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Integrated Practical Solutions

Report on
Desktop Geotechnical Assessment

Proposed Health Services Facility
31 - 33 Smith Street, Charlestown

Prepared for
GPV Property Group

Project 210780.00
November 2022

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	210780.00	Document No.	R.002.Rev1
Document title	Report on Desktop Geotechnical Assessment Proposed Health Services Facility		
Site address	31 - 33 Smith Street, Charlestown		
Report prepared for	GPV Property Group		
File name	210780.00.R.002.Rev1.docx		

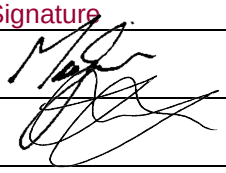
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Michael Gawn	Scott McFarlane	25 January 2022
Revision 1	Michael Gawn	Scott McFarlane	18 November 2022

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Ian Gill, GPV Property Group
Revision 1	1	0	Ian Gill, GPV Property Group

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		18 November 2022
Reviewer		18 November 2022

bsi. ISO 9001 Quality Management
FS 604853

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1. Introduction

This report presents the results of a desktop geotechnical assessment undertaken for a proposed health services facility at 31 - 33 Smith Street, Charlestown. The investigation was commissioned by Ian Gill of GPV Property Group and was undertaken in accordance with Douglas Partners' proposal 210780.00.P.001 dated 11 November 2021.

It is understood that the proposed development will include construction of a new four-storey health care facility with rooftop plant fronting the Pacific Highway and a multi-deck car park structure facing Smith Street.

DP has undertaken previous investigation at the site, including a number of subsurface investigation episodes as well as desktop assessments. Further details are provided in Section 2.

The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site in order to provide additional information on the following:

- Slope stability;
- Site Classification, including site reactivity;
- Design parameters for spread footings and piles;
- Safe batter slopes (short term and long term);
- Retaining wall design parameters;
- Requirements for temporary working platforms;
- Pavement thickness design for internal pavements; and
- Identification of the presence of acid sulfate soils.

2. Previous DP Projects

Douglas Partners Pty Ltd (DP) have undertaken a number of investigations at the site, including the following:

- Report on Preliminary Geotechnical and Contamination Investigation, Proposed Multi-Storey Development, 31 to 33 Smith Street, Charlestown, Project 81563 dated December 2014;
- Report on Detailed Site Investigation (Contamination), Proposed Multi-Storey Development, 31 to 33 Smith Street, Charlestown, Project 81563.01, dated November 2014;

- Report on Additional Investigation for Contamination, Proposed Multi-Storey Development, 31 to 33 Smith Street, Charlestown, Project 81563.02, dated September 2016;
- Remediation Action Plan, Proposed Multi-Storey Development, 31 to 33 Smith Street, Charlestown, Project 81563.02, dated September 2016;
- Report on Validation of Remediation, Proposed Multi-Storey Development, 31 to 33 Smith Street, Charlestown, Project 81563.03, dated February 2018;
- Report on Mine Subsidence Desktop Assessment, Proposed Multi-Storey Development, 31-33 Smith Street, Charlestown, Project 210780.00, dated December 2021;
- Report on Desktop Geotechnical Assessment, Proposed Health Services Facility, 31-33 Smith Street, Charlestown, Project 210780.00, dated January 2022; and
- Report on Geotechnical Investigation, Proposed Medical Facility, 31-33 Smith Street, Charlestown, Project 210780.01, dated June 2022.

The approximate location of the previous DP bores are shown in Figure 1 below and also on Drawing 1 in Appendix C.

Figure 1: Location of previous bores undertaken by DP on site

The results of the previous investigation included fill to depths of up to 0.95 m, underlain by clayey sand or clay to depths ranging from 0.95 m to 3.5 m. The underlying bedrock was initially extremely low to low strength, becoming medium to high strength from about 4.25 m to 9.5 m depth, and continued to termination of the bores at depths ranging from 10.15 m to 11.64 m.

The geotechnical information was undertaken with reference to AS 1726:1993 which predates the current revised standard (AS 1726, 2017) which was published in May 2017. Interpretations presented in this report are based on descriptions in AS 1726:1993 most notably the description of extremely low strength rock which is classified as having a Point Load strength $I_s(50)$ ≤0.03 MPa, ie a material with rock structure but with soil-like properties.

3. Site Description and Site Inspection

The site is located on the north-eastern corner of the intersection of Pacific Highway and Frederick Street, Charlestown with a frontage to Smith Street (refer Figure 2). The site is a rectangular parcel of land of approximately 8,000 m^2.

Figure 2: Aerial image showing the site (sourced from MetroMap dated 23 April 2021)

The address of the site is 31 to 33 Smith Street, Charlestown and comprises Lots 1 and 2 in DP877977.

At the time of the previous investigation (DP, 2014), development on the site included a car park in the northern half and a fenced off predominantly grassed area in the southern half. The building shown in the aerial image in Figure 1 is understood to have been demolished about a month before the commencement of field work for the investigation.

Several trees, as shown in Figure 1, were present on the site at the time of the previous investigation (DP, 2014).

The ground surface at the site falls uniformly to the south-west at slopes of less than 5°, with elevations ranging from 112 m AHD in the north-eastern corner to 108 m AHD in the south-western corner.

A site inspection was undertaken on 18 January 2022 to confirm that no significant changes have occurred within the site since the previous investigation undertaken by DP in 2014. A further inspection was undertaken by a senior geotechnical engineer on 16 November 2022.

Figure 3 to Figure 8 show the condition of the site at the time of inspections (January 2022 and November 2022).

Figure 3: View looking north-west from southern boundary (January 2022)

Figure 4: View looking south-west from near centre of site (January 2022)

Figure 5: Exposed weathered rock along northern boundary (January 2022)

Figure 6: View looking south-west from north-east corner (January 2022)

Figure 7: View of site looking south-west (left) and existing wall along western boundary (right) [November 2022]

Figure 8: View looking north-west to building beyond western boundary (November 2022)

4. Geology, Acid Sulfate Soils and Hydrogeology

Reference to the 1:250,000 state-wide geodatabase provided by the Geological Survey of NSW indicates the site is underlain by the Adamstown Subgroup of the Late Permian Aged Newcastle Coal Measures which generally comprise conglomerate, sandstone, siltstone, coal and tuffaceous claystone.

Reference to the state-wide digital Acid Sulfate Soil Risk Mapping indicates that the site lays in an area of no known occurrence of acid sulfate soil conditions.

A review of the Department of Water on-line information did not reveal any registered groundwater bores within 3 km of the site. The regional groundwater flow direction is believed to be either in a south-east or south-west direction. The nearest mapped watercourse lies approximately 500 m to the south-east (Flaggy Creek), which eventually discharges into the ocean approximately 4 km to the east of the site. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

5. Proposed Development

It is understood that the proposed development will include construction of a new four-storey health care facility with rooftop plant fronting the Pacific Highway and a multi-deck car park structure facing Smith Street (refer Figure 9 and Figure 10). The development will require excavation to 105.6 m AHD (about 3 m depth along Smith Street).

Figure 9: Layout of proposed development

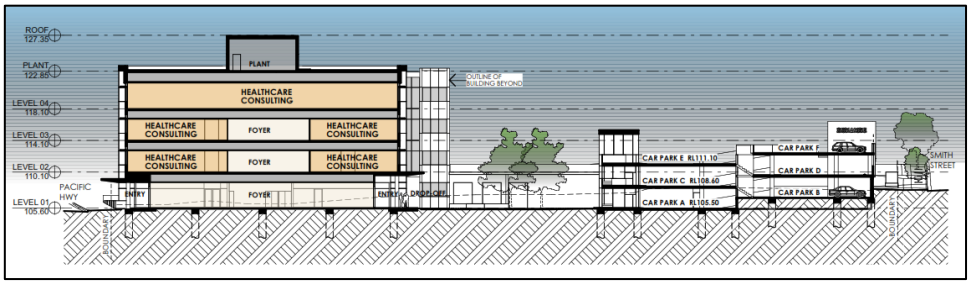

Figure 10: Section through proposed development

6. Field Work

6.1 DP (2014)

Field work for (DP, 2014) included the drilling of three deep boreholes (Bores 1 to 3) to depths ranging from 10.15 m to 11.64 m together with five shallow bores (Bores 4 to 8) to depths ranging from 0.7 m to 4.45 m.

The test locations were set out by a geotechnical engineer relative to existing site features and were recorded using a hand held GPS unit which has an accuracy of about ±10 m. Surface levels at each bore were provided by LMCC and are shown on each borehole log.

All the bores (except Bore 8) were drilled using a truck mounted drilling rig using solid flight auger techniques within the soil profile, followed by NLMC diamond coring techniques in the bedrock. Standard penetration tests (SPTs) were performed at selected depths. A geotechnical engineer from DP logged the subsurface conditions encountered in the bores and collected samples for subsequent laboratory testing and identification purposes.
The approximate test locations are shown on Drawing 1 in Appendix C.

6.2 DP (2014a)

Field work for (DP, 2014a) included the drilling of an additional 12 boreholes (Bores 101 to 112) to depths of 1.1 m to 1.5 m using a truck-mounted drilling rig.

Logging of bores by an environmental engineer and collection of soil samples at regular depths or changes in strata;

Collection of soil samples from the bores with reference to standard contamination protocols (i.e. directly from the auger and standard penetration test (SPT) sampler).

6.3 DP (2022)

This investigation was aimed at providing additional information for mine subsidence assessment, and included the drilling of a single bore (Bore 1001) to a depth of 158 m. The subsurface conditions included:

- Predominantly clayey soil (probably including weathered bedrock) to 4.5 m depth;
- Conglomerate and sandstone bedrock to 54.5 m depth;
- Coal to 57.5 m depth;
- Predominantly laminite and siltstone to 71.8 m depth;
- Coal to 73 m depth;
- Conglomerate, sandstone and carbonaceous siltstone to 120 m depth;
- Coal with tuffaceous siltstone seam to 130.5 m depth;
- Tuffaceous claystone, siltstone and laminite to 153.9 m depth;
- Coal, mine void and rubble to 156.9 m depth;
- Unknown bedrock (floor) to termination of bore at 158 m depth.

6.4 Summary

Table 1, below provides a summary of the subsurface investigation undertaken on the site.

Table 1: Summary of Subsurface Investigations

Bore	Easting	Northing	Surface Level (m AHD)	Termination Depth (m)
1	378183	6351826	110.3	10.15
2	378148	6351784	107.3	11.64
3	378114	6351829	107.3	10.3
4	378180	6351783	108.2	4.45
5	378157	6351806	108.3	2.9
6	378124	6351787	106.0	2.5
7	378141	6351841	108.7	2.5
8	378131	6351802	107.1	0.7
101	378120	6351837	107.6	1.45
102	378177	6351833	110.3	1.45
103	378163	6351820	109.1	1.1
104	378120	6351816	107.3	1.45
105	378136	6351816	107.8	1.45
106	378175	6351810	1098.0	1.16
107	378193	6351807	109.5	1.45
108	378116	6351798	106.2	1.5
109	378168	6351793	108.4	1.5
110	378190	6351787	108.3	1.5
111	378134	6351790	107.0	1.2
112	378176	6351776	107.8	1.5
201	NR	NR	NR	1.2
202	NR	NR	NR	1.2
203	NR	NR	NR	1.2
204	NR	NR	NR	1.0
1001	378148	6351797	107.7	158.0

Notes to Table 1:

NR = Not recorded

6.5 Field Work Results

The subsurface conditions encountered within the bores from previous investigations are presented in detail in the borehole logs in Appendix A. These should be read in conjunction with the accompanying notes in Appendix A which explain the descriptive terms and classification methods used in the logs. The geotechnical units identified during the investigations are summarised in Table 2.

Table 2: Identified Geotechnical Units

Unit No.	Stratum	Description
1	Fill	Generally sandy gravel or gravelly sand (pavement material), or brown to red brown sand or silty sand. Anthropogenic inclusions (including brick and tile fragments, asphalt fragments, slag and concrete) were observed within the filling in Bores 2, 3, 4, 7 and 8.
2	Residual Clay	Stiff through to hard brown mottled light grey sandy clay or clay. SPT values recorded in this material ranged from 10 to 13 blow counts per 300 mm of penetration. This layer graded to extremely weathered bedrock.
3	Extremely Weathered bedrock (dense clayey sand or hard sandy clay)	Grey mottled red and brown/yellow mottled red clayey sand or sandy clay with rock-like structure. High SPT blow counts were recorded in this material (ranging from 24 to 48 blows per 300 mm penetration) which may indicate that it is extremely weathered sandstone bedrock.
4	Bedrock	Initially sandstone becoming conglomerate with depth with the following strength profile: • Generally very low to low strength, occasionally extremely weathered in the upper 2 m (Unit 4.1). Core loss was recorded in the upper sections of the bedrock and may be as a result of weathered seams within the rock mass. The upper sections of bedrock had a fracture spacing ranging from about 0.1 m to 1 m; • Medium to high strength (Unit 4.2). The medium to high strength, and high strength sections of the recovered core has fracture spacing's of up to 3 m.

A summary of the depths of each unit is presented in Table 3 below.

Table 3: Summary of Depth to Base of Each Geotechnical Unit

Location	Surface RL (AHD)	Depth to Base of Each Unit (m)					Depth of Investigation (m)
		Unit 1 (Filling)	Unit 2 (Clayey sand or Clay)	Unit 3 (Extremely weathered bedrock - Clayey Sand or sandy clay)	Unit 4.1 Very Low to Low strength Bedrock	Unit 4.2 Medium to High Strength Bedrock	
1	110.3	0.70	1.10	2.80	>10.15[(b)]	7.0[(a)(b)]	10.15
2	107.3	0.40	1.2	4.36	-	>11.64	11.64
3	107.3	0.70	0.90	3.00	3.60	>10.27[(c)]	10.27
4	108.2	0.95	1.90	3.50	>4.45	-	4.45
5	108.3	0.80	0.95	-	>2.90	-	2.90
6	106.0	0.35	2.20	-	>2.50	-	2.50
7	108.7	0.30	0.70	2.50	>2.50	-	2.50
8	107.1	0.55	-	-	>0.70	-	0.70
101	107.6	0.9	1.1	>1.45	-	-	1.45
102	110.3	0.8	1.1	>1.45	-	-	1.45
103	109.0	0.75	1.0	>1.1	-	-	1.1
104	107.3	0.8	1.1	>1.45	-	-	1.45
105	107.8	0.7	0.95	>1.45	-	-	1.45
106	109.0	0.8	0.95	>1.16	-	-	1.16
107	109.5	0.6	1.1	>1.45	-	-	1.45
108	106.2	0.3	1.0	>1.5	-	-	1.5
109	108.4	0.9	1.3	>1.5	-	-	1.5
110	108.3	0.4	1.2	>1.5	-	-	1.5
111	107.0	0.3	0.8	>1.2	-	-	1.2
112	107.8	1.1	>1.5	-	-	-	1.5
1001	107.7	1.0	4.5		Strength not assessed		158.0

Notes to Table 3:

(a) "extremely low" strength same from 4 m to 4.25 m depth

(b) Low to medium strength from 7.0 m depth

(c) Low strength from 8.4 m to 9.5 m depth

A summary of the elevation of the top of each geotechnical unit is provided in Table 4.

Table 4: Elevation of Top of each Geotechnical Unit

Location	Elevation of Top of Each Unit (mAHD)				
	Unit 1 (Filling)	Unit 2 (Clayey sand or Clay)	Unit 3 (Extremely weathered bedrock - Clayey Sand or sandy clay)	Unit 4.1 Very Low to Low strength Bedrock	Unit 4.2 Medium to High Strength Bedrock
1	110.3	109.6	109.2	103.3	**107.5**
2	107.3	106.9	106.1	102.94	102.9
3	107.3	106.6	106.4	104.3	103.7
4	108.2	107.25	106.3	104.7	NE
5	108.3	107.5	107.35	NE	NE
6	106	105.65	103.8	NE	NE
7	108.7	108.4	108	**106.2**	NE
8	107.1	106.55	NE	NE	NE
101	107.6	106.7	106.5	NE	NE
102	110.3	109.5	109.2	NE	NE
103	109	108.25	108	NE	NE
104	107.3	106.5	106.2	NE	NE
105	107.8	107.1	106.85	NE	NE
106	109	108.2	108.05	NE	NE
107	109.5	108.9	108.4	NE	NE
108	106.2	105.9	105.2	NE	NE
109	108.4	107.5	107.1	NE	NE
110	108.3	107.9	107.1	NE	NE
111	107	106.7	106.2	NE	NE
112	107.8	106.7	NE	NE	NE
1001	107.7	106.7		Strength not assessed	

Notes to Table 4:

Blue shaded cells indicates geotechnical unit encountered at anticipated bulk excavation level of 105.6 mAHD.

Bold entries indicate locations where very low strength or stronger rock encountered above proposed bulk excavation level

Drawings 2 to 4, in Appendix E provide sections through the site based on the conditions encountered in the bores. Interpolation between bores should be considered approximate and additional investigations should be undertaken to confirm conditions between bore locations.

No free groundwater was observed during the drilling of the bores, although it should be noted that the introduction of drilling fluids precluded groundwater measurements in some bores. Solid flight auger drilling was generally carried out to at least 2.5 m depth, with no groundwater observed within this depth of investigation. It should be noted that groundwater conditions are dependent on factors such as soil permeability and recent weather conditions and will vary with time.

7. Comments

7.1 Slope Stability Assessment

Based on correspondence provided by the client, it is understood that Lake Macquarie City Council (LMCC) considers that '*based on Council's Geotechnical Slope Stability Guidelines, the development is categorised as a Sensitive Use and therefore requires a Slope Stability Assessment'.* It is further understood that due to the comprehensive nature of DP's geotechnical report that *'Council would accept an abbreviated report from the same consultant stating that site slope stability hazards are below the accepted thresholds for risk to property and risk to life'.*

There were no overt signs of deep seated slope instability at the time of the assessment. No obvious signs of instability were observed within the visible elements of existing structures immediately adjacent to the site.

There is no site-specific data that would allow a quantitative assessment of risk. Based on site geomorphology, however, and the geology and general history of landslip in the Newcastle / Lake Macquarie area, a qualitative assessment can be made as outlined in Appendix C of AGS (2007) and with reference to LMCC (2020).

Based on site observations and topographical / geological information for the site the principal identified slope hazard relates to failure of proposed retaining walls. In this regard, several walls, up to 3 m in height, are required for the proposed development. Provided these walls are engineer designed and the recommendations contained within this report are implemented in the design, the likelihood of this hazard is considered 'rare'. The consequence of such failure would involve damaged to parts of the structure and possible upslope services / structures have been assessed as of 'major' consequence. Hence the risk associated with this hazard has been assessed as "Low", which would normally be considered acceptable by owners and authorities.

7.2 Excavation Conditions

Excavation of approximately 3 m is required along the western boundary of the site for the Level 1 carpark to a level of 105.6 m AHD.

Based on the results of the nearest bores (Bores 1, 4, 107, 110 and 112), excavation is anticipated through the following strata:

- Generally gravelly sand fill and gravelly clay or sandy clay filling to depths ranging from about 0.6 m to 1.1 m;
- Residual sandy clay and clay soils to depths of about 1.5 m to 2 m; underlain by;

- Extremely weathered sandstone (dense clayey sand) to depths ranging from about 2 m to 3.5 m depth; underlain by
- Very low to medium strength sandstone.

Therefore, based on conditions encountered in the bores, it is anticipated that the basement excavation will be predominantly through filling, residual clayey sand or sandy clay soils, extremely weathered bedrock or very low to low strength bedrock (Units 1 to 3 and 4.1). Excavation of the soils and extremely weathered sandstone should be readily achievable by conventional earthmoving equipment, such as hydraulic excavators. Medium strength conglomerate bedrock was encountered in Bore 1 at a depth of 2.8 m (RL 107.7 m AHD) and is likely to be encountered during basement excavation and detailed excavation for footings. Similarly, high strength bedrock was encountered in Bores 1 to 3 at depths ranging from 3.6 m to 4.36 m, and depending on the final depth of excavation, may be encountered during bulk earthworks and footing excavation.

Excavation of low to medium strength bedrock is likely to necessitate the use of heavy excavation equipment, such as a 30 tonne excavator fitted with a narrow buck and “tiger teeth” or possibly the use of a rock hammer. Excavation of medium to high strength bedrock, if encountered, which has a fracture spacing generally of greater than 1 m may require heavy ripping (with D9L or larger) or excavation using a hydraulic hammer. It is considered unlikely that blasting would be allowed during excavation.

Detailed excavation for footings and side trimming of the bulk excavation may require use of a hydraulic hammer fitted to an excavator of at least 25 tonnes gross mass. Rock milling or rock sawing equipment could also be used to penetrate the low strength or stronger rock where there is a need to limit noise and vibration emanating from the excavation work or provide relatively clean excavation perimeters.

Groundwater inflow into the excavation of less than 3 m depth is expected to be only slight (if any), given that groundwater was not encountered whilst augering or sampling the bores during field work. If water is encountered, it could be managed by simple sump and pump methods.

7.3 Excavation Support

Where space permits, it will be most practicable to batter the slopes of the excavation and it is suggested that batter slopes outlined in Table 5 below be used for temporary (construction) and long term batter slopes.

Table 5: Suggested Safe Batter Slopes

Material	Short Term Safe Batter Slope (H:V)	Long Term Safe Batter Slope (H:V)
Filling, residual clay and extremely weathered sandstone (Units 1,2 and 3)	1.5:1	2.5:1
Very low to low strength sandstone (Unit 4.1 and 4.2)	1:1	1.5:1
Medium and high strength sandstone (Unit 4.3)	Vertical*	0.5:1*

Notes to Table 5: * - subject to inspection by Engineering Geologist or Geotechnical Engineer

The batter slopes given above assume that there are no additional pressures due to surcharging from footings or vehicular loads, or sloping surface above the cut face.

The adoption of the batter slopes of medium to high strength (Unit 4.3) rock shown in Table 5 must be accompanied by geological inspection every 2 m of excavation depth to assess any adverse jointing which could give rise to localised instability such as block fallout or wedge failure. The support of these locally unstable blocks and wedges, or very low to low strength bands can then be provided by in-situ stabilisation techniques utilising dowelled mesh, rock bolts and / or sprayed concrete. It is noted that occasional high angle joints (above 40°) were noted in the retrieved core. Particular care and close inspection will be required if such discontinuities are exposed in the excavations to assess support requirements.

Where there is insufficient space for temporary batters as described above or where there are existing structures or services near the crest of the batter, then temporary excavation support will be required. The temporary excavation support could include a soldier pile retaining wall which is installed prior to excavation, and designed for the appropriate earth pressures.

Where retaining walls are constructed at the completion of earthworks, the design of retaining structures should be based on the parameters presented in Table 6. Cantilevered support should be designed on a triangular earth pressure distribution, and where propped support is provided by the final structure design should be based on a trapezoidal earth pressure distribution.

The pressure distribution given above assumes that no surcharging of the walls occurs from nearby footings. If the footings behind retaining walls from further retaining walls, or proposed structures are not taken below the retaining wall zone of influence (which is approximated by a line drawn at 45^{o} above the horizontal from the base of the wall) or to low strength or stronger rock, then additional allowance should be made for the load from the footings. In this case and where movement of the walls cannot be tolerated (such as where it supports internal walls or overlying structure), the wall should be designed for ‘at rest’ conditions to minimise lateral deflections in the wall.

Table 6: Suggested Unfactored Retaining Wall Design Parameters

Parameter	Symbol	Filling, Soil and Extremely Low and Very Low Strength Rock (Units 1 to 3)	Very Low to Low Strength Rock (Unit 4.1)	Medium or High Strength Rock (Unit 4.2)
Unit weight (above water table)	γ_b	20 kN/m^3	20 kN/m^3	20 kN/m^3
Active earth pressure coefficient	K_a	0.4	0.2	0.1
At-rest earth pressure coefficient	K_o	0.6	0.3	0.2
Passive earth pressure coefficient / pressure	K_p or P_P	2.5	200 kPa	2000 kPa

It should be noted that these parameters will produce unfactored, working (or serviceability) loadings and deflections and resultant bending moments and anchor or strut forces (if proposed) should be factored for ultimate design loadings.

Furthermore, the earth pressure design parameters given above are based on the assumption that full drainage will be provided behind the retaining walls. All retaining walls, regardless of height, should be provided with geotextile encapsulated free draining backfill (such as 10 mm single size aggregate) with a slotted drainage pipe at the base of the wall for the relief of hydrostatic pressures. Water collected by the drainage system should be discharged to a formal stormwater drainage system down slope of the proposed development. If drainage is not provided behind retaining walls, then the walls should be designed to withstand hydrostatic pressures over the full height of the respective walls.

7.4 Foundation Strategies

The proposed development generally includes construction of a new four-storey health care facility fronting the Pacific Highway and a multi-deck car park structure facing Smith Street (refer Figure 9 and Figure 10).

The design loads are not known at this stage, however, given the presence of lower level car parks, the column loads are likely to be significant and support of these structures on piled footings or large pad footings founded within bedrock will be required.

Based on the available information, conditions anticipated at bulk excavation level are summarised in Table 7. In summary, the anticipated conditions at bulk excavation level is:

- Medical Facility — extremely weathered rock or hard sandy clay, although possible stiff clay in parts; and
- Multi-Storey Carpark — predominantly bedrock, ranging from extremely weathered to high strength, hard sandy clay in parts.

Table 7: Summary of Anticipated Conditions at Bulk Excavation Level

Building	Bore	Conditions Encountered at Bulk Excavation Level 105.6 mAHD
Medical Facility	2	Hard sandy CLAY (grading to rock)
	3	Extremely weathered rock (dense clayey sand)
	6	Stiff Sandy CLAY / medium dense Clayey SAND
	7	Below depth of investigation (auger refusal at 106.2 m AHD)
	8	Below depth of investigation (auger refusal at 106.3 m AHD in sandstone)
	104	Extremely weathered sandstone (encountered from 106.2 m AHD)
	108	Stiff sandy CLAY
	111	Extremely weathered sandstone (encountered from 106.2 m AHD)
Multi-storey Carpark	1	High strength Conglomerate
	2	Hard sandy CLAY (grading to rock)
	4	Extremely weathered sandstone (dense clayey sand)
	5	Very low strength SANDSTONE (v-bit auger refusal at 105.8 m AHD)

Comments on possible footing types are provided in the following sections, based on the subsurface conditions encountered in the investigation and DP's experience in the area.

7.4.1 High Level Footings

High level footings founded within the natural hard sandy clay or dense clayey sand, or underlying bedrock may be suitable subject to a detailed settlement analysis once footing loads have been provided. Pad or strip footings wholly founded within material of similar stiffness may be proportioned for the allowable bearing pressures provided in Table 8.

Table 8: Suggested Maximum Allowable Bearing Pressures for High Level Footings

Foundation Material	Unit *	Maximum Allowable Bearing Pressure (kPa)
Filling	1	0
Very stiff to hard sandy clay or dense clayey sand	2	100
Extremely weathered bedrock (dense clayey sand and hard sandy clay)	3	150
Very low to low strength sandstone	4.1	1000
Medium and high strength sandstone	4.2	2500

Notes to Table 8:
*Refer to Table 4 for estimated depth of each unit.

The maximum allowable bearing pressures outlined in Table above are conditional on all footing excavations being inspected by a geotechnical engineer prior to casting of concrete to confirm the suitability of the exposed material for the design pressures.

Settlements for pad footings apportioned in accordance with the maximum allowable bearing pressure given above are not expected to exceed a 1% of the footing width but should be confirmed once loads are provided.

7.4.2 Piled Footings

In the event that significant column loads are applied by the buildings, piled footings socketed in rock may be required. The depth to bedrock ranged from 0.55 m to 3.5 m within the bores drilled during the investigation.

As the final layout of the development or the design loads area not known the required depth of piled footings cannot be ascertained with any degree of accuracy at this stage and site specific investigation and assessment at each of the proposed structures will be required.

The following piled footing systems which may be suitable for the development of the site.

Concrete Bored Piles
Predominantly granular filling overlying sandy clay or clayey sand soils were encountered in the bores. Hence, bored piles may be suitable for the support of the proposed structures. Bored piles can be cased or uncased as required.

Grout-Injected Piles
As an alternative to drilling bored piles using conventional piling rigs, continuous flight auger (CFA) piles (also commonly referred to as 'grout-injected' piles) could be installed at the site. This method is generally limited to equipment fitted with augers having a diameter of up to about 600 mm - 1050 mm.

The main differences between grout-injected piles and large diameter bored piles are:

- Inspection of founding material during boring is not possible with grout-injected piles;

- Higher torque and thrust capacity boring equipment is required for grout-injected piling continuous flight augers to penetrate to the same level as bored pile rigs for the same diameter; and
- Better control of grout / concrete levels during pile construction is possible for large diameter bored piles.

Table provides the preliminary ultimate limit state end bearing pressures and preliminary shaft adhesion values for piles socketed into sandstone or conglomerate bedrock.

Table 9: Preliminary Design Pressures for Founding Rock Strata

Strata	Unit	Ultimate End Bearing Pressure (kPa)	Serviceability End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)
Extremely weathered bedrock (dense clayey sand and hard clay)	3	2000	1000	100
Very low to low strength sandstone / conglomerate	4.1	4000	1500	300
Medium to high strength or high strength sandstone / conglomerate	4.3	40000	5000	1500

Notes to Table 9:
Rock classification based on Pells, Mostyn, Walker, (1998)
The upper 1.5 m of the pile shaft, and any portions within existing fill should be ignored in shaft capacity calculations

In the current Piling Code AS2159 (2009), the design geotechnical strength of a pile ($R_{d,g}$) is the ultimate geotechnical strength ($R_{d,ug}$) multiplied by the geotechnical strength reduction factor (ϕ_g), such that:

- $R_{d,g} = \phi_g \, . \, R_{d,ug}$

The calculated value $R_{d,g}$ must equal or exceed the structural design action effect E_d.

Selection of the geotechnical strength reduction factor (ϕ_g) is based on a series of individual risk ratings (IRR) which are weighted and lead to an average risk rating (ARR). The individual risk ratings and final value of ϕ_g depend on the following factors:

- Site: the type, quantity and quality of testing;
- Design: design methods and parameter selection;
- Installation: construction control and monitoring;
- Pile testing regime; testing benefit factor based on percentage of piles tested and the type of testing; and
- Redundancy: whether other piles can take up load if a given pile settles or fails.

Using the methodology outlined in the piling code and the supplementary site data retrieved during the present investigation, average risk ratings have been assessed for future foundations.

The recommended geotechnical strength reduction factors (ϕ_g) for piles founded in bedrock is as follows in Table 10.

Table 10: Recommended Geotechnical Strength Reduction Factor

Foundation Strata	Geotechnical Strength Reduction Factor (Øg)	
	Low Redundancy in Design of Piles	High Redundancy in Design of Piles
Piles founded in underlying bedrock	0.55	0.60

These strength reduction factors are based on inspections to be completed by a qualified geotechnical engineer during piling operations, and on dynamic or static load testing in accordance with the requirements of AS2159 (2009) during piling operations. It is however pointed out that the final strength reduction factor will depend on the piling contractor chosen and experience of the pile designer. The strength reduction factors should be checked when this information is available. Piles should be installed by experienced operators, using suitably sized piling rigs, monitoring equipment and supervision.

All piles should also be assessed against serviceability requirements.

7.5 Exposure Classifications

Specific testing of soil aggressivity testing has not been undertaken during the investigation owing to the shallow depth to bedrock and anticipating that the footings will be supported on the underlying bedrock. Reference to the soil landscape mapping for the area and the accompanying notes indicate that the Warners Bay erosional soil landscape typically has a pH ranging from 4 to 12 pH units. It is recommended that preliminary design of piles should be undertaken for a mildly aggressive exposure classification with reference to the current Piling Code (AS2159, 2009). This can be confirmed at the time of more detailed investigation.

7.6 Excavation Vibration

It would be prudent to allow for dilapidation surveys to be carried out on the nearby buildings and existing services to document their condition prior to the commencement of all work.

The use of rock breaking and pneumatic equipment for side trimming and footing excavation in medium strength and high strength rock normally has the potential to affect structures adjoining the proposed excavation.

As a guide, the damage threshold due to vibration is dependent on the quality of the building foundations and construction of the building as well as the wavelength of the vibration and the source distance. The longer the wavelength, the more likely a building is to resonate and suffer damage. For construction equipment (generally in the high frequency or short wavelength range), the damage threshold is 40 mm / sec to 80 mm / sec for buildings founded on rock. Most vibration codes set safe limits for building vibrations at lower levels.

The Standards Australia explosives code recommends the maximum peak particle velocities for various structures subjected to blasting vibration (generally a low frequency vibration).

It should be noted that humans are very sensitive to vibration and consequently may be disturbed by vibration levels which are considered relatively insignificant for buildings. It may therefore be beneficial to carry out vibration monitoring to confirm vibration levels during site works. These potential restraints can be tested by a properly designed trial.

8. References

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LMCC. (2020). *Geotechnical Slope Stability Guidelines.* F2019-00741, Revision 0, Adopted by Council 28 September 2020: Lake Macquarie City Council.

Pells, Mostyn, Walker. (1998). *Foundations on Sandstone and Shale in the Sydney Region.* Australian Geomechanics Journal - Dec 1998.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at 31 to 33 Smith Street, Charlestown in accordance with DP's proposal 190208 dated 3 April 2019 and acceptance received from Ian Gill of GPV Property Group dated 12 November 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of GPV Property Group for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.
The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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

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

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

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Appendix A

About This Report
Sampling Methods
Soil Descriptions
Rock Descriptions
Symbols and Abbreviations
Appendix C (AGS, 2007) – Qualitative Terminology for Use in Assessing Risk to Property
Appendix G (AGS, 2007) – Some Guidelines for Hillside Construction

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections > 100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

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Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

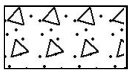
Symbols & Abbreviations

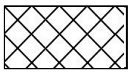
Graphic Symbols for Soil and Rock

General

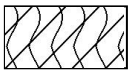

Asphalt

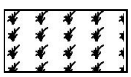

Road base

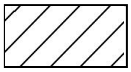

Concrete

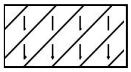

Filling

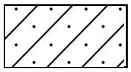
Soils


Topsoil

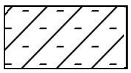

Peat

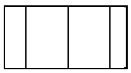

Clay

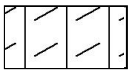

Silty clay

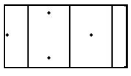

Sandy clay

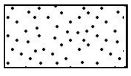

Gravelly clay

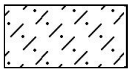

Shaly clay

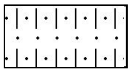

Silt


Clayey silt


Sandy silt

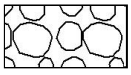

Sand

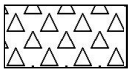

Clayey sand


Silty sand


Gravel

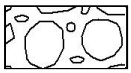

Sandy gravel


Cobbles, boulders

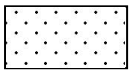

Talus

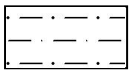
Sedimentary Rocks

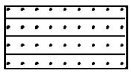

Boulder conglomerate

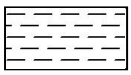

Conglomerate


Conglomeratic sandstone

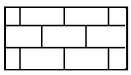

Sandstone


Siltstone

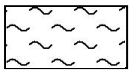

Laminite

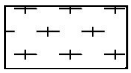

Mudstone, claystone, shale

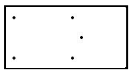

Coal


Limestone

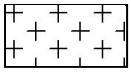
Metamorphic Rocks

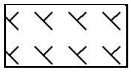

Slate, phyllite, schist

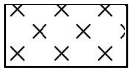

Gneiss

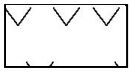

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	**1: CATASTROPHIC 200%**	**2: MAJOR 60%**	**3: MEDIUM 20%**	**4: MINOR 5%**	**5: INSIGNIFICANT 0.5%**
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

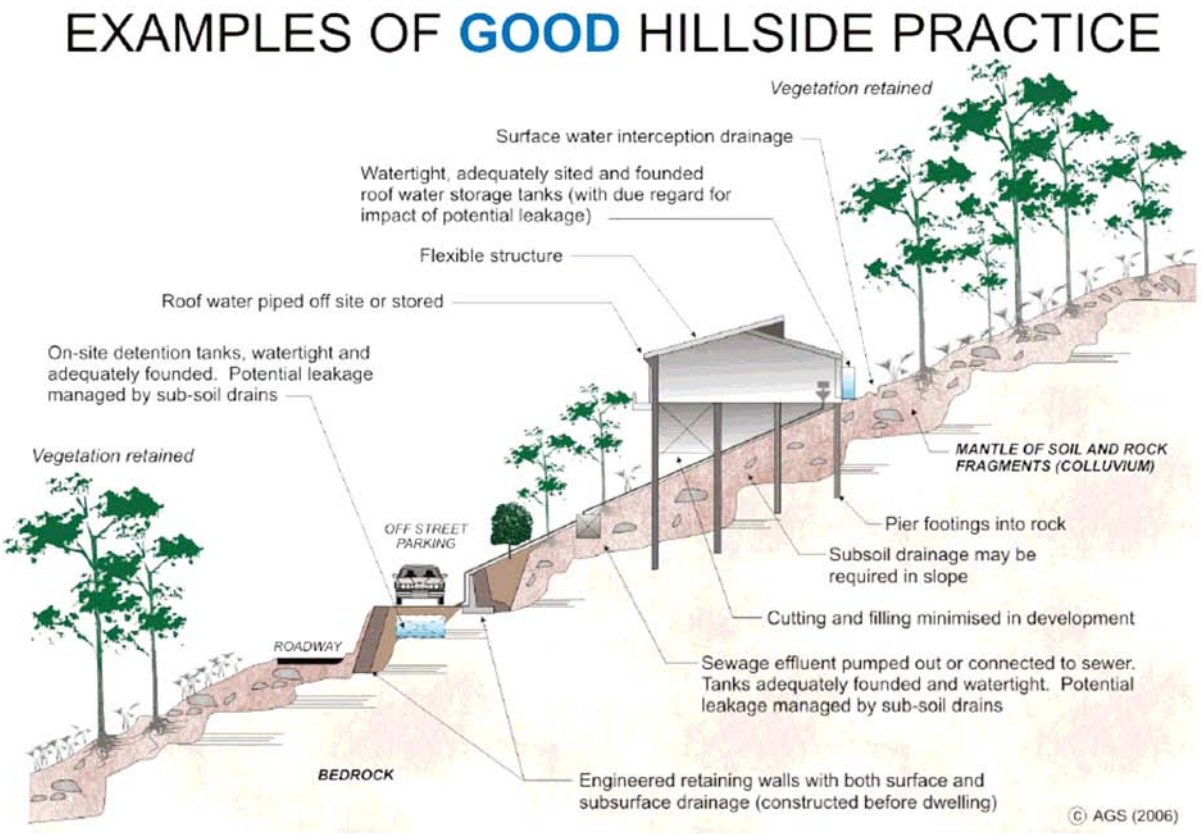
RISK LEVEL IMPLICATIONS

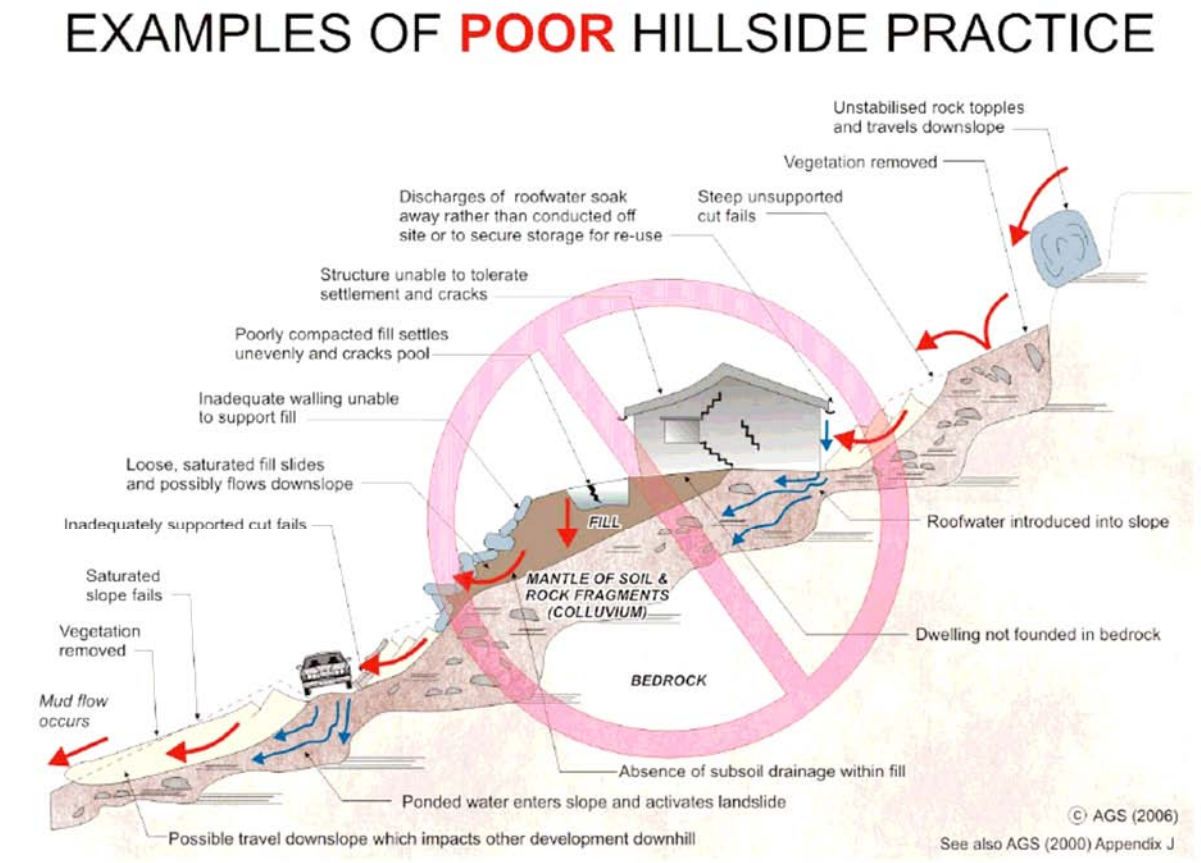
Risk Level		**Example Implications** (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	


EXAMPLES OF GOOD HILLSIDE PRACTICE
Vegetation retained
Surface water interception drainage
Watertight, adequately sited and founded roof water storage tanks (with due regard for impact of potential leakage)
Flexible structure
Roof water piped off site or stored
On-site detention tanks, watertight and adequately founded. Potential leakage managed by sub-soil drains
Vegetation retained
MANTLE OF SOIL AND ROCK FRAGMENTS (COLLUVIUM)
OFF STREET PARKING
Pier footings into rock
Subsoil drainage may be required in slope
Cutting and filling minimised in development
ROADWAY
Sewage effluent pumped out or connected to sewer. Tanks adequately founded and watertight. Potential leakage managed by sub-soil drains
BEDROCK
Engineered retaining walls with both surface and subsurface drainage (constructed before dwelling)
© AGS (2006)


EXAMPLES OF POOR HILLSIDE PRACTICE
Unstabilised rock topples and travels downslope
Vegetation removed
Discharges of roofwater soak away rather than conducted off site or to secure storage for re-use
Steep unsupported cut fails
Structure unable to tolerate settlement and cracks
Poorly compacted fill settles unevenly and cracks pool
Inadequate walling unable to support fill
Loose, saturated fill slides and possibly flows downslope
Inadequately supported cut fails
FILL
Roofwater introduced into slope
Saturated slope fails
MANTLE OF SOIL & ROCK FRAGMENTS (COLLUVIUM)
Vegetation removed
Dwelling not founded in bedrock
BEDROCK
Mud flow occurs
Absence of subsoil drainage within fill
Ponded water enters slope and activates landslide
© AGS (2006)
Possible travel downslope which impacts other development downhill
See also AGS (2000) Appendix J

Appendix B

Borehole Logs (Bores 1 to 8)
Borehole Logs (Bores 101 to 112)
Borehole Logs (Bore 201 to 214)
Borehole Log (Bore 1001)
Core Photoplates (Bores 1 to 3)

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 110.317 AHD **BORE No:** 01
EASTING: 378183 **PROJECT No:** 81563
NORTHING: 6351826 **DATE:** 2/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
110	0.02	ASPHALT - 20mm thick										
		FILLING - Generally comprising (medium dense) light grey fine to medium sized subangular, gravelly fine to medium grained sand							A			<1 ppm
	0.4	FILLING - Generally comprising (medium dense) red-brown fine to medium sized subangular, gravelly fine to medium grained sand							A			<1 ppm
	0.7	CLAY - Stiff to very stiff brown mottled light grey clay, slightly silty, M>Wp							A			pp = 180-300 <1 ppm
109	1 1.1	CLAYEY SAND - Dense, grey fine grained clayey sand, humid (extremely weathered sandstone) From 1.4m, 300mm interbedded red and grey bands, strength generally increasing with depth							S			4,12,12 N = 24 <1 ppm
108	2								S			18,27,bouncing refusal <1 ppm
107	2.8	SANDSTONE - Medium strength, highly weathered, red-brown fine grained sandstone						2.95m: P, sh, pl, sm 3.07m: J, 35°, pl, sm, 1mm clay infill 3.11m: P, sh, pl, ro	C	100	96	PL(A) = 0.45 PL(D) = 0.45
	3 3.47	CONGLOMERATE - Medium strength, moderately weathered, orange fine to medium sized subangular / subrounded conglomerate with fine to medium grained sand						3.45m: Bp, 5-10°, un, sm				
106	4 4.0	CORE LOSS - 0.13m (4.0 to 4.13)						4m: CORE LOSS: 130mm	C	86	91	PL(A) = 0.59 PL(D) = 0.45
	4.13 4.25	CONGLOMERATE - Extremely low strength, extremely weathered, brown fine to medium sized subangular conglomerate						4.35m: J, 10°, w, ro 4.43m: P, 5°, un, ro				
		CONGLOMERATE - High strength, moderately weathered, orange fine to coarse sized subangular conglomerate with fine to medium grained sand							C	100	85	PL(A) = 1.4 PL(D) = 1.3

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2.5

TYPE OF BORING: Solid flight augar to 2.5m, rock roller to 2.8m, NMLC to 10.15m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS: 10% water loss from 5.8m

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 110.317 AHD **BORE No:** 01
EASTING: 378183 **PROJECT No:** 81563
NORTHING: 6351826 **DATE:** 2/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
105		CONGLOMERATE - High strength, moderately weathered, orange fine to coarse sized subangular conglomerate with fine to medium grained sand *(continued)*										
		From 5.37m, medium strength						5.25m: -5, 25°, pl, ro 5.35m: P, sh, pl, ro 5.44m: P, sh, un, ro, clay infill 5.52m: P, sh, un, ro, clay infill	C	100	85	
		From 5.76m to 5.9m, sandstone band										PL(A) = 0.63 PL(D) = 0.71
104	6							6.07m: P, 5-10°, ir, ro				
												PL(A) = 0.55 PL(D) = 0.61
103	7	From 7.0m, low to medium strength							C	100	100	
												PL(A) = 0.4 PL(D) = 0.27
102	8											PL(A) = 0.28 PL(D) = 0.45
101	9							9.17m: J, 10°, pl, ro clay infill	C	100	100	PL(A) = 0.41 PL(D) = 0.26

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2.5

TYPE OF BORING: Solid flight augar to 2.5m, rock roller to 2.8m, NMLC to 10.15m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS: 10% water loss from 5.8m

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 110.317 AHD **BORE No:** 01
EASTING: 378183 **PROJECT No:** 81563
NORTHING: 6351826 **DATE:** 2/8/2014
DIP/AZIMUTH: 90°/-- **SHEET** 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
									C	100	100	
100	10.15	Bore discontinued at 10.15m, limit of investigation										
99	11											
98	12											
97	13											
96	14											

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2.5

TYPE OF BORING: Solid flight augar to 2.5m, rock roller to 2.8m, NMLC to 10.15m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS: 10% water loss from 5.8m

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.28 AHD
EASTING: 378148
NORTHING: 6351784
DIP/AZIMUTH: 90°/--

BORE No: 02
PROJECT No: 81563
DATE: 2/8/2014
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
107	0.15	FILLING - Generally comprising dark brown silty sand topsoil filling with trace brick fragments up to 5mm in diameter							A			<1ppm
									A			<1ppm
	0.4	FILLING - Generally comprising brown silty sand filling with some fine size subrounded gravel (brick and asphalt fragments)							A			<1ppm
		SANDY CLAY - Brown, fine to medium grained sandy clay, slightly silty, M<Wp (possible filling)										
	0.8											
	1	SANDY CLAY - Hard, orange mottled light grey fine grained sandy clay with some silt							A			pp = 330-340 <1ppm
106		From 1.2, grading to rock							S			8,19,24 N = 43 <1ppm
	2											
105												
	2.5	CORE LOSS - 0.32 (2.5m to 2.82m)						2.5m: CORE LOSS: 320mm				
	2.82	SANDSTONE - Extremely low strength, extremely weathered, brown mottled orange-rd and light grey sandstone (friable)							C	68	0	
	3											
104		From 3.41m, subangular / subrounded gravel (extremely weathered conglomerate) up to 25mm in diameter										
	3.5	CORE LOSS - 0.35m (3.5m to 3.85m)						3.5m: CORE LOSS: 350mm				
	3.85	SANDSTONE - Extremely low strength, extremely weathered, brown mottled orange-rd and light grey sandstone (friable)							C	51	0	
	4											
103	4.27	CORE LOSS - 0.09m (4.27m to 4.36m)						4.27m: CORE LOSS: 90mm				
	4.36	CONGLOMERATE - High strength, moderately weathered brown conglomerate with fine to medium grained sand and fine to coarse sized subrounded gravel						4.8m: P, sh, un, sm, fe	C	100	100	

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2

TYPE OF BORING: Solid flight augar to 2.5m, NMLC to 11.64m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.28 AHD
EASTING: 378148
NORTHING: 6351784
DIP/AZIMUTH: 90°/--

BORE No: 02
PROJECT No: 81563
DATE: 2/8/2014
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
102		CONGLOMERATE - High strength, moderately weathered brown conglomerate with fine to medium grained sand and fine to coarse sized subrounded gravel *(continued)*										
		From 5.2m, medium to high strength						5.53m: P, 5°, un, ro	C	100	100	PL(A) = 2.4 PL(D) = 2.3
								5.77m: P, 2°, un, ro, fe				PL(A) = 0.94 PL(D) = 1.4
	6											
101		From 6.2m, medium strength						6.17m: P, 2°, un, ro, fe				
												PL(A) = 0.31 PL(D) = 0.35
	7											
100									C	100	100	
		From 7.72m, fresh, grey										PL(A) = 0.9 PL(D) = 0.52
	8	From 8.00 to 9.5m, conglomerate infilled with exteremly low strength, white claystone										PL(A) = 0.67 PL(D) = 0.47
99												
	9							>>				
98									C	100	100	PL(A) = 0.37 PL(D) = 0.41

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2

TYPE OF BORING: Solid flight augar to 2.5m, NMLC to 11.64m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.28 AHD
EASTING: 378148
NORTHING: 6351784
DIP/AZIMUTH: 90°/--

BORE No: 02
PROJECT No: 81563
DATE: 2/8/2014
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
97		CONGLOMERATE - High strength, moderately weathered brown conglomerate with fine to medium grained sand and fine to coarse sized subrounded gravel *(continued)*										PL(A) = 0.63 PL(D) = 0.52
									C	100	100	
96	11											PL(A) = 0.24 PL(D) = 0.34
	11.64	Bore discontinued at 11.64m, limit of investigation										
95	12											
94	13											
93	14											

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 2

TYPE OF BORING: Solid flight augar to 2.5m, NMLC to 11.64m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.3 AHD
EASTING: 378114
NORTHING: 6351829
DIP/AZIMUTH: 90°/--

BORE No: 03
PROJECT No: 81563
DATE: 3/8/2014
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
107	0.03	ASPHALT - 30mm thick										
		FILLING - Generally comprising (dense) light grey fine to medium sized subangular gravelly fine to medium grained sand, humid							A			<1pmm
	0.35	FILLING - Generally comprising (medium dense) brown fine to coarse grained sand, with some concrete, brick and tile fragments up to 30mm							A			<1pmm
	0.7	CLAY - Light brown clay with some silt, (possibly filling, odour)							A			pp = 180-200 <1pmm
	0.9	CLAYEY SAND - Dense, light grey and red fine grained clayey sand (extremely low to very low strength, highly weathered sandstone)							S			10,22,26 N = 48 <1pmm
106	1	At 1.5m, V-bit refusal										
105	2	From 2.5m to 3.1m, medium dense, decreased drilling resistance (damp)							S			7,6,9 N = 15 <1ppm
	3.0	CONGLOMERATE - Very low strength, moderately weathered light brown fine sized conglomerate							A			
104	3											
	3.6	CONGLOMERATE - High strength, moderately weathered, brown-orange fine to coarse sized subangular conglomerate						3.85m: J, 15°, ir, ro	C	100	95	PL(A) = 1.3 PL(D) = 1.1
103	4	From 4.5m, medium strength										PL(A) = 0.35 PL(D) = 0.91

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 3.5

TYPE OF BORING: Solid flight augar to 3.6m, NMLC to 10.27m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.3 AHD
EASTING: 378114
NORTHING: 6351829
DIP/AZIMUTH: 90°/--

BORE No: 03
PROJECT No: 81563
DATE: 3/8/2014
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
102		CONGLOMERATE - High strength, moderately weathered, brown-orange fine to coarse sized subangular conglomerate *(continued)*							C	100	95	
												PL(A) = 1.4 PL(D) = 0.64
	6							6.12m: J, 40°, pl, ro 6.18m: J, 35°, un, ro				
101												PL(A) = 1.1 PL(D) = 0.94
												PL(A) = 1.5 PL(D) = 0.68
	7	From 6.95m, fresh										
		From 7.05m to 7.51m, high strength, fine to medium grained sandstone with interbedded gravel bands, up to 30mm thick							C	100	98	PL(A) = 2.3 PL(D) = 1.5
100												
	8											
99		From 8.4m to 9.5m, low strength										PL(A) = 0.13 PL(D) = 0.28
								8.74m: -8.93m, fragmented				
	9											
98									C	100	88	PL(A) = 0.32 PL(D) = 0.25
								9.82m: J, 40°, pl, sm, coal				PL(A) = 0.56

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 3.5

TYPE OF BORING: Solid flight augar to 3.6m, NMLC to 10.27m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.3 AHD
EASTING: 378114
NORTHING: 6351829
DIP/AZIMUTH: 90°/--

BORE No: 03
PROJECT No: 81563
DATE: 3/8/2014
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
									C	100	88	PL(D) = 0.47
97	10.27	Bore discontinued at 10.27m, limit of investigation										
	11											
96												
	12											
95												
	13											
94												
	14											
93												

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:** HQ to 3.5

TYPE OF BORING: Solid flight augar to 3.6m, NMLC to 10.27m

WATER OBSERVATIONS: Groundwater observation obscured by introduction of drilling fluid

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.23 AHD
EASTING: 378180
NORTHING: 6351783
DIP/AZIMUTH: 90°/--

BORE No: 04
PROJECT No: 81563
DATE: 3/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
108	0.0	FILLING - Generally comprising brown gravelly clay filling, generally composed of fine to medium sized brick fragments, M>Wp		A	0.2		<1ppm		
				A	0.5		<1ppm		
	0.55	FILLING - Generally comprising dark grey fine grained sandy clay / clayey sand filling with some fine sized gravel (including some slag fragments)		A	0.9		<1ppm		
	0.95	SANDY CLAY - Stiff to very stiff brown mottled light grey fine grained sandy clay, M>Wp			1.0				
107	1			S			pp = 250-400 4,5,5 N = 10 <1ppm		1
					1.45				
	1.9	CLAYEY SAND - Medium dense red, fine to medium grained clayey sand (moist) (extremely weathered, extremely low to very low strength sandstone)		A	2.0		<1ppm		
106	2	From 2.25m to 2.45m, firm light brown sandy gravel		A	2.3		<1ppm pp = 100		2
					2.5				
				S			5,11,20 N = 31		
	3				2.95				3
105	3.5	SANDSTONE - Very low strength, moderately weathered, grey and red fine to medium grained sandstone							
	4	At 4.0m, V-bit refusal			4.0				4
104				S			18,24,27 N = 51 <1ppm		
	4.45	Bore discontinued at 4.45m, limit of investigation			4.45				

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:**

TYPE OF BORING: Solid flight augar to 4.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.29 AHD
EASTING: 378157
NORTHING: 6351806
DIP/AZIMUTH: 90°/--

BORE No: 05
PROJECT No: 81563
DATE: 1/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
108	0.35	FILLING - Grey-brown sandy gravel filling, fine to coarse grained sand and fine sized subangular gravel with some clay, moist		A	0.2		<1ppm		
		FILLING - Generally comprising brown clay filling with trace fine sized gravel and trace silt		A	0.5		pp = 180-200 <1ppm		
	0.8	CLAY - Stiff to very stiff, brown clay with some silt, M>Wp		A	0.85		pp = 170 <1ppm		
	0.95	SANDSTONE - Very low strength, moderately weathered, orange and light grey fine grained sandstone		S	1.0		15,25,120 N = 145		
107	1				1.27				1
		From 1.5m, red							
106	2								2
		At 2.5m, V-bit refusal		S	2.5		7,16,25/100mm refusal		
	2.9	Bore discontinued at 2.9m, limit of investigation			2.9				
105	3								3
104	4								4

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:**

TYPE OF BORING: Solid flight augar to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 106.01 AHD
EASTING: 378124
NORTHING: 6351787
DIP/AZIMUTH: 90°/--

BORE No: 06
PROJECT No: 81563
DATE: 1/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
106		FILLING - Generally comprising brown fine to medium grained sandy clay filling, slightly silty, M>Wp (possibly natural)		A	0.2		<1ppm		
	0.35	SANDY CLAY / CLAYEY SAND - Medium dense / stiff, brown fine to medium grained sandy clay / clayey sand, M<Wp		A	0.5		<1ppm		
105	1	From 0.9m to 1.4m, light grey, decreased drilling resistance (damp, possibly from drain)			1.0				1
				S			4,6,7 N = 13 <1ppm		
		From 1.6m, red			1.45				
104	2	At 1.90m, V-bit refusal							2
	2.2	SANDSTONE - Very low to low strength, moderately weathered, fine to medium grained sandstone							
	2.5	At 2.5m, TC-bit refusal Bore discontinued at 2.5m, limit of investigation		S	2.5		2,bouncing refusal		
103	3								3
102	4								4

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:**

TYPE OF BORING: Solid flight augar to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.7 AHD
EASTING: 378141
NORTHING: 6351841
DIP/AZIMUTH: 90°/--

BORE No: 07
PROJECT No: 81563
DATE: 2/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
108	0.03	ASPHALT - 30mm thick							
		FILLING - Generally comprising (medium dense) light grey fine to medium sized subangular gravelly, fine to medium grained sand, filling		A	0.2		<1ppm		
	0.3	CLAY - Very stiff, brown clay with some silt, M>Wp (possibly filling), (odour)		A	0.5		pp = 250 <1ppm		
	0.7	CLAYEY SAND - (dense) red clayey, fine to medium grained sand, humid, (extremely weathered, very low sandstone)		A	0.8		<1ppm		
107	1	At 0.8m, V- bit refusal		A	1.0		<1ppm		1
				S			8,14,21 N = 35		
					1.45				
	2			A	2.35		<1ppm		2
	2.5	Bore discontinued at 2.5m, refusal		S	2.5 2.51		6/10mm,bouncing refusal		
106	3								3
105	4								4
104									

RIG: Scout 2 **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:**

TYPE OF BORING: Solid flight augar to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Preliminary Geotechnical and Contamination Inv
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.08 AHD
EASTING: 378131
NORTHING: 6351802
DIP/AZIMUTH: 90°/--

BORE No: 08
PROJECT No: 81563
DATE: 1/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
107	0.05	FILLING - Generally comprising, grey fine to coarse grained sand filling with trace medium sized subangular / subrounded gravel, humid		A	0.1				
		FILLING - Generally comprising red-brown fine to coarse grained sand filling with some concrete, brick and tile fragments 10 to 50mm in diameter		A	0.3		<1ppm		
				A	0.5		<1ppm		
	0.55	SANDSTONE - Extremely low to very low strength, highly weathered, orange-light grey fine grained sandstone		A	0.55		<1ppm		
				A	0.6				
	0.7	Bore discontinued at 0.7m, limit of investigation							
106	1								1
105	2								2
104	3								3
103	4								4

RIG: Hand Tools **DRILLER:** Total (Whyte) **LOGGED:** Fulham **CASING:**

TYPE OF BORING: 90mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.63 AHD
EASTING: 378119.7
NORTHING: 6351837.2
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, trace cobbles, moist		A, PID	0.1	E	PID<1		
		From 0.2m, colour change to dark grey		A, PID	0.3	E	PID<1		
	0.5	FILLING - Generally comprising brown and yellow silty sandy clay with trace ash/slag gravel, slight hydrocarbon odour, M>Wp		A, PID	0.6	E	PID=2		
	0.9	SANDY CLAY - Very stiff, brown/yellow and mottled red sandy clay, M>Wp			1.0				
1		From 1.1m, grading to extremely low strength, extremely weathered sandstone		SPT, PID		E	19,19,17 N = 36 PID<1		1
	1.45	Bore discontinued at 1.45m , limit of investigation			1.45				
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 110.28 AHD **BORE No:** 102
EASTING: 378176.8 **PROJECT No:** 81563.01
NORTHING: 6351833.2 **DATE:** 7/10/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, trace cobbles, moist		A, PID	0.2	E	PID<1		
		From 0.3m, colour change to red/brown		A, PID	0.4	E	PID<1		
	0.55	FILLING - Generally comprising grey and brown/yellow silty sandy clay with trace gravel, M>Wp		A, PID	0.6	E	PID<1		
	0.8	SANDY CLAY - Stiff to very stiff, brown/yellow and mottled red sandy clay, M>wp							
1					1.0				1
		From 1.1m, grading to extremely low strength, extremely weathered sandstone		SPT, PID		E	11,13,14 N = 27 PID<1		
	1.45	Bore discontinued at 1.45m , limit of investigation			1.45				
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 109.06 AHD
EASTING: 378162.8
NORTHING: 6351819.8
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, some silt and trace cobbles, moist		A, PID	0.2	E	PID<1		
		From 0.3m, change to red/brown		A, PID	0.5	E	PID=1		
	0.6	FILLING - Generally comprising dark grey and brown/yellow silty sandy clay with trace gravel, M>Wp		A, PID	0.7	E	PID<1		
	0.75	SANDY CLAY - Brown/yellow, fine grained sandy clay, M>Wp		A, PID	0.9	E	PID<1		
1		From 1.0m, grading to extremely low strength, extremely weathered sandstone							1
	1.1	Bore discontinued at 1.1m , limit of investigation							
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.1m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.34 AHD
EASTING: 378119.8
NORTHING: 6351816.3
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising light brown and grey, fine to medium grained sand filling with abundant gravel and trace cobbles, moist		A, PID	0.1	E	PID<1		
		From 0.2m, colour change to red/brown		A, PID	0.3	E	PID<1		
	0.5	FILLING - Generally comprising grey and brown/yellow silty sandy clay with trace slag gravel and ash gravel, slight hydrocarbon odour, M>Wp		A, PID	0.6	E	PID<1		
	0.8	SANDY CLAY - Hard, brown/yellow mottled red sandy clay, M>Wp							
	1				1.0				1
		From 1.1m, grading to extremely low strength, extremely weathered sandstone		SPT, PID		E	9,18,25 N = 43 PID<1		
	1.45	Bore discontinued at 1.45m , limit of investigation			1.45				
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.82 AHD
EASTING: 378136.3
NORTHING: 6351815.6
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, with some cobbles, moist From 0.1m, colour change to red/brown		A, PID	0.3	E	PID=3		
	0.55	FILLING - Generally comprising dark grey and brown/yellow silty clay with some slag gravel, trace ash gravel, slight hydrocarbon odour, M>Wp		A, PID	0.6	E	PID=2		
	0.7	SANDY CLAY - Very stiff, brown and yellow sandy clay, M>Wp							
1		From 0.95m, grading to extremely low strength, extremely weathered sandstone			1.0				1
				SPT, PID		E	19,17,20 N = 37 PID<1		
	1.45	Bore discontinued at 1.45m , limit of investigation			1.45				
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.98 AHD
EASTING: 378174.7
NORTHING: 6351810.1
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, some silt, moist		A, PID	0.2	E	PID<1		
		From 0.3m, red/brown		A, PID	0.5	E	PID<1		
	0.6	FILLING - Generally comprising dark grey, brown/yellow silty sandy clay filling, with some gravel, M>Wp		A, PID	0.7	E	PID<1		
	0.8	SANDY CLAY - Hard, generally comprising brown/yellow sandy clay, M>Wp							
1		From 0.95m, grading to extremely low strength, extremely weathered sandstone		SPT, PID	1.0	E	18,25/10 refusal PID<1		1
	1.16	Bore discontinued at 1.16m , limit of investigation			1.16				
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 109.51 AHD
EASTING: 378193
NORTHING: 6351806.6
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling, some silt, moist		A, PID	0.2	E	PID<1		
		From 0.3m, grey and red		A, PID	0.5	E	PID<1		
	0.6	SANDY CLAY - Stiff, brown/yellow sandy clay, M>Wp		A, PID	0.8	E	PID<1		
	1				1.0				1
		From 1.1m, grading to extremely low strength, extremely weathered sandstone		SPT, PID		E	4,5,7 N = 12 PID<1		
	1.45	Bore discontinued at 1.45m , limit of investigation			1.45				
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 106.23 AHD
EASTING: 378116.4
NORTHING: 6351798.2
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - Generally comprising brown silty, fine to medium grained gravelly sand filling, some cobbles, moist		A, PID	0.2	E	PID<1		
	0.3	SANDY CLAY - (Stiff) brown and yellow sandy clay, M>Wp		A, PID	0.5	E	PID<1		
		From 0.8m, brown, yelllow, orange and red mottled							
	1	From 1.0m, grading to extremely low strength, extremely weathered sandstone		A, PID	1.0	E	PID<1		1
				A, PID	1.4	E	PID<1		
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.39 AHD
EASTING: 378168.1
NORTHING: 6351792.9
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	VEGETATION							
		FILLING - Generally comprising brown silty, fine to medium grained sand filling, with trace gravel, timber and trace organics to 0.2m, moist		A, PID	0.1	E	PID<1		
		From 0.4m, some clay		A, PID	0.5	E	PID<1		
	0.9	SANDY CLAY - (Stiff) brown and yellow sandy clay, M>Wp		A, PID	1.0	E	PID<1		
1		From 1.3m, grading to extremely low strength, extremely weathered sandstone		A, PID	1.4	E	PID<1		1
	1.5	Bore discontinued at 1.5m , limit of investigation							
2									2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 108.34 AHD
EASTING: 378189.9
NORTHING: 6351787.4
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	VEGETATION							
		FILLING - Generally comprising brown silty, fine to medium grained sand filling, with some gravel and organics, moist		A, PID	0.2	E	PID<1		
	0.4	SANDY CLAY - (Stiff) brown and yellow sandy clay, M>Wp		A, PID	0.5	E	PID<1		
	1			A, PID	1.0	E	PID<1		1
		From 1.2m, grading to red and light grey and orange, extremely low strength, extremely weathered sandstone		A, PID	1.4	E	PID<1		
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 106.99 AHD
EASTING: 378134.3
NORTHING: 6351789.5
DIP/AZIMUTH: 90°/--

BORE No: 111
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising silty, fine to medium grained gravelly sand filling, moist		A, PID	0.2	E	PID<1		
	0.3	SANDY CLAY - (Stiff) brown and yellow mottled red sandy clay, M>Wp		A, PID	0.5	E	PID<1		
		From 0.8m, grading to extremely low strength, extremely weathered sandstone							
	1			A, PID	1.0	E	PID<1		1
	1.2	Bore discontinued at 1.2m , limit of investigation							
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.2m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Detailed Site Investigation
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.75 AHD
EASTING: 378175.6
NORTHING: 6351775.6
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 81563.01
DATE: 7/10/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	VEGETATION							
	0.1	FILLING - Generally comprising brown, fine to medium grained sand filling, trace gravel, moist							
		FILLING - Generally comprising brown and yellow, silty sandy clay filling, with trace brick and tile fragments, M>Wp		A, PID	0.2	E	PID<1		
				A, PID	0.5	E	PID<1		
	0.7	FILLING - Generally comprising dark brown, fine to medium grained sandy silt, moist							
	1			A, PID	1.0	E	PID<1		1
	1.1	SANDY CLAY - (Stiff) brown and grey sandy clay with some sand, M>Wp							
		From 1.3m, brown and yellow		A, PID	1.4	E	PID<1		
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck mounted (TD104) **DRILLER:** Total Drilling **LOGGED:** Sebastian **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger with TC bit to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Survey co-ordinates and levels provided by Lake Macquarie City Council

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling with trace cobbles, moist		D	0.2	E	PID <1		
	0.4	FILLING - Generally comprising, dark grey and brown-red, fine to medium grained gravelly sand filling, moist		A	0.5	E	PID <1		
	0.7	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
1				A	1.0	E	PID <1		1
	1.2	Bore discontinued at 1.2m , limit of investigation							
2									2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey, fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.2	E	PID <1		
	0.4	FILLING - Generally comprising, dark grey and brown-red, fine to medium grained gravelly sand filling, moist		A	0.5	E	PID <1		
	0.7	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
1				A	1.0	E	PID <1		1
	1.2	Bore discontinued at 1.2m , limit of investigation							
2									2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.2	E	PID <1		
		From 0.3m, brown-red and grey							
	0.4	FILLING - Generally comprising grey and brown silty sandy clay filling with trace ash, slag and roots, moderate to strong organic citrus odour, M>Wp		A	0.5	E	PID = 1		
	0.7	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
	1			A	1.0	E	PID = 6		1
		From 1.1m, grading to sandstone							
	1.2	Bore discontinued at 1.2m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.1	E	PID = 2		
	0.2	FILLING - Generally comprising, brown-red and grey, fine to meidum grained gravelly sand filling, moist From approximately 0.25m to 0.35m, abundant asphalt, coal		A	0.3	E	PID = 1		
	0.5	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp		A	0.7	E	PID <1		
	1 1.0	Bore discontinued at 1.0m , limit of investigation							1
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 205
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.2	E	PID <1		
	0.25	FILLING - Generally comprising brown-red and grey, fine to medium grained gravelly sand filling, moist		A	0.35	E	PID <1		
	0.4	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp		A	0.6	E	PID <1		
	0.8	Bore discontinued at 0.8m , limit of investigation							
	1								1
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising brown and grey gravelly silty sand filling, moist		A	0.2	E	PID <1		
				A	0.5	E	PID <1		
	0.6	SANDY CLAY - Brown and yellow sandy clay, grading to extremely low strength, extremely weathered sandstone, M<Wp							
	1			A	1.0	E	PID <1		1
	1.1	Bore discontinued at 1.1m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 207
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey gravelly sand filling, moist		A	0.2	E	PID <1		
	0.3	FILLING - Generally comprising mix of dark grey and brown silty sand and sandy clay filling wiht trace roots, red-brown sandstone fragments, possible slag and ash and moderate organic hydrocarbon citrus odour		A	0.5	E	PID <1		
		From 0.4m, mix of light grey and brown sandy clay grading to red and brown extremely low strength, extremely weathered sandstone							
	0.8	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp		A	1.0	E	PID <1		
1									1
				A	1.5	E	PID <1		
	1.6	Bore discontinued at 1.6m , limit of investigation							
2									2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 208
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - Generally comprising dark brown sandy silt filling with abundant rootlets and organics, moist		A	0.2	E	PID <1		
				A	0.3	E	PID <1		
	0.4	FILLING - Generally comprising brown sand filling with some gravel, moist							
	0.8	SANDY CLAY - (Stiff), brown and yellow sandy clay with trace gravel, M>Wp							
	1			A	1.0	E	PID <1		1
		From 1.1m, grading to red and orange extremely low strength, extremely weathered sandstone							
				A	1.4	E	PID <1		
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 209
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey gravelly sand filling, moist		A	0.2	E	PID <1		
	0.3	FILLING - Generally comprising mix of brown and grey silty grey sand with some gravel and dark grey gravelly sandy clay filling with trace hydrocarbon odour (possible organic citrus odour), moist, M>Wp		A	0.5	E	PID <1		
	1			A	1.0	E	PID <1		1
	1.2	SANDY CLAY - Brown-yellow and red sandy clay, M>Wp							
		From 1.35m, grading to extremely low strength, extremely weathered brown and red sandstone		A	1.4	E	PID <1		
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 210
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey gravelly sandy filling, moist		A	0.1	E	PID <1		
	0.2	FILLING - Generally comprising brown and red gravelly sand filling, moist		A	0.3	E	PID <1		
	0.4	FILLING - Generally comprising dark grey gravelly sandy clay filling with trace hydrocarbon odour and slag / ash, M>Wp		A	0.5	E	PID <1		
	0.6	FILLING - Generally comprising brown and grey silty gravelly sand filling, moist							
		From 0.8m, increase drilling resistance							
	0.85	SANDY CLAY - Brown and red sandy clay, M>Wp							
	1								1
				A	1.2	E	PID <1		
	1.3	Bore discontinued at 1.3m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 211
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.2	E	PID <1		
				A	0.5	E	PID <1		
	0.8	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
	1			A	1.0	E	PID <1		1
	1.2	Bore discontinued at 1.2m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 212
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey fine to medium grained gravelly sand filling with trace cobbles, moist		A	0.2	E	PID <1		
				A	0.4	E	PID <1		
	0.5	FILLING - Generally comprising mix of brown silty gravelly sand and dark grey sandy clay filling with trace ash / slag with slight hydrocarbon odour		A	0.7	E	PID <1		
	0.8	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
	1			A	1.2	E	PID <1		1
	1.5	Bore discontinued at 1.5m , limit of investigation							
	2								2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 213
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALT							
		FILLING - Generally comprising grey gravelly sand filling, moist		A	0.2	E	PID <1		
	0.4	FILLING - Generally comprising red-brown gravelly sand filling with trace sandy clay, moist to wet		A	0.5	E	PID <1		
	0.8	SANDY CLAY - (Very stiff), brown and yellow sandy clay, M>Wp							
1				A	1.0	E	PID <1		1
	1.3	Bore discontinued at 1.3m , limit of investigation							
2									2

RIG: Truck Mounted (FG101) **DRILLER:** (FICO) Dudley **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: 120mm solid flight auger with TC-Bit
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lake Macquarie City Council
PROJECT: Additional Investigation
LOCATION: 31 to 33 Smith Street, Charlestown

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 214
PROJECT No: 81563.02
DATE: 20/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - Generally comprising brown silty fine to medium grained sand filling with some rootlets, gravel and angular cobbles (grass covered, moist		A	0.05	E	PID <1		
		SANDY CLAY - (Very stiff), brown-orange mottled fine to medium grained sandy clay, M>Wp		A	0.2	E	PID <1		
		From 0.4m, orange and brown sandy clay with red and light grey mottling, grading to extremely low strength, extremely weathered		A	0.45	E	PID <1		
	0.5	From 0.5m, auger spinning Bore discontinued at 0.5m , virtual refusal							
	1								1
	2								2

RIG: Hand Tools **DRILLER:** Sebastian **LOGGED:** Sebastian **CASING:** Uncased
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 1 of 16

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	ROCK FRACTURE SPACING (m)	ROCK DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
	107	0.0	FILL/ (CH) CLAY, with gravel; yellow brown; clay fraction high plasticity; gravel fraction fine to medium, sub-angular to sub-rounded		FILL	NA	>PL											0		
		1.0	(CH) CLAY, with sand; yellow brown mottled grey; clay fraction high plasticity; sand fraction fine to medium		RES	(ST)	>PL											1		
	106	1.4	(CL) Sandy CLAY; orange brown mottled grey; clay fraction low plasticity; sand fraction fine to medium			(VST)	<PL											2		
	105	2			RES	(VST)	<PL											3		
	104	3.4	(CH) CLAY, with gravel; red brown mottled grey; clay fraction high plasticity; gravel fraction fine to medium, sub-angular to sub-rounded		RES	(ST)	>PL											4		
	103	4.5	CONGLOMERATE; grey brown; fine to coarse					MW	4.5	UK								5		
	102	6							6.5									6		
	101	7						SW-FR										7		
	100	8																8		
	99	9																9		
	98																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth
OPERATOR:
LOGGED: RLP/CTB

METHOD: AT to 5.5m, then WB to 157.3m
CASING: HWT to 5.5m

REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

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BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 2 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
seepage	97	10	CONGLOMERATE; grey brown; fine to coarse *(continued)*																	
	96	11																11		
	95	12																12		
	94	13						SW-FR		UK								13		
	93	14																14		
	92	15																15		
	91	16																16		
	90	17																17		
	89	17.5	SANDSTONE; grey; fine to medium						17.5									18		
	88	18						SW-FR		UK								19		
		19																		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 3 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	87	21	SANDSTONE; grey; fine to medium *(continued)*															21		
	86		21.0-22.0m: Conglomerate band																	
	85	22																22		
	84	23						SW-FR		UK								23		
	83	24																24		
	82	25																25		
	81	26.0	CONGLOMERATE; grey; fine and coarse						26.0									26		
	80	27																27		
	79	28						SW-FR		UK								28		
	78	29																29		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE E:378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 4 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH VL L M H VH EH	ROCK RECOVERY (%)	ROCK RQD	ROCK FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	ROCK DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	77	31	CONGLOMERATE; grey; fine and coarse *(continued)*															31		
	76	32																32		
	75	33																33		
	74	34																34		
	73	35						SW-FR		UK								35		
	72	36																36		
	71	37																37		
	70	38																38		
	69	39																39		
	68																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 5 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL				ROCK																	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	67	41	CONGLOMERATE; grey; fine and coarse *(continued)*															41		
	66	42																42		
	65	43																43		
	64	44																44		
	63	45						SW-FR		UK								45		
	62	46																46		
	61	47	47.0-48.0m: Sandstone band															47		
	60	48																48		
	59	49																49		
	58																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 6 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	57		CONGLOMERATE; grey; fine and coarse *(continued)*																	
	51																	51		
	56																			
	52							SW-FR		UK								52		
	55																			
	53																	53		
	54																			
	54																	54		
54.5	53		54.5m: Drilling slowed						54.5											
	55		COAL; black															55		
	52																			
	56							MW		UK								56		
	51																			
57.5	57		CARBONACEOUS SILTSTONE; dark grey						57.5											
	50																	57		
	58																			
	49							SW		UK								58		
	59																			
	48																	59		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 7 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL				ROCK																	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	47		CARBONACEOUS SILTSTONE; dark grey *(continued)*																	
	61							SW		UK								61		
	46	62.0	LAMINITE; grey and dark grey						62.0									62		
	45																			
	63																	63		
	44																			
	64																	64		
	43																			
	65							SW		UK								65		
	42																			
	66																	66		
	41																			
	67																	67		
	40	68.0	TUFFACEOUS SILTSTONE; pale grey						68.0									68		
	39																			
	69							SW		UK								69		
	38																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 8 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	37		TUFFACEOUS SILTSTONE; pale grey *(continued)*																	
	71							SW		UK								71		
	36	71.8							71.8											
	72		COAL; black															72		
								SW		UK										
	35	73.0							73.0											
			SANDSTONE; grey; fine to coarse															73		
	34																			
	74																	74		
	33																			
	75																	75		
	32																			
	76							SW		UK								76		
	31																			
	77																	77		
	30																			
	78																	78		
	29																			
		79.0	CONGLOMERATE; grey						79.0									79		
	28							SW		UK										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE E:378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 9 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	27		CONGLOMERATE; grey *(continued)*																		
	81																	81		
	26																			
	82																	82		
	25																			
	83																	83		
	24																			
	84																	84		
	23																			
	85							SW		UK								85		
	22																			
	86																	86		
	21																			
	87																	87		
	20																			
	88																	88		
	19																			
	89																	89		
	18																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 10 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	91	17	CONGLOMERATE; grey *(continued)*					SW		UK								91		
	92	16							92.0									92		
			SANDSTONE; grey; fine to medium																	
	93	15						SW		UK								93		
	94	14							94.0									94		
			TUFFACEOUS LAMINITE; pale grey																	
	95	13																95		
	96	12																96		
	97	11						SW		UK								97		
	98	10																98		
	99	9	99.0m: Possible siderite banding															99		
		8																		

Approximate from camera only following drilling

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NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 11 of 16

CONDITIONS ENCOUNTERED																SAMPLE				TESTING	
				SOIL				ROCK													
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	101		TUFFACEOUS LAMINITE; pale grey *(continued)*																	
			101.0m: High percentage of cutting passing through sieve					SW		UK										
	103.0		CARBONACEOUS SILTSTONE; grey; with interbedded tuffaceous siltstone						103.0											
								SW		UK										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth
OPERATOR:
LOGGED: RLP/CTB

METHOD: AT to 5.5m, then WB to 157.3m
CASING: HWT to 5.5m

REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 12 of 16

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL			ROCK																		
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	111	-3	CARBONACEOUS SILTSTONE; grey; with interbedded tuffaceous siltstone *(continued)*															111		
	112	-4																112		
	113	-5																113		
	114	-6																114		
	115	-7						SW		UK								115		
	116	-8																116		
	117	-9																117		
	118	-10																118		
	119	-11																119		
		-12																		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 13 of 16

CONDITIONS ENCOUNTERED																SAMPLE				TESTING	
				SOIL			ROCK														
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	120.0 / -13	COAL; black						120.0												
	121 / -14						SW		UK								121		
	122 / -15																122		
	123.0 / -16	TUFFACEOUS SILTSTONE; pale grey						123.0									123		
	124 / -17						SW		UK								124		
	125 / -18																125		
	125.5 / -18	COAL; black						125.5											
	126 / -19																126		
	127 / -20						MW		UK								127		
	128 / -21																128		
	129 / -22																129		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 14 of 16

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH (VL L M H VH EH)	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m) (0.01 0.05 0.10 0.50 1.00 5.00)	ROCK: DEFECTS & REMARKS	SAMPLE: SAMPLE REMARKS	SAMPLE: TYPE	SAMPLE: INTERVAL	DEPTH (m)	TESTING: TEST TYPE	TESTING: RESULTS AND REMARKS
	130.5	-23	COAL; black *(continued)*					MW		UK								131		
			TUFFACEOUS SILTSTONE; pale grey						130.5											
		-24						MW		UK								132		
	133.0	-25	MUDSTONE; grey; medium						133.0									133		
		-26																134		
		-27						SW		UK								135		
		-28																136		
	137.0	-29	TUFFACEOUS SILTSTONE; red green						137.0									137		
		-30						SW		UK								138		
	138.0	-31	LAMINITE; grey						138.0									139		
		-32						SW-FS		UK										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 15 of 16

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH (VL L M H VH EH)	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m) (0.01 0.05 0.10 0.50 1.00 5.00)	ROCK: DEFECTS & REMARKS	SAMPLE: SAMPLE REMARKS	SAMPLE: TYPE	SAMPLE: INTERVAL	DEPTH (m)	TESTING: TEST TYPE	TESTING: RESULTS AND REMARKS
			LAMINITE; grey *(continued)*																	
	141	-33																141		
	142	-34																142		
	143	-35																143		
	144	-36						SW-FS		UK								144		
	145	-37																145		
	146	-38																146		
	147	-39																147		
	148.0	-40	TUFF; pale brown						148.0									148		
		-41						SW		UK										
	149.0		LAMINITE; grey						149.0									149		
		-42						SW-FS		UK										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth **OPERATOR:** **LOGGED:** RLP/CTB
METHOD: AT to 5.5m, then WB to 157.3m **CASING:** HWT to 5.5m
REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

EXPORTED 20/05/22 17:41. TEMPLATE ID: DP_103.02.00_COMBINED

BOREHOLE LOG

CLIENT: Archadia Projects Pty Ltd
PROJECT: Proposed Medical Facility
LOCATION: 31-33 Smith Street, Charlestown

SURFACE LEVEL: 107.7 AHD
COORDINATE **E:**378148.5 **N:** 6351797.7
DATUM/GRID: MGA94 Zone 56
DIP/AZIMUTH: 90°/---

LOCATION ID: 1001
PROJECT No: 210780.01
DATE: 09/05/22 - 17/05/22
SHEET: 16 of 16

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH (VL L M H VH EH)	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m) (0.01 0.05 0.10 0.50 1.00 5.00)	ROCK: DEFECTS & REMARKS	SAMPLE: SAMPLE REMARKS	SAMPLE: TYPE	SAMPLE: INTERVAL	DEPTH (m)	TESTING: TEST TYPE	TESTING: RESULTS AND REMARKS
			LAMINITE; grey *(continued)*																	
	-43																			
	151																	151		
	-44																			
	152							SW-FS		UK								152		
	-45																			
	153																	153		
	-46																			
	153.9								153.9											
	154		COAL; black					SW-FR		UK								154		
Total water loss	154.4								154.4											
	-47		VOID; (Drill string drop, rods lowered without rotation to 155.65 m depthwith no resistance encountered. Sudden total water loss)																	
	155							NA		NA								155		
	155.65								155.6											
	156		RUBBLE; (Rods lowered with minimal rotation and water pressure)					NA		NA								156		
	-49																			
	156.88								156.88											
	157		FLOOR; (Consistent increased drill resistance)					UK		UK								157		
	-50																			
	158.0								158.0									158		
			Borehole discontinued at 158.00m depth Limit of investigation																	
	-51																			
	159																	159		
	-52																			

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hydrapower Scout Switched to Henjin DB8 from 140 m depth
OPERATOR:
LOGGED: RLP/CTB

METHOD: AT to 5.5m, then WB to 157.3m
CASING: HWT to 5.5m

REMARKS: Coordinates obtained using a differential GPS typically accurate to ±0.1 m.

DOUGLAS PARTNERS PTY LTD
31 – 33 Smith Street, Charlestown

BORE 1 PROJECT 81563 2014

2.80 m – 7.0 m

DOUGLAS PARTNERS PTY LTD
31 – 33 Smith Street, Charlestown

BORE 1 PROJECT 81563 2014

7.0 m – 10.15 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplates** **Preliminary Geotechnical Contamination Investigation** **31-33 Smith Street, Charlestown**	PROJECT: 81563 PLATE No: 1 REV: 0
	CLIENT: Lake Macquarie City Council	DATE: 2 Aug 14

DOUGLAS PARTNERS PTY LTD
31 – 33 Smith Street, Charlestown

BORE 2 PROJECT 81563 2014

2.5 m – 11.64 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplates** **Preliminary Geotechnical Contamination Investigation** **31-33 Smith Street, Charlestown**	PROJECT: 81563 PLATE No: 2 REV: 0
	CLIENT: Lake Macquarie City Council	DATE: 1 Aug 14

DOUGLAS PARTNERS PTY LTD
31 – 33 Smith Street, Charlestown

BORE 3 PROJECT 81563 2014

3.6 m – 8.0 m

DOUGLAS PARTNERS PTY LTD
31 – 33 Smith Street, Charlestown

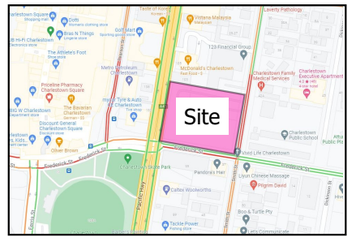
BORE 3 PROJECT 81563 2014

8.0 m – 10.27 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplates** **Preliminary Geotechnical Contamination Investigation** **31-33 Smith Street, Charlestown**	PROJECT: 81563 PLATE No: 3 REV: 0
	CLIENT: Lake Macquarie City Council	DATE: 3 Aug 14

Appendix C

Drawing 1 – Test Location Plan
Drawing 2 – Cross-section A
Drawing 3 – Cross-section B
Drawing 4 – Cross-section C



Locality Plan

Drawing adapted from NearMap image dated April 2019 and previous DP investigations drawings

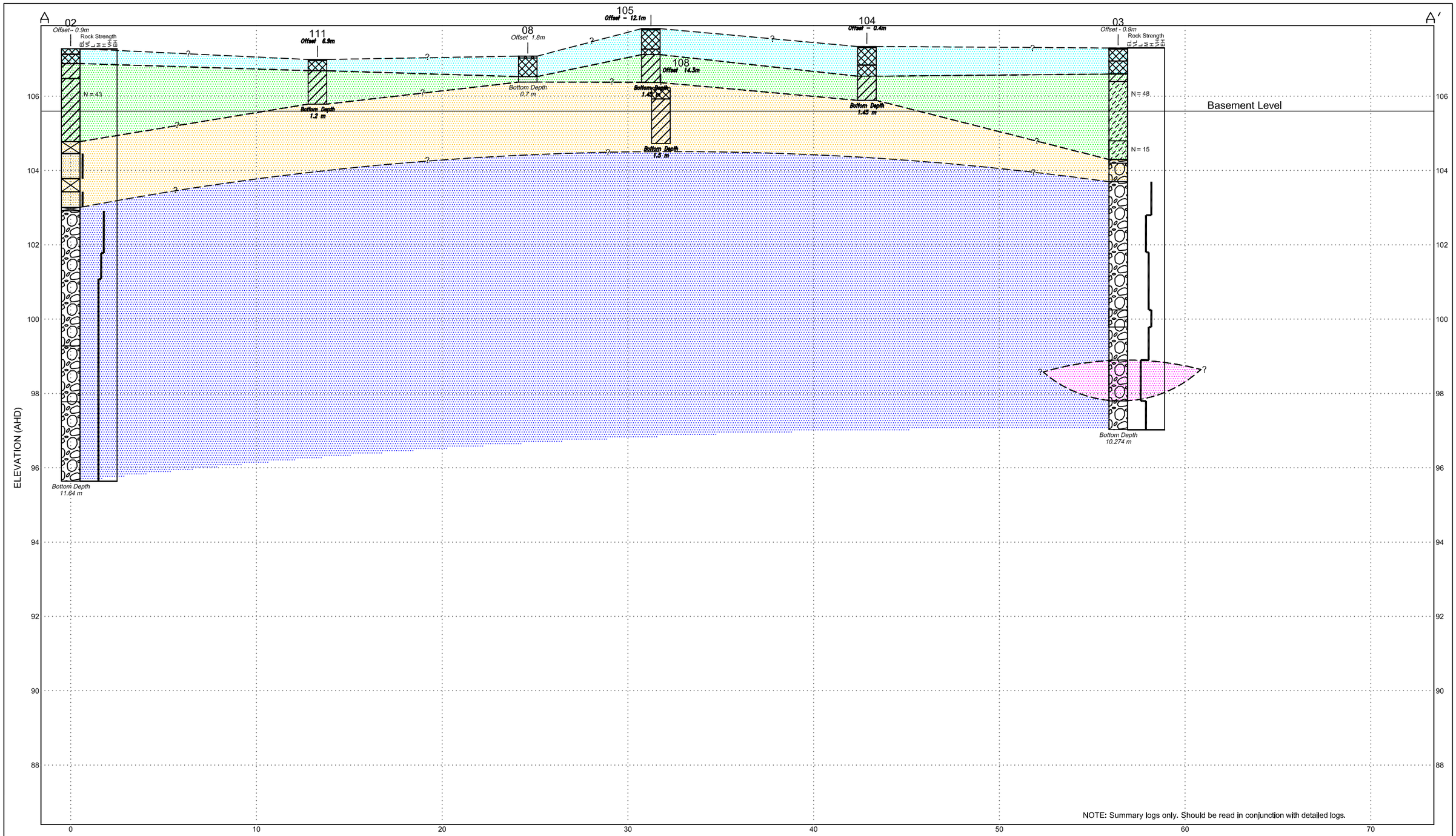
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	GPV Property Group		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:500 @ A3	DATE:	17.11.2022

TITLE: **Test Location Plan**
Proposed Multi-Storey Development
31 to 33 Smith Street, Charlestown

N

PROJECT No:	210780.00
DRAWING No:	1
REVISION:	1



LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Clayey Sand
- Conglomerate
- Filling
- Sandstone
- Sandy Clay
- Unit 1 Filling
- Unit 2 & 3 Clay and Clayey Sand
- Unit 4.1 Extremely Low to Low Strength Rock
- Unit 4.2 Low Strength Rock
- Unit 4.3 Medium to High Strength Rock

NOTES:

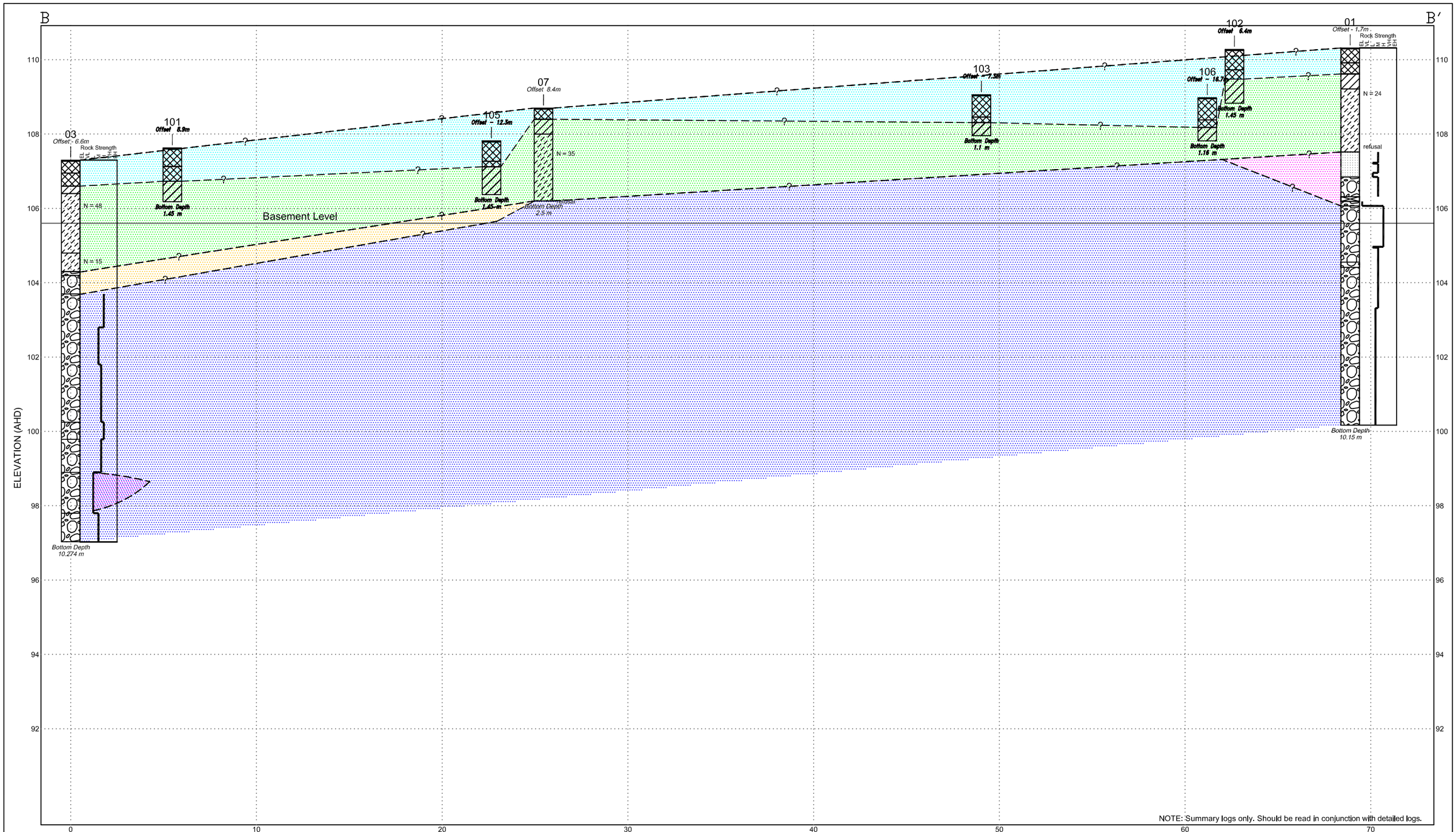
1. Refer to Drawing 1 for location of sections.
2. Refer to geotechnical report for detailed description of geotechnical units.
3. Reference should be made to borehole logs for detailed descriptions
4. Layer boundaries have been established from discrete test locations and has involved interpolation between data points and should be regarded as approximate only.

TESTS / OTHER
N - Standard penetration test value
▼ - Water level

Horizontal Scale (metres)
0 4
Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lake Macquarie City Council	TITLE: Cross-section A Preliminary Geotechnical and Contamination Investigation 31-33 Smith Street, Charlestown	PROJECT No: 210780.00
OFFICE: Newcastle / DRAWN BY: PLH		DRAWING No: 2
SCALE: 1:200 (H) 1:100 (V) @ A3 / DATE: 18.01.2022		REVISION: 0



LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Clayey Sand
- Conglomerate
- Filling
- Sandstone
- Unit 1 — Filling
- Unit 2 & 3 — Clay and Clayey Sand
- Unit 4.1 — Extremely Low to Low Strength Rock
- Unit 4.2 — Low Strength Rock
- Unit 4.3 — Medium to High Strength Rock

NOTES:

1. Refer to Drawing 1 for location of sections.
2. Refer to geotechnical report for detailed description of geotechnical units.
3. Reference should be made to borehole logs for detailed descriptions
4. Layer boundaries have been established from discrete test locations and has involved interpolation between data points and should be regarded as approximate only.

TESTS / OTHER

N - Standard penetration test value

▼ - Water level

0 4

Horizontal Scale (metres)

Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lake Macquarie City Council		TITLE: Cross-section B Preliminary Geotechnical and Contamination Inv 31-33 Smith Street, Charlestown	PROJECT No: 210780.00
OFFICE: Newcastle	DRAWN BY: PLH		DRAWING No: 3
SCALE: 1:200 (H) 1:100 (V) @ A3	DATE: 18.01.2022		REVISION: 0

C

C′

01
Offset – 0.1m
Rock Strength
N = 24
refusal
Bottom Depth
10.15 m

106
Offset – 7.1m
Bottom Depth
1.16 m

107
Offset 11.4m
Bottom Depth
1.45 m

110
Offset 9.7m
Bottom Depth
1.5 m

04
Offset 0.2m
N = 10
N = 31
N = 51
Bottom Depth
4.45 m

Basement Level

ELEVATION (AHD)

110 108 106 104 102 100 98 96 94 92

0 10 20 30 40 50 60 70

DISTANCE ALONG PROFILE (m)

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Clayey Sand
- Conglomerate
- Filling
- Sandstone
- Sandy Clay

Unit 1	Filling
Unit 2 & 3	Clay and Clayey Sand
Unit 4.1	Extremely Low to Low Strength Rock
Unit 4.2	Low Strength Rock
Unit 4.3	Medium to High Strength Rock

NOTES:

1. Refer to Drawing 1 for location of sections.
2. Refer to geotechnical report for detailed description of geotechnical units.
3. Reference should be made to borehole logs for detailed descriptions
4. Layer boundaries have been established from discrete test locations and has involved interpolation between data points and should be regarded as approximate only.

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

0 4
Horizontal Scale (metres)

Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Lake Macquarie City Council		
OFFICE:	Newcastle	DRAWN BY:	PLH
SCALE:	1:200 (H) 1:100 (V) @ A3	DATE:	18.01.2022

TITLE: Cross-section C
Detailed Site Investigation
31-33 Smith Street, Charlestown

PROJECT No:	81563.01
DRAWING No:	4
REVISION:	0