems will need to be able to be maintained throughout the life of the structures and thus allow for access to flushing to remove chemical deposits that may build up over time or include redundancy in the system to allow for possible reduction in capacity in the future

   Details of the drainage system are a matter of design but would typically include a sub-floor drainage blanket with slotted drainage pipes within drainage aggregate, plus strip drains behind the shotcreted / concreted walls (or a plenum space between the rock face and an internal dry-wall where shotcrete is not required), and sump and pump system with the ability to effectively back flush the system for long-term maintenance.

   By including redundancy in the drainage system, the need for maintenance can be reduced to where it does not result in unreasonable maintenance requirements in perpetuity.

3) Maintaining the water treatment plant (if required).

9.7 Disposal/Reuse of groundwater

Groundwater flowing into the basement during construction and in perpetuity will need to be either re-used on site as grey water or for irrigation purposes or disposed of either in stormwater or sewer.

Where disposal is proposed this will need to be agreed with the appropriate authorities i.e. Local Council for stormwater and Sydney Water for sewer. Each authority will have their requirements with regards to peak and average flows and water quality.

The predicted yearly inflows are small and would not be expected to result in overloading of the stormwater system. Should capacity of the stormwater be considered an issue this could be addressed by sizing of the sump and pump to allow collection and disposal at low flow rates during periods of dry weather.

Water quality issues would need to be addressed separately and local water treatment plants can be used to treat the water if required.

9.8 Conclusion

In the sections above we have discussed the impact of a proposed drained basement at the Site on the:

- Groundwater resource
- Neighbouring structures
- Neighbouring groundwater users
- Long term energy demand on future owners
- Long term maintenance requirements on future owners
- Disposal/reuse of the intercepted groundwater.

On this basis we consider that the impact of a drained basement is minimal.

The above sections have also identified the approvals that will need to be sought and the measures that would need to be designed and constructed to result in this minimal impact in the long term.

10. Basement drainage design considerations

The permanent drainage system is expected to comprise a sub-floor drainage blanket with slotted drainage pipes within drainage aggregate, plus strip drains behind the shotcreted / concreted walls (or a plenum space between the rock face and an internal dry-wall where shotcrete is not required), and sump and pump system with the ability to effectively back flush the system for long-term maintenance.

We recommend that such a system be designed and constructed, keeping in mind the recommendations regarding redundancy and disposal in Sections 9.6 and 9.7, and as a minimum:

- Include at least two sumps each with its own pump and emergency pump to allow for redundancy in the system
- Consider potential for partial blockages in the drainage over the life of the building
- Consider additional inflows into the system from rainfall infiltration, cleaning, potential flooding from broken services etc
- Include ability to treat the inflow prior to disposal if required
- Include ability to monitor the inflows and outflows from the system
- Have enough storage capacity to allow discharge in lower flow rates and in dry periods to minimise load on receiving system.

On the above basis we consider that it would be prudent to design the permanent drainage system for inflow of 0.5 l/s long term conditions and peak flows of up to 2 l/s. Whilst these are significantly greater inflows than are expected, the increased capacity would be expected to come at very minor additional costs and provide significant level of redundancy.

Inspections of the basement and monitoring of inflows and water levels during construction are recommended to allow confirmation of the assumptions and the outcomes presented in this report.

11. Exclusions

This report does not consider the groundwater quality, contamination and environmental issues associated with the proposed basement at the Site. We understand that these are being addressed separately by others.

Should you have any queries please do not hesitate to contact the undersigned.

Yours Sincerely

KEN TONG LEE
GEOTECHNICAL ENGINEER

AGUSTRIAL SALIM
PRINCIPAL

Encl.

Figure 1	Site Locality Plan of Previous Investigations
Figure 2	Selected Site Photos (1 of 2)
Figure 3	Selected Site Photos (2 of 2)
Appendix A	Well Construction Records
Appendix B	Results of Rising Head Tests
Appendix C	DPE letter
Appendix D	Seepage Analysis

Legend

- Monitoring Wells (Coffey)
- Augered Boreholes (PSM) - December 2021
- Hand Augered Boreholes (PSM) - December 2021
- Cored Boreholes (PSM) - December 2021
- Cored Boreholes (PSM) - May 2023
- Site Boundary

Notes:

1. Aerial image sourced from Nearmap dated 20 June 2023.

Scale 1:500

0 5 10 15 20 25 m

Map Projection: GDA2020 / MGA zone 56
Grid: EPSG:7856

P S M	Created By: PSM	Revision: A	
	Date: 14 Aug 2023	Paper Size: A3	

Goodman Property
ABC Site
Artarmon NSW

LOCALITY PLAN OF EXISTING INTRUSIVE INVESTIGATIONS

PSM4669-013L | FIGURE 1

N:\PSM4669\GIS\02_WorkSpace\01_MXDs\PSM4669.qgz Layout: PSM4669-013L Figure 1

Photo 1 - Water observed outside well casing of BH1 on 18 November 2022

Photo 2 - Condition of BH12 on 18 November 2022

Goodman Property

ABC Site Artarmon

Corner Lanceley St and Campbell St, Artarmon

GROUNDWATER MONITORING
SELECTED SITE PHOTOGRAPHS (1 OF 2)

PSM4669-013L	Figure 2

Photo 3 - Water observed outside of well casing at BH12 prior to removal of PVC cap (26 July 2023)

Photo 4 - Condition of BH12 on 26 July 2023 following removal of PVC Cap

Goodman Property

ABC Site Artarmon

Corner Lanceley St and Campbell St, Artarmon

GROUNDWATER MONITORING
SELECTED SITE PHOTOGRAPHS (2 OF 2)

PSM4669-013L	Figure 3

Appendix A
Well Construction Records

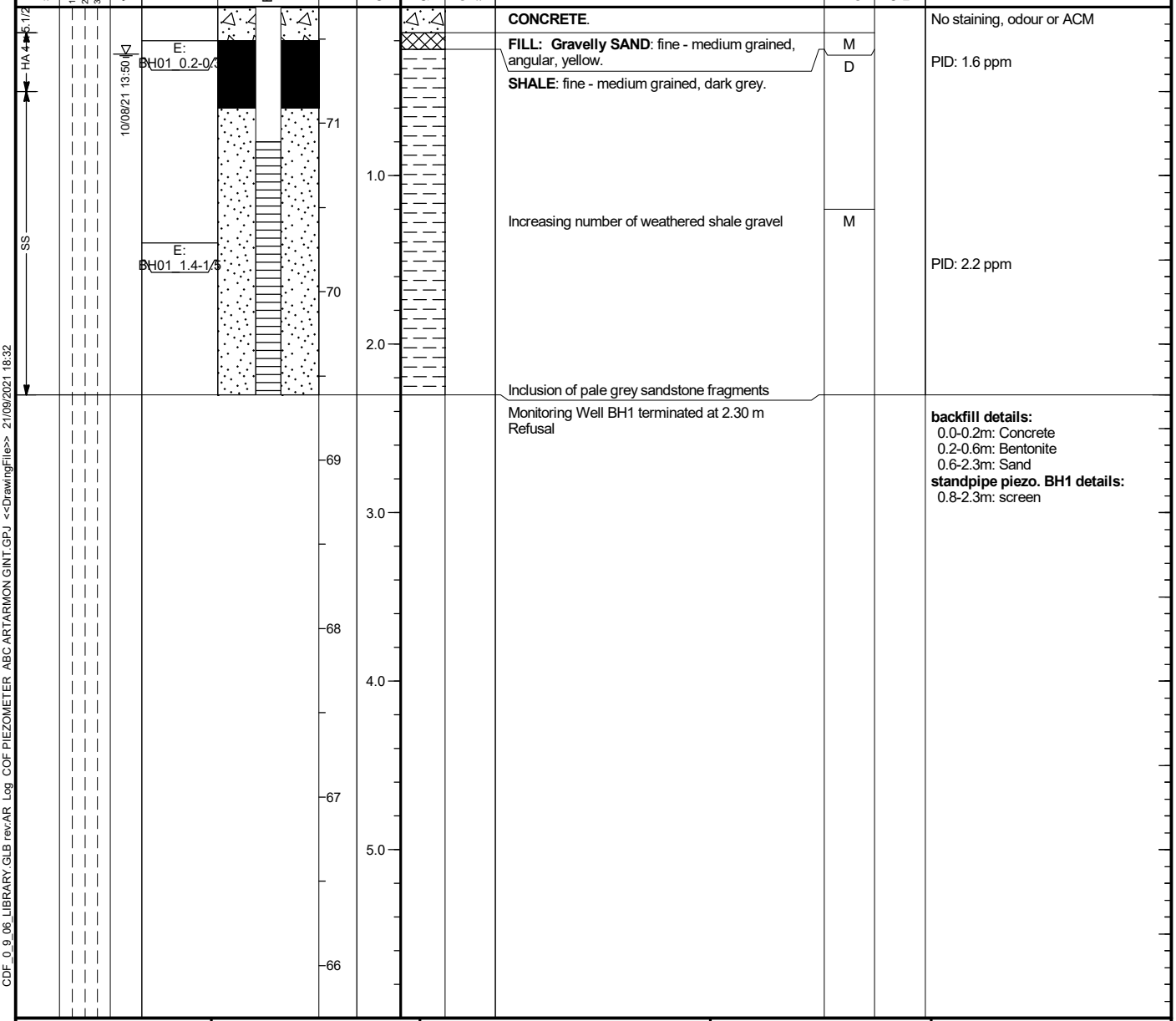
coffey
A TETRA TECH COMPANY

Engineering Log - Monitoring Well

Hole ID.	**BH1**
sheet:	1 of 1
project no.	**754-SYDEN288946**
client:	**Australian Broadcasting Corporation**
date started:	**09 Aug 2021**
principal:	
date completed:	**09 Aug 2021**
project:	**ABC Artarmon DSI**
logged by:	**J.Y**
location:	**2 Lanceley Place & 14 Campbell Street, Artarmon**
checked by:	**M.L**

position: E: 332127; N: 6256466 | surface elevation: 71.69 mAHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter : 100 mm



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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
HA	hand auger
SS	solid stem flight auger
4 x 5.1/2	5.1/2 coring (100.8mm)
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nil

penetration

1 2 3 — no resistance ranging to refusal

water

10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests

B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear; peak/remouded (kPa)
R	refusal
HB	hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
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Engineering Log - Monitoring Well

Hole ID.	**BH10**
sheet:	1 of 1
project no.	**754-SYDEN288946**
client:	**Australian Broadcasting Corporation**
date started:	**09 Aug 2021**
principal:	
date completed:	**09 Aug 2021**
project:	**ABC Artarmon DSI**
logged by:	**J.Y**
location:	**2 Lanceley Place & 14 Campbell Street, Artarmon**
checked by:	**M.L**

position: E: 332190; N: 6256517 | surface elevation: 67.15 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information				well details	material substance							
method & support	penetration 1 2 3	water	samples & field tests	BH10	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
HA			E: BH10_0.1-0.2		67				**FILL: Gravelly SAND**: fine - medium grained, Dark brown, Sub angular to sub rounded gravells, plastic fragments.	D		No odour, staining or ACM PID: 0.8 ppm
			E: BH10_0.4-0.5						**Sandy GRAVEL**: sub-angular to angular, Pale grey.			Weathered Shale PID: 0.6 ppm
SS					66	1.0						PID: 1.5 ppm
					65	2.0				M		
									Traces of sandstone			PID: 1.4 ppm
					64	3.0						
									Hard shale bedrock Monitoring Well BH10 terminated at 3.50 m Refusal			**backfill details:** 0.0-0.2m: Concrete 0.2-0.8m: Bentonite 0.8-3.5m: Sand **standpipe piezo. BH10 details:** 1.0-3.5m: screen
					63	4.0						
					62	5.0						

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 5.1/2 coring (100.8mm)
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Monitoring Well

Hole ID.	**BH12**
sheet:	1 of 1
project no.	**754-SYDEN288946**
date started:	**09 Aug 2021**
date completed:	**09 Aug 2021**
logged by:	**J.Y**
checked by:	**M.L**

client: ***Australian Broadcasting Corporation***

principal:

project: ***ABC Artarmon DSI***

location: ***2 Lanceley Place & 14 Campbell Street, Artarmon***

position: E: 332152; N: 6256491 | surface elevation: 71.70 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information				well details	material substance							
method & support	penetration 1 2 3	water	samples & field tests	BH12	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
4 x 5.1/2 HA SS		10/08/21 14:10	E: BH12_0.3-0.4 E: BH12_0.6-0.7		71 70 69 68 67 66	1.0 2.0 3.0 4.0 5.0			**CONCRETE**. **FILL: Clayey Gravelly SAND**: fine - medium grained, sub-angular to angular, low plasticity, pale grey and dark grey, shale gravel. **Gravelly CLAYEY SAND**: fine - medium grained, sub-angular, high plasticity, grey. increase in shale gravel fragments some grey clay Monitoring Well BH12 terminated at 4.45 m Refusal	D D M	D	No staining, odour, ACM PID: 0.8 ppm Fragments of ash, slag and glass 3-20mm. PID: 7.2 ppm Weathered shale **backfill details:** 0.0-0.5m: Concrete 0.5-1.0m: Bentonite 1.0-4.45m: Sand **standpipe piezo. BH12 details:** 1.45-4.45m: screen

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 5.1/2 coring (100.8mm)
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Monitoring Well

		Hole ID.	**BH4**
		sheet:	1 of 1
		project no.	**754-SYDEN288946**
client:	**Australian Broadcasting Corporation**	date started:	**10 Aug 2021**
principal:		date completed:	**10 Aug 2021**
project:	**ABC Artarmon DSI**	logged by:	**J.Y**
location:	**2 Lanceley Place & 14 Campbell Street, Artarmon**	checked by:	**M.L**

position: E: 332094; N: 6256562 | surface elevation: 73.86 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information				well details	material substance						
method & support	penetration 1 2 3	water	samples & field tests	BH4	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
HA			E: BH4 0.2-0.3						**ASPHALT**.	D		No staining, odour, ACM
									FILL: Sandy GRAVEL: fine - medium grained, sub-angular to angular, dark brown.			PID: 0.4 ppm
			E: BH4 0.4-0.5						**FILL: Gravelly SAND**: medium grained, to 20 mm, sub-angular to angular, dark brown.			PID: 0.4 ppm
					73	1.0			**Gravelly Sandy CLAY**: high plasticity, dark brown and dark red, Fine to medium grained sand, sub rounded to sub angular gravels.			Residual soil
												PID: 0.5 ppm
		11/08/21 08:35			72	2.0						
SS									**Sandy CLAY**: low plasticity, Grey, Fine to medium grained sand.			Weathered shale
					71	3.0						PID: 0.5 ppm
										M		
					70	4.0			Becoming dark brown			
									Gravel increasing in size			
					69	5.0			Monitoring Well BH4 terminated at 5.00 m Target depth			**backfill details:** 0.0-0.2m: Concrete 0.2-0.8m: Bentonite 0.8-4.99m: Sand **standpipe piezo. BH4 details:** 1.2-5.0m: screen
					68							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 5.1/2 coring (100.8mm)
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Monitoring Well

Hole ID.	**BH7**
sheet:	1 of 1
project no.	**754-SYDEN288946**
client:	***Australian Broadcasting Corporation***
date started:	***10 Aug 2021***
principal:	
date completed:	***10 Aug 2021***
project:	***ABC Artarmon DSI***
logged by:	***J.Y***
location:	***2 Lanceley Place & 14 Campbell Street, Artarmon***
checked by:	***M.L***

position: E: 332142; N: 6256587 | surface elevation: 69.97 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	BH7	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
5.1/2 HA SS			E: BH7_0.1-0.2 E: BH7_0.3-0.4		69 68 67 66 65 64	1.0 2.0 3.0 4.0 5.0			**CONCRETE**.	D		No odour, staining or ACM
									FILL: Gravelly SAND: medium - coarse grained, Dark brown, 2-20mm gravels, tree roots.			PID: 1.1 ppm
									FILL: Gravelly Sandy CLAY: high plasticity, Pale grey, 3-50mm gravels, fine to coarse grained sand, ironstone.		H	Residual soil PID: 1.4 ppm
									Gravelly CLAY: high plasticity, Red, pale grey, 3-50mm gravels.			PID: 1.1 ppm
									Colour change to pale grey		St	
									Colour change to pale brown, fragments of weathered shale and sandstone	M	F	
									Gravelly Sandy CLAY: high plasticity, Dark grey, with weathered shale and sandstone gravels.	W	S	Weathered shale
									Gravelly CLAY: high plasticity, Pale grey, Increase in size of weathered shale gravel fragments.			
									Monitoring Well BH7 terminated at 5.00 m Target depth			**backfill details:** 0.0-0.2m: Concrete 0.2-0.8m: Bentonite 0.8-5.0m: Sand **standpipe piezo. BH7 details:** 0.9-5.0m: screen

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF PIEZOMETER ABC ARTARMON GINT.GPJ <<DrawingFile>> 21/09/2021 18:32

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 5.1/2 coring (100.8mm)
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
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Engineering Log - Monitoring Well

		Hole ID.	**BH8**
		sheet:	1 of 1
		project no.	**754-SYDEN288946**
client:	**Australian Broadcasting Corporation**	date started:	**10 Feb 2021**
principal:		date completed:	**10 Aug 2021**
project:	**ABC Artarmon DSI**	logged by:	**J.Y**
location:	**2 Lanceley Place & 14 Campbell Street, Artarmon**	checked by:	**M.L**

position: E: 332153; N: 6256561 | surface elevation: 69.75 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information				well details	material substance							
method & support	penetration 1 2 3	water	samples & field tests	BH8	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
HA 4 5.1/2			E: BH8 0.2-0.3 E: BH8 0.3-0.4 E: BH8 0.5-0.6		69	0.0			**CONCRETE**.			
									FILL: Gravelly SAND: fine - medium grained, Dark brown, 3-80mm gravels, concrete, brick, bitumen ash, glass,.	D		No odour, staining or ACM PID=1.9
									FILL: Gravelly SAND: medium - coarse grained, Dark brown, Fill.			PID: 1.9 ppm
									Gravelly Sandy CLAY: high plasticity, Pale brown/red, 3-80mm gravels, fine to medium sand, sub angular to angular gravels.			PID: 0.4 ppm Residual soil
					68	1.0					St	PID: 0.3 ppm
SS						2.0			**Sandy CLAY**: high plasticity, Red/pale brown, Fine to medium sand.		S	
					67	3.0			**Gravelly Sandy CLAY**: high plasticity, Dark brown, 3-50mm sub angular to angular gravels, fine to medium sand, weathered shale.	M		
					66				**Gravelly CLAY**: high plasticity, Pale brown.	W		
						4.0			Monitoring Well BH8 terminated at 4.20 m Refusal			**backfill details:** 0.0-0.2m: Concrete 0.2-0.8m: Bentonite 0.8-4.2m: Sand **standpipe piezo. BH8 details:** 1.0-4.2m: screen
					65	5.0						
					64							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 5.1/2 coring (100.8mm)
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Monitoring Well

Hole ID.	**BH9**
sheet:	1 of 1
project no.	**754-SYDEN288946**
client:	**Australian Broadcasting Corporation**
date started:	**09 Aug 2021**
principal:	
date completed:	**09 Aug 2021**
project:	**ABC Artarmon DSI**
logged by:	**J.Y**
location:	**2 Lanceley Place & 14 Campbell Street, Artarmon**
checked by:	**M.L**

position: E: 332181; N: 6256528 | surface elevation: 71.47 m AHD | angle from horizontal: 90°

equipment type: Geoprobe, Track mounted | drilling fluid: | hole diameter :

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	BH9	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
HA			E: BH9_0.1-0.2		71				**FILL: Gravelly SAND**: fine - medium grained, sub-angular to angular, pale brown.	D		No staining, odour, ACM PID: 0.5 ppm
			E: BH9_0.4-0.5									PID: 0.6 ppm Brick and concrete fragments
			E: BH9_0.9-1.0			1.0			**FILL: Gravelly SAND**: fine - medium grained, sub-angular, pale brown.			Brick fragments
SS		11/08/21 08:15			70				**SHALE**: fine - medium grained, pale grey.			PID: 1 ppm Weathered shale
						2.0						PID: 1.2 ppm
					69							
					68	3.0						PID: 1.1 ppm
						4.0			Monitoring Well BH9 terminated at 4.00 m Refusal			**backfill details:** 0.0-0.8m: Concrete 0.8-1.3m: Bentonite 1.3-4.0m: Sand **standpipe piezo. BH9 details:** 1.5-4.0m: screen
					67							
						5.0						
					66							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger
- SS solid stem flight auger
- 4 x 5.1/2 coring (100.8mm)

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration 1 2 3 — no resistance ranging to refusal

water — 10-Oct-12 water level on date shown; water inflow; water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Appendix B
Results of Rising Head Tests

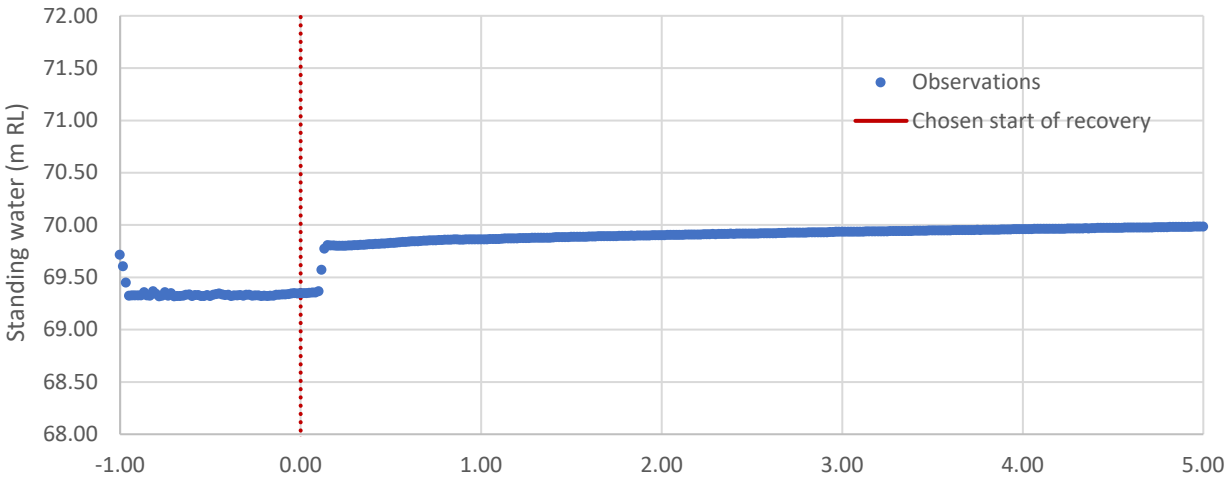
Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

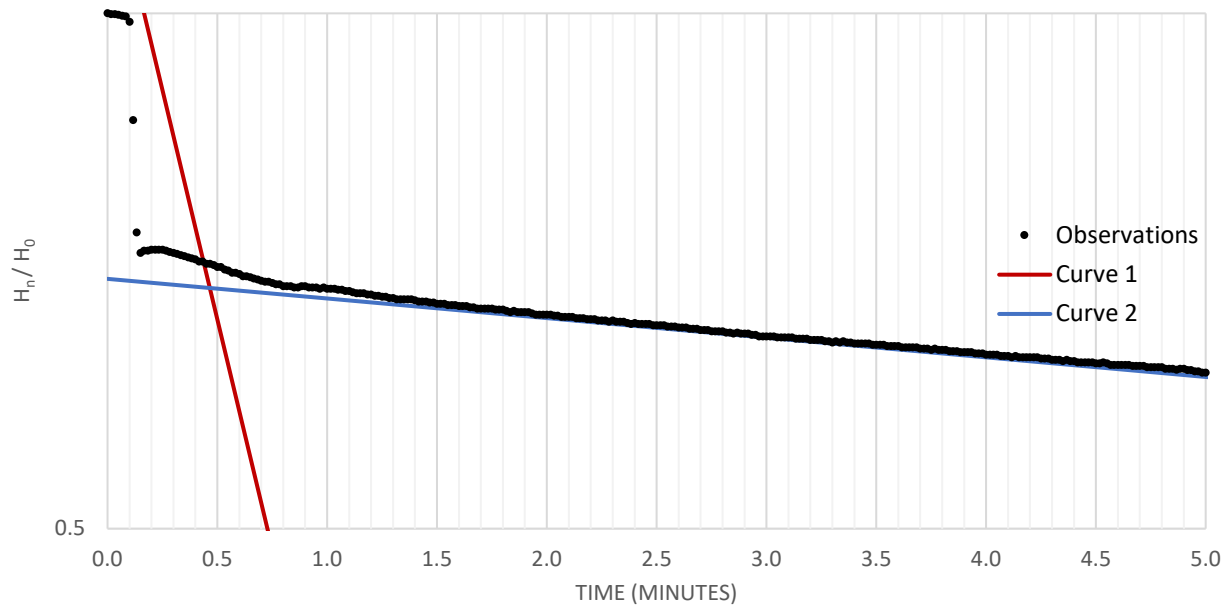
JOB no.: **PSM4669**

PROJECT: **ABC Artarmon**

Slug Test

HOLE NUMBER:		DEPTH OF HOLE (m):	**2.30**
BORE EASTING:	**332127.0**	SCREEN LENGTH 'L' (m):	**1.5**
BORE NORTHING:	**6256466.0**	INTERNAL DIAMETER 'D_I' (m):	**0.04**
COLLAR RL(m):	**71.56**	EXTERNAL DIAMETER 'Do' (m):	**0.05**
DATUM:	**m AHD**	SCREEN SHAPE FACTOR 'F'	**2.30**
CONTRACTOR		WATER DIP (m below collar)	**0.55**
WELL TESTED BY:	**KTL / JBL**	STANDING WATER (m AHD)	**71.01**
SCREENED LITHOLOGY:	**SHALE**	DATE	**26-Jul-23**





	Time lag 'T'	Hydraulic conductivity 'k'	
	mins	m/s	m/day
Curve 1	0.2	3.6E-05	3.07E+00
Curve 2	37.9	2.2E-07	1.87E-02

From Hvorslev (1951) $k = \frac{A}{FT}$

where $A = \pi D_I^2/4$

$$F = \frac{2\pi L}{\ln\left(\frac{L}{D_o} + \sqrt{1 + \left(\frac{L}{D_o}\right)^2}\right)}$$

$$T = \frac{t_2 - t_1}{\ln(H_1/H_0) - \ln(H_2/H_0)}$$

H_n = drawdown at time t_n

COMMENTS:

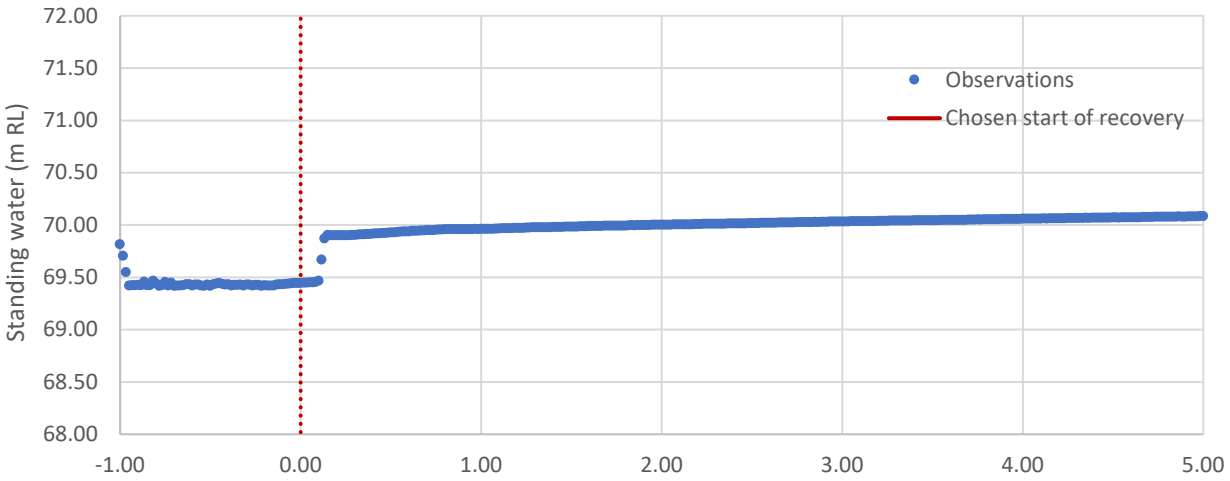
Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

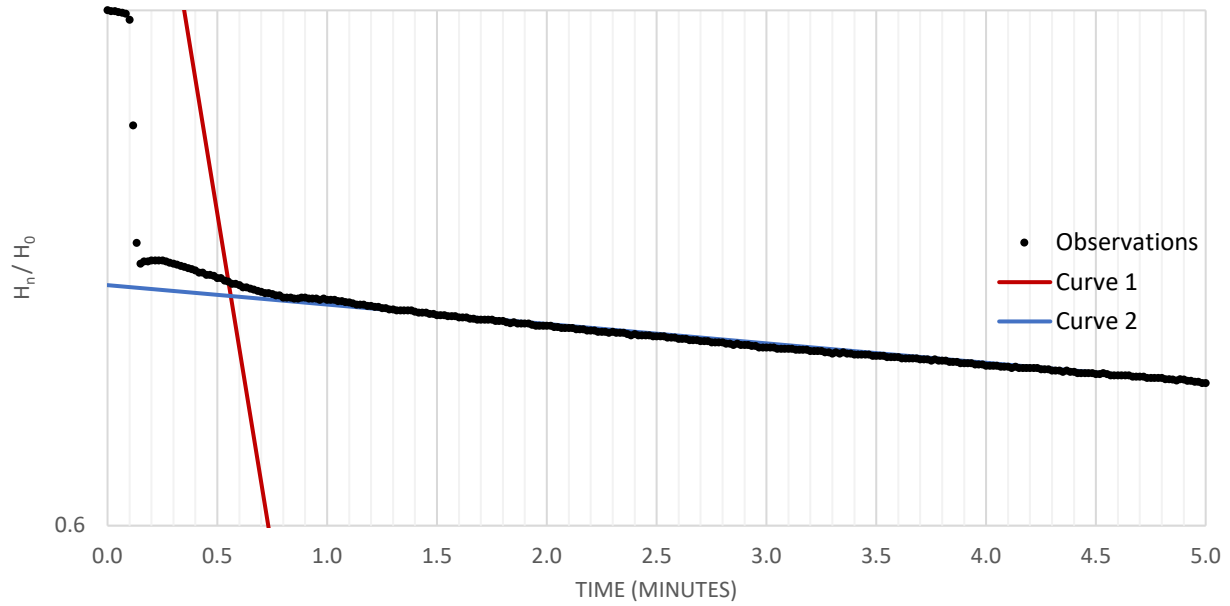
JOB no.: **PSM4669**

PROJECT: **ABC Artarmon**

Slug Test

HOLE NUMBER:		DEPTH OF HOLE (m):	**5.00**
BORE EASTING:	**332094.0**	SCREEN LENGTH 'L' (m):	**3.8**
BORE NORTHING:	**6256562.0**	INTERNAL DIAMETER 'D_I' (m):	**0.04**
COLLAR RL(m):	**73.86**	EXTERNAL DIAMETER 'Do' (m):	**0.05**
DATUM:	**m AHD**	SCREEN SHAPE FACTOR 'F'	**4.75**
CONTRACTOR		WATER DIP (m below collar)	**2.35**
WELL TESTED BY:	**KTL / JBL**	STANDING WATER (m AHD)	**71.51**
SCREENED LITHOLOGY:	**NATURAL**	DATE	**26-Jul-23**





	Time lag 'T'	Hydraulic conductivity 'k'	
	mins	m/s	m/day
Curve 1	0.2	1.9E-05	1.64E+00
Curve 2	52.0	7.7E-08	6.61E-03

From Hvorslev (1951) $k = \frac{A}{FT}$

where $A = \pi D_I^2/4$

$$F = \frac{2\pi L}{\ln\left(\frac{L}{D_o} + \sqrt{1 + \left(\frac{L}{D_o}\right)^2}\right)}$$

$$T = \frac{t_2 - t_1}{\ln(H_1/H_0) - \ln(H_2/H_0)}$$

H_n = drawdown at time t_n

COMMENTS:

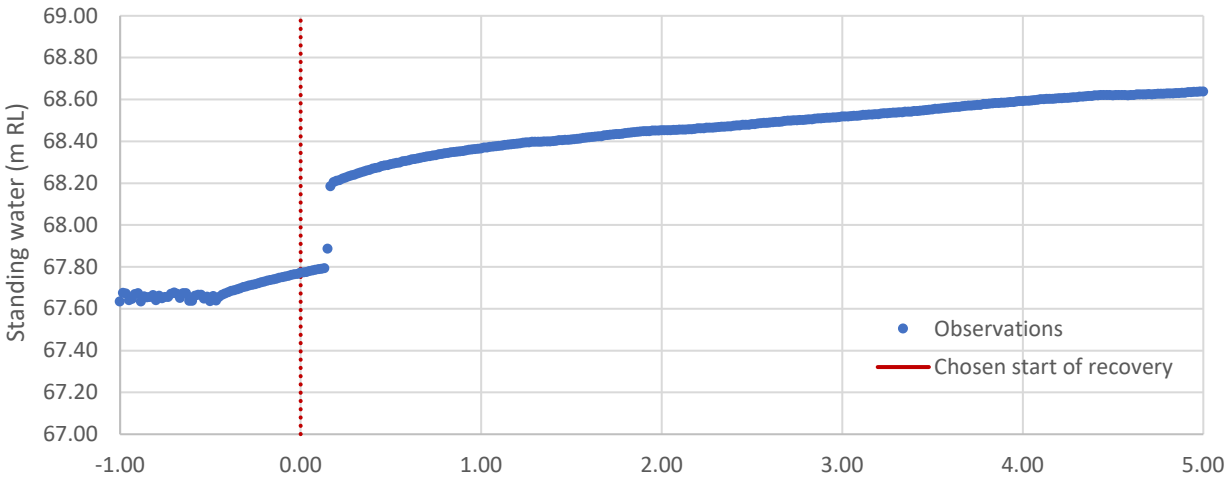
Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

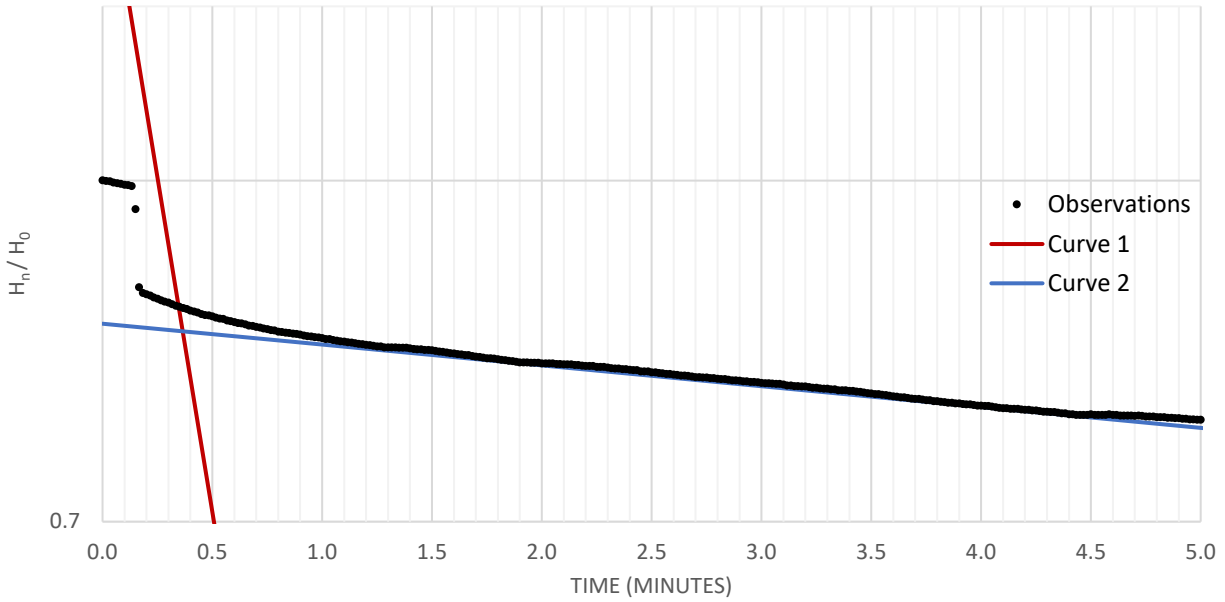
JOB no.: **PSM4669**

PROJECT: **ABC Artarmon**

Slug Test

HOLE NUMBER:		DEPTH OF HOLE (m):	**4.45**
BORE EASTING:	**332152.0**	SCREEN LENGTH 'L' (m):	**3.0**
BORE NORTHING:	**6256491.0**	INTERNAL DIAMETER 'D_I' (m):	**0.04**
COLLAR RL(m):	**71.70**	EXTERNAL DIAMETER 'Do' (m):	**0.05**
DATUM:	**m AHD**	SCREEN SHAPE FACTOR 'F'	**3.94**
CONTRACTOR		WATER DIP (m below collar)	**0.02**
WELL TESTED BY:	**KTL / JBL**	STANDING WATER (m AHD)	**71.68**
SCREENED LITHOLOGY:	**NATURAL**	DATE	**26-Jul-23**





	Time lag 'T'	Hydraulic conductivity 'k'	
	mins	m/s	m/day
Curve 1	0.4	1.3E-05	1.08E+00
Curve 2	45.9	1.0E-07	9.04E-03

From Hvorslev (1951) $k = \frac{A}{FT}$

where $A = \pi D_I^2 / 4$

$$F = \frac{2\pi L}{\ln\left(\frac{L}{D_o} + \sqrt{1 + \left(\frac{L}{D_o}\right)^2}\right)}$$

$$T = \frac{t_2 - t_1}{\ln(H_1/H_0) - \ln(H_2/H_0)}$$

H_n = drawdown at time t_n

COMMENTS:

Appendix C
DPE Letter

Department of Planning and Environment

Our ref: OUT23/7611

Dave Auster

Planning and Assessment Group
NSW Department of Planning and Environment

Email: dave.auster@dpie.nsw.gov.au

23 May 2023

Subject: **Lanceley Place Multi-Level Warehouse (SSD-48478458) – Environmental Impact Statement (EIS)**

Dear Dave Auster,

I refer to your request for advice sent on 18 April 2023 to the Department of Planning and Environment (DPE) Water about the above matter.

Goodman Property Services Pty Ltd is seeking application approval for the Lanceley Place Multi-Level Warehouse project, to demolish existing buildings and construct a three-storey warehouse and distribution facility with a new underground basement car-parking level.

DPE Water has reviewed the Environmental Impact Statement (EIS) and has recommendations regarding water take, entitlement and groundwater impacts. Please see Attachment A for more detail.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments water.assessments@dpie.nsw.gov.au.

Yours sincerely

Tim Baker
Senior Project Officer
Department of Planning and Environment: Water

Attachment A

Detailed advice to DPE Planning & Assessment regarding the Lanceley Place Multi-Level Warehouse Project (SSD-48478458) EIS

1.0 Water Take and Entitlement

1.1 Recommendation – Prior to Determination

That the proponent:

- quantify the maximum annual volume of water take from each water source due to aquifer interference activities required for the project.
- demonstrate sufficient entitlement can be acquired in the relevant water source unless an exemption applies.

1.2 Recommendation – Post approval

The proponent must ensure sufficient water entitlement is held in a water access licence/s to account for the maximum predicted take for each water source prior to take occurring.

Explanation

The project notes that groundwater will be intercepted during basement construction. Quantification of the maximum groundwater inflows both during construction and operation is requested. These inflows must have sufficient entitlement held to cover this take unless an exemption applies.

The proposal acknowledges that groundwater will likely be accessed, and its level lowered, by bulk excavation (Appendix 16 Section 2.2). Conversely, the proponent's response (Appendix 4 Table 3) to DPE Water's advice on 8 December 2022 states that the proposal does not require any underground works.

A comparison of the bulk excavation level of 66.82+/-0.5 mAHD (Appendix 21 Section 3.2) and reported groundwater level measurements, ranging 68.3 to 72.0 mAHD (Appendix 15 Table 1) from seven site boreholes, indicates that groundwater will be intercepted across much of the site.

The prediction of water take and licensing requirements and the assessment of aquifer interference will require the clarification of some site details:

- inconsistent current site elevations have been reported – ranging from 70.7 to 73.2 mAHD (Appendix 21 Section 2.2) or, as inferred from groundwater-level measurements given in both mbgl and mAHD (Appendix 18A Table 5.2), 67.1 to 73.7 mAHD.
- inconsistent groundwater levels measured on 18 August 2021 have been reported for each monitoring bore – the difference per bore ranging from 0.2 to 4.6 mAHD (cf. Appendix 15 Table 1 and Appendix 18A Table 5.2)
- inconsistent site groundwater-level trends are evident – rising at borehole BH1 and falling at BH12 by comparable amounts from 18 August 2021 to 1 December 2022
- groundwater levels have not been presented with respect to the proposed bulk excavation level
- the duration and details (e.g. shoring, drained/tanked basement, etc) of the excavation and construction works are unclear.

3.0 Groundwater Impacts

3.1 Recommendation – Pre-determination

That the proponent assesses the proposal against the requirements and applicable considerations of the NSW Aquifer Interference Policy 2012.

Explanation

Based on the available groundwater monitoring results and proposed bulk excavation level (described above), the proposed excavation work would involve aquifer penetration and groundwater interference and thus requires an assessment against the NSW Aquifer Interference Policy (2012).

The potential for aquifer interference was raised by DPE Water on 8 December 2022 as acknowledged by the proponent (EIS Section 5.1 and Appendix 4 Table 3).

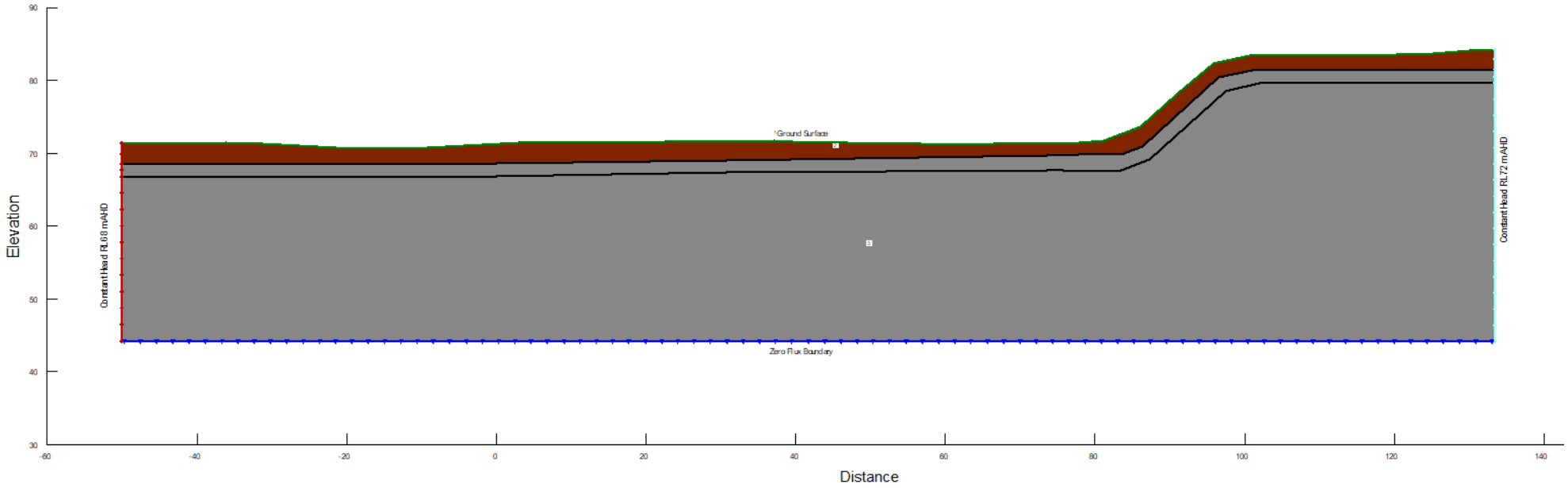
Any construction activities and subsequent site operations that may result in aquifer interference must be assessed against the NSW Aquifer Interference Policy.

End Attachment A

Appendix D
Seepage Analysis

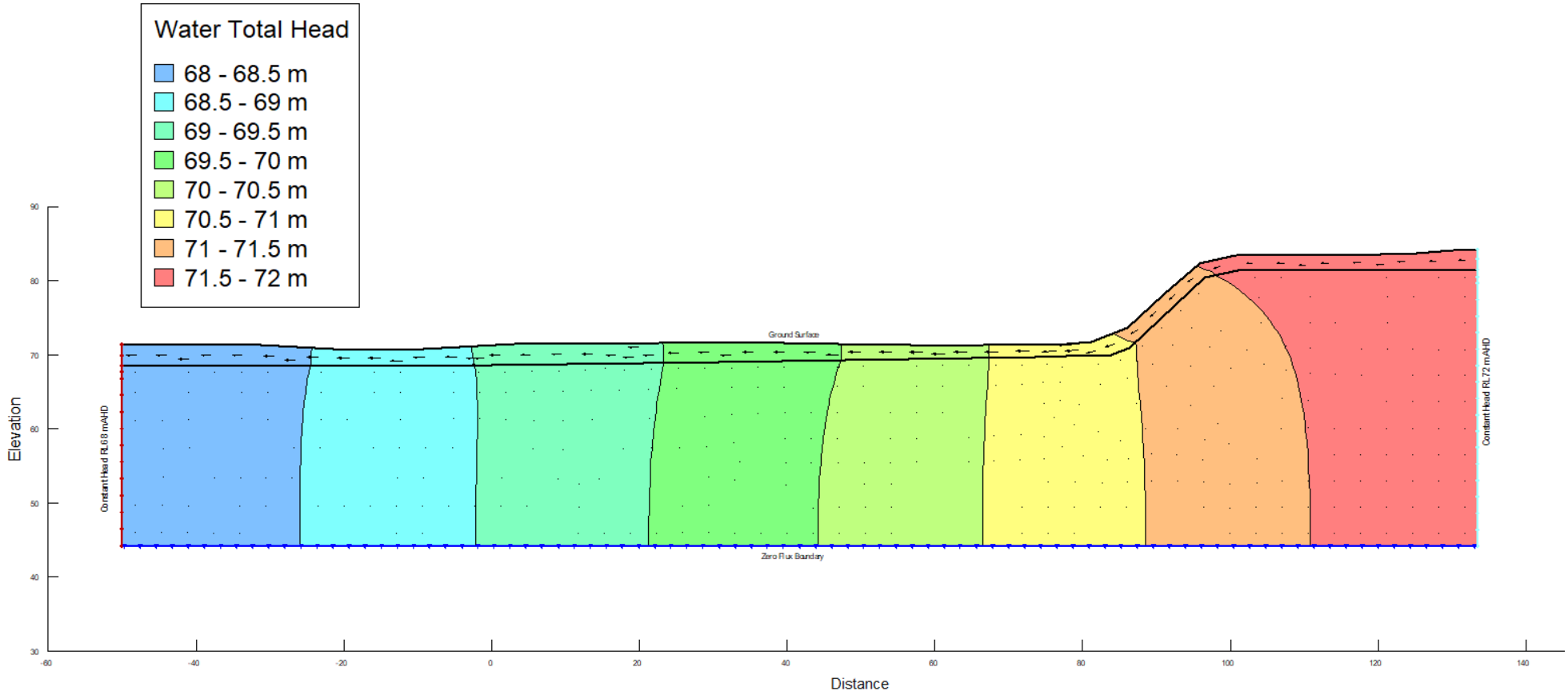
Color	Name	Hydraulic Material Model	Sat Kx (m/sec)	Ky'/Kx' Ratio
	BEDROCK	Saturated Only	1e-08	0.2
	FILL/NATURAL	Saturated Only	1e-07	0.2

Color	Name	Kind	Parameters
	Constant Head RL 68 m	Water Total Head	68 m
	Constant Head RL 72 m	Water Total Head	72 m
	Zero Flux	Water Flux	0 m/sec



Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 1 - CALIBRATION MODEL
MODEL GEOMETRY

PSM4669-013L | APPENDIX D



Goodman Property

ABC Artarmon Site

Groundwater Assessment

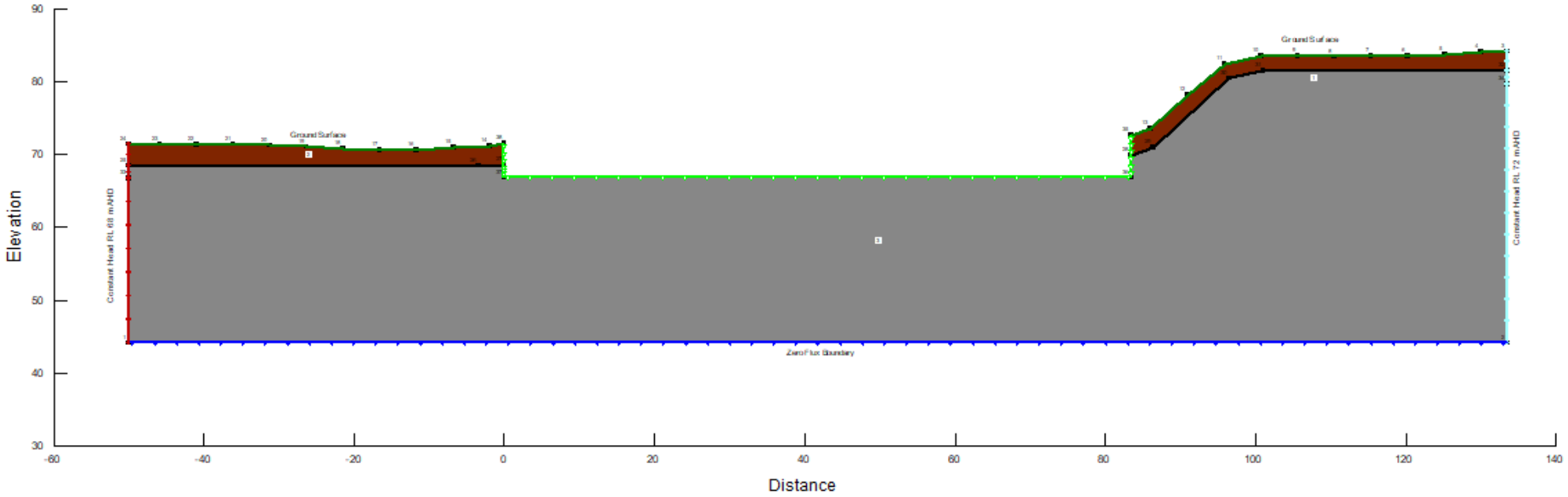
RUN 1 - CALIBRATION MODEL

WATER TOTAL HEAD RESULTS

PSM4669-013L	APPENDIX D

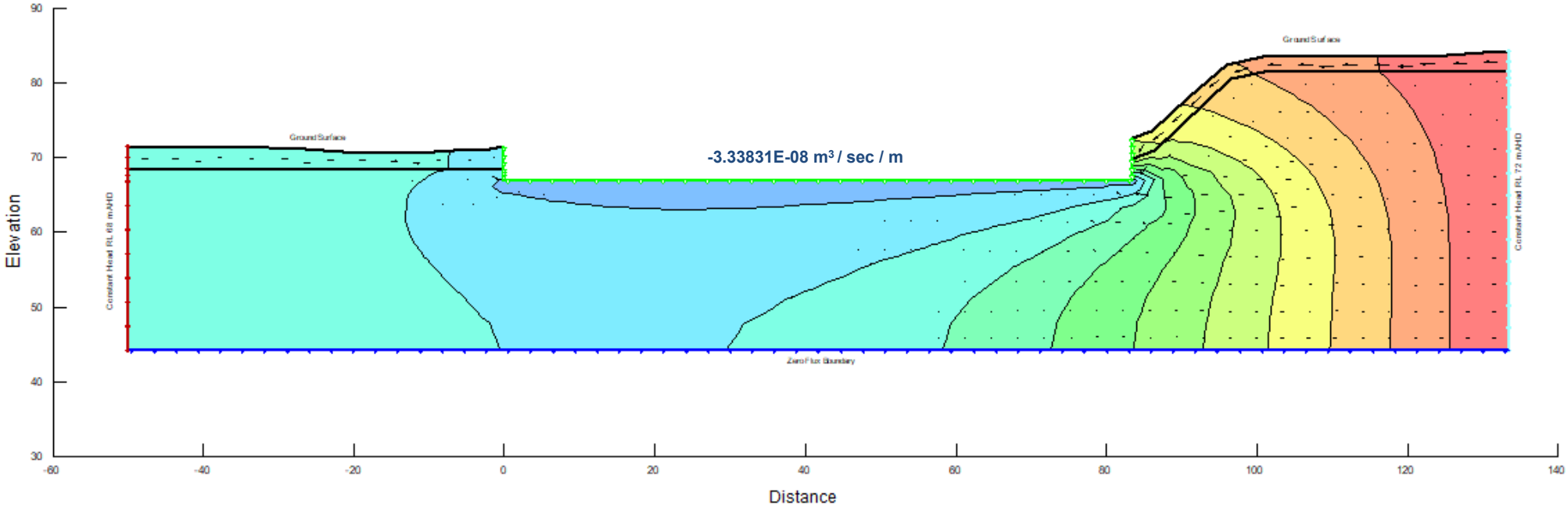
Color	Name	Hydraulic Material Model	Sat Kx (m/sec)	Ky'/Kx' Ratio
	BEDROCK	Saturated Only	1e-08	0.2
	FILL/NATURAL	Saturated Only	1e-07	0.2

Color	Name	Kind	Parameters
	Constant Head RL 68 m	Water Total Head	68 m
	Constant Head RL 72 m	Water Total Head	72 m
	Potential Seepage Surface	Water Flux	0 m/sec
	Zero Flux	Water Flux	0 m/sec



Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 2 - BEST ESTIMATE
MODEL GEOMETRY

PSM4669-013L | APPENDIX D

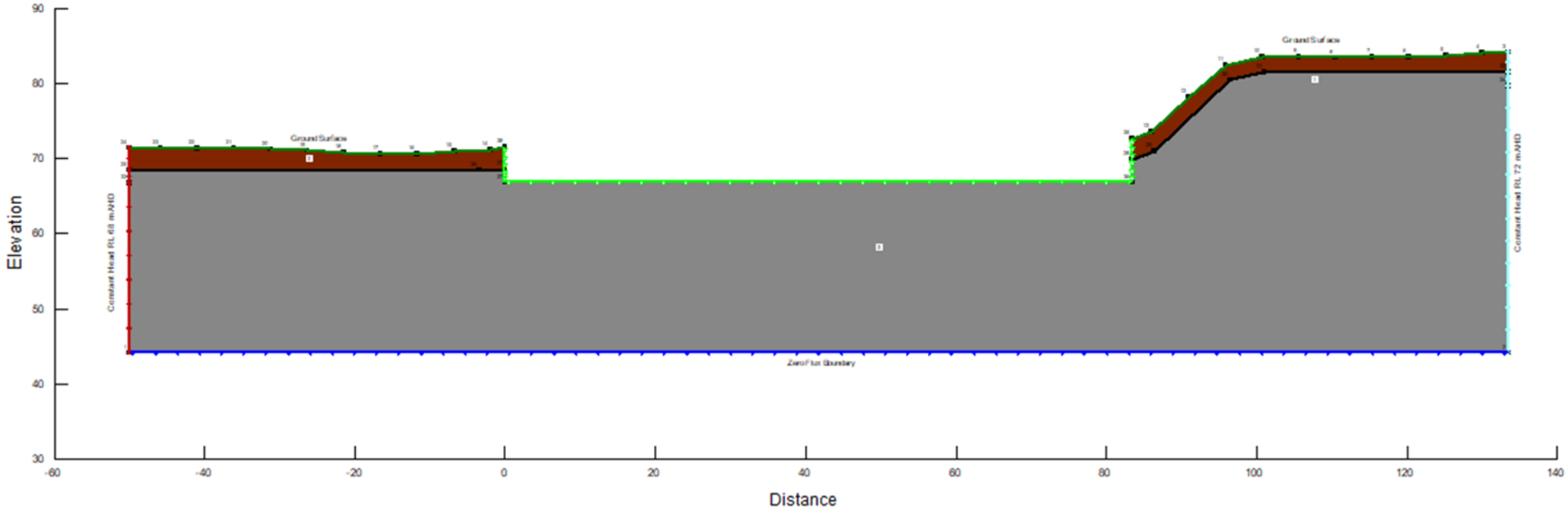


Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 2 - BEST ESTIMATE
ANALYSIS RESULTS

PSM4669-013L	APPENDIX D

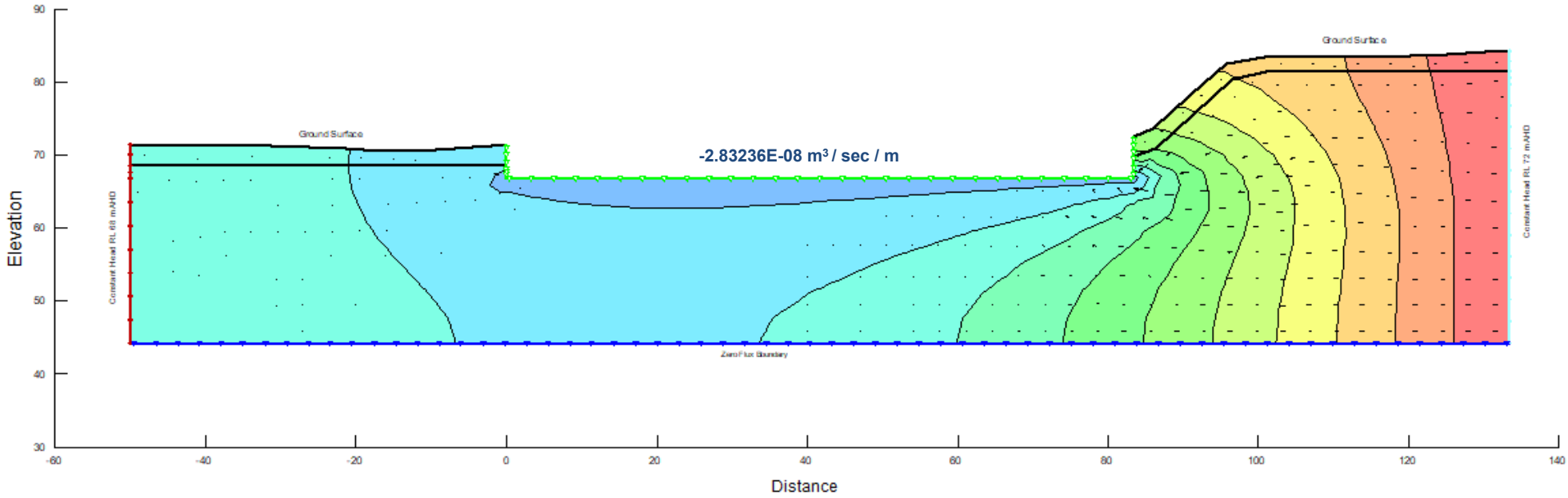
Color	Name	Hydraulic Material Model	Sat Kx (m/sec)	Ky'/Kx' Ratio
	BEDROCK	Saturated Only	1e-08	0.2
	FILL/NATURAL	Saturated Only	1e-08	0.2

Color	Name	Kind
	Constant Head RL 68 m	Water Total Head
	Constant Head RL 72 m	Water Total Head
	Potential Seepage Surface	Water Flux
	Zero Flux	Water Flux



Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 3 - LOWER BOUND
MODEL GEOMETRY

PSM4669-013L | APPENDIX D

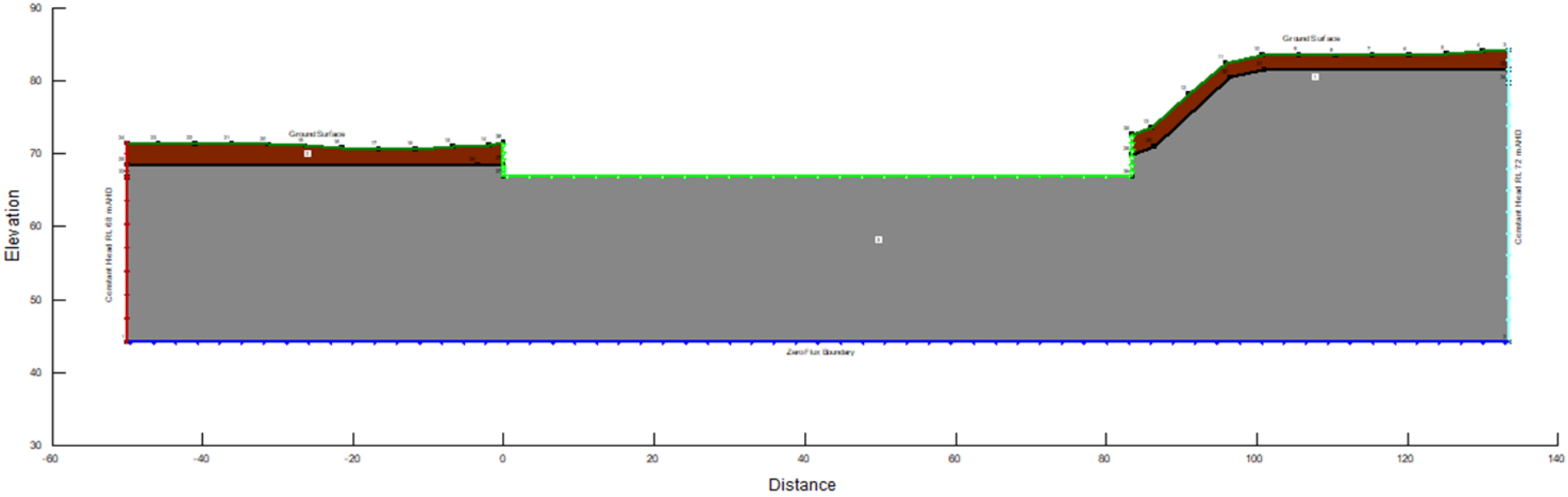


Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 3 - LOWER BOUND
ANALYSIS RESULTS

PSM4669-013L	APPENDIX D

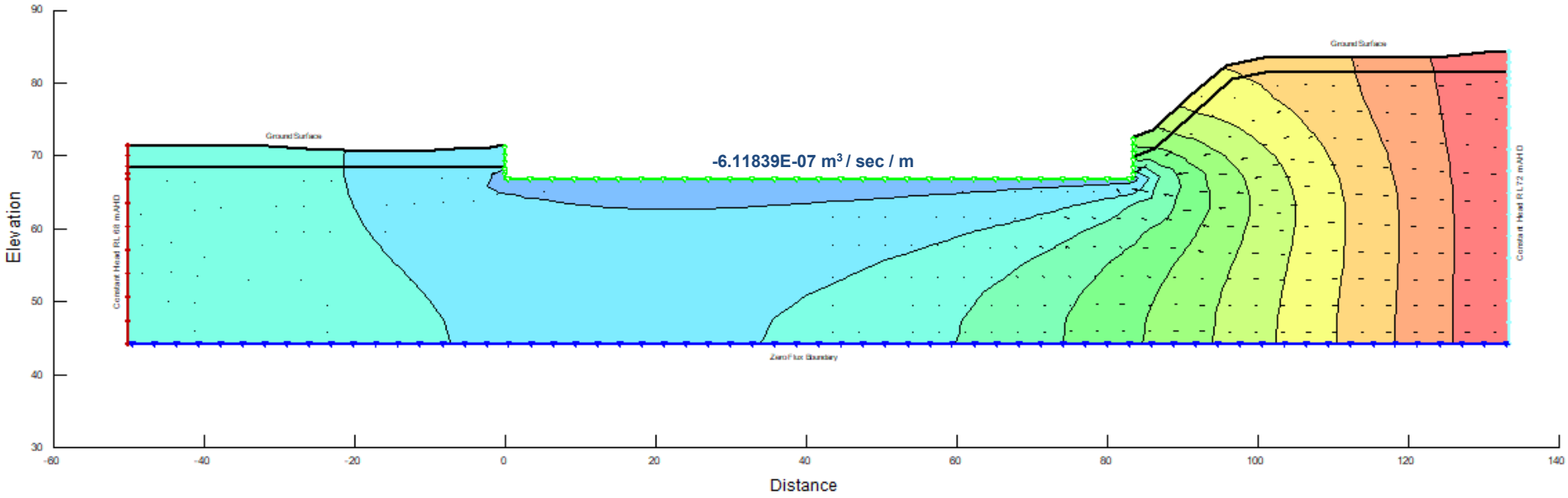
Color	Name	Hydraulic Material Model	Sat Kx (m/sec)	Ky'/Kx' Ratio
	BEDROCK	Saturated Only	2.2e-07	0.2
	FILL/NATURAL	Saturated Only	1e-07	0.2

Color	Name	Kind
	Constant Head RL 68 m	Water Total Head
	Constant Head RL 72 m	Water Total Head
	Potential Seepage Surface	Water Flux
	Zero Flux	Water Flux



Goodman Property
ABC Artarmon Site
Groundwater Assessment
RUN 4 - UPPER BOUND
MODEL GEOMETRY

PSM4669-013L | APPENDIX D



Goodman Property

ABC Artarmon Site

Groundwater Assessment

RUN 4 - UPPER BOUND

ANALYSIS RESULTS

PSM4669-013L	APPENDIX D