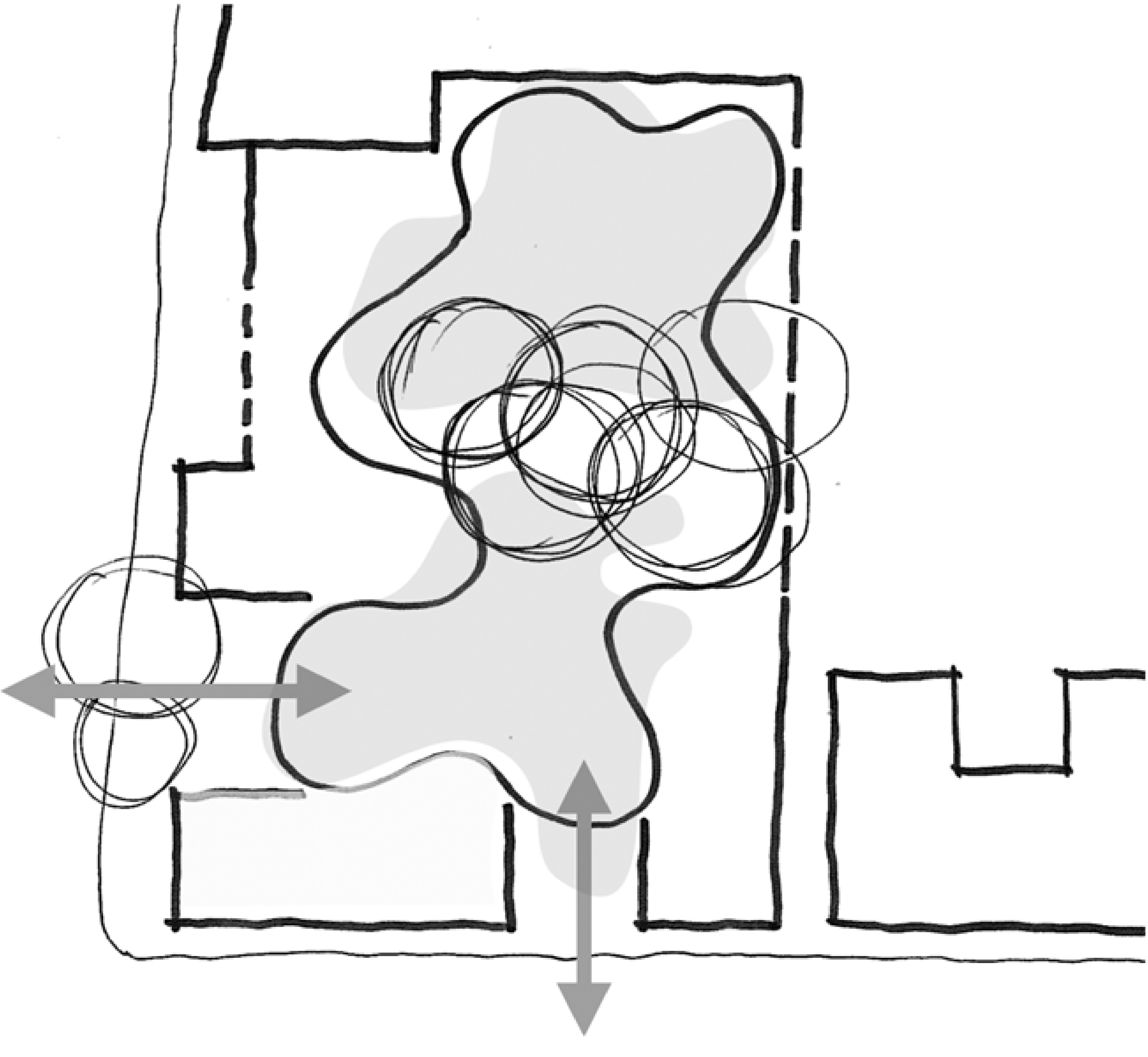
DARLINGTON PUBLIC SCHOOL REDEVELOPMENT

Appendix Y — Geotechnical Report

SSD-9914

Prepared by Douglas Partners

For NSW Department of Education



Douglas Partners
Geotechnics / Environment / Groundwater

Report on
Geotechnical Investigation

Proposed Upgrade Works
Darlington Public School, Darlington

Prepared for
Gardner Wetherill & Associates

Project 92277.01
February 2019

Integrated Practical Solutions

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

	Signature	Date
Author		12 February 2019
Reviewer	pp MJT	12 February 2019

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Report on Geotechnical Investigation
Proposed Upgrade Works
Darlington Public School, Darlington

1. Introduction

This report presents the results of a supplementary geotechnical investigation undertaken for proposed upgrade works at Darlington Public School, Darlington. The investigation was commissioned by Luen Samonte of Gardner Wetherill & Associates and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal MAC180298 dated 13 September 2018.

DP understands that the site currently comprises an operating primary school and preschool. It is also understood that the proposed redevelopment and upgrading works include the demolition of existing buildings and the construction of new teaching blocks within the site; however the detailed design information of the proposed buildings and or any cut-fill plans were yet to be finalised at the time of this report.

A preliminary geotechnical investigation was previously undertaken by DP (Project 92277.00) which comprised the drilling of nine shallow boreholes to auger refusal. This supplementary investigation was undertaken to support the preliminary investigation report and assist in the design of proposed upgrade works.

The supplementary investigation included the drilling of six cored boreholes and laboratory testing of selected samples. Details of the work performed and the results obtained are given within this report, together with comments relating to foundation design and earthworks. This report should be read in conjunction with the Preliminary Geotechnical Investigation Report.

DP has undertaken a Detailed Site Investigation (DSI) for Contamination in conjunction with this investigation (Report 92277.01.R.002) which will be reported on separately. A prior Contamination Assessment (Report 92277.00.R.001) and Hazmat Survey (Report 92277.00.R.003) were also undertaken concurrently with the Preliminary Geotechnical Investigation for the site.

2. Site Description

Darlington Public School is located on the corner of Golden Grove Street and Abercrombie Street at Darlington, and covers a rectangular area of approximately 0.72 ha with maximum north-south and east-west dimensions of approximately 100 m and 80 m, respectively.

The school campus consists of two basketball courts to the north, school buildings to the south and west, and playgrounds in the central portion of the site.

At the time of the investigation, large trees covered most of the playgrounds, as well as surrounding the basketball courts. The playground areas were variably concrete and rubber matting.

3. Regional Geology

Reference to the 1:100 000 Sydney Geological Series Sheet (Ref 1) indicates that the site is underlain by Ashfield Shale (mapping unit Rwa) of the Wianamatta Group of Triassic age. This formation typically comprises siltstone and laminite which weather to form clays of high plasticity. The results of the investigation were generally consistent with the geological mapping where residual clays and shale of variable weathering and strength conditions were encountered in all boreholes.

4. Field Work

4.1 Methods

The field work comprised the drilling of six boreholes (Bores A – F) to a depths of up to 10.4 m using a bobcat mounted drilling rig and a combination of continuous solid flight augers with a nominal 100 mm diameter and 'NMLC' rotary coring techniques and water flush with steel casing to obtain continual rock core samples. Standard penetration tests (AS 1289.6.3.1) were also carried out at regular intervals whilst augering. The standard penetration test procedure is given in the attached notes and the penetration ‘N’ value obtained during testing is shown on the borehole logs.

The field work was undertaken by a geotechnical engineer who logged the boreholes and collected disturbed samples to assist in strata identification and for laboratory testing. Following logging, testing and sampling, each borehole was backfilled and the ground surface reinstated with either cold-mix asphalt, quick-set concrete or spoil material depending on surface material at each borehole location.

The borehole locations were nominated by the client and located on site by DP. The locations are shown on Drawing 1 (Appendix A) and were surveyed with a differential GPS, for which an accuracy of ± 20 mm is typical.

All field measurements and mapping for this project has been carried out using the Geodetic Datum of Australia 1994 (GDA94) and the Map Grid of Australia 1994 (MGA94 Zone 56). All reduced levels are given in relation to Australian Height Datum (AHD).

4.2 Results

The borehole logs are included in Appendix B, and should be read in conjunction with the accompanying standard notes that define classification methods and descriptive terms. Relatively uniform conditions were encountered underlying the site, with the general succession of strata broadly summarised as follows:

- FILLING – comprising asphaltic concrete, concrete and sandy clay with some gravel to depths in the range of 0.07 – 0.20 m encountered in Bores A, B and D – F, with clayey silt topsoil to a depth of 0.2 m in Bore C;
- FILLING – variable mixtures of sand, silt and clay filling with some gravel to depths in the range of 0.7 – 2.4 m in all boreholes;
- CLAY – stiff to hard silty clay to depths of 2.0 – 3.5 m in all boreholes; and

- BEDROCK – extremely low strength shale first encountered at depths of 2.0 – 3.5 m in all boreholes and generally increased in strength with depth. Shale generally became medium strength, interbedded siltstone and fine-grained quartz-lithic sandstone at depths in the range of 8.30 – 9.04 m and continued to the termination depths of 9.80 – 10.44 m in all boreholes, except for Bore D which terminated in low strength shale at 9.55 m.

No free groundwater was observed in the boreholes during auger drilling and for the short time that they were left open. The introduction of water into the boreholes during the rotary coring and the immediate backfilling of the test locations precluded any long-term observations of groundwater levels that might be present. It is noted that groundwater levels are affected by factors such as weather conditions and can fluctuate with time.

5. Laboratory Testing

5.1 Plasticity Testing

Selected samples from the boreholes excavated for the preliminary geotechnical investigation were tested in the laboratory for measurement of field moisture content, Atterberg limits and linear shrinkage. The detailed laboratory test report sheets are given in Appendix C, with the results summarised in Table 1.

Table 1: Results of Plasticity Testing

Bore No	Depth (m)	Material	W_F (%)	LL (%)	PL (%)	PI (%)	LS (%)
A	1.0 – 1.45	Silty Clay	21.0	68	23	45	14.0
B	1.0 – 1.45	Silty Clay	23.4	66	24	42	13.5
C	1.0 – 1.45	Silty Clay	25.8	72	23	49	16.5
F	1.0 – 1.45	Filling	14.9	41	23	18	8.0

Where W_F = Field moisture content
W_L = Liquid limit
LS = Linear shrinkage
W_P = Plastic limit
PI = Plasticity Index

The results indicate that the natural clays and clay filling encountered on site appear to be of moderate to high plasticity and as such, would be expected to be susceptible to shrinkage and swelling movements due to seasonal moisture variations.

5.2 Point Load Testing

Selected rock core samples were tested in the laboratory for measurement of point load strength index ($Is_{(50)}$) to estimate rock strength at variable depths. The detailed laboratory test report sheets are given in Appendix C and the values of $Is_{(50)}$ are shown on the borehole logs.

6. Proposed Development

It is understood that conceptual planning for the site is in progress, with detailed design not yet completed. Based on preliminary information, the redevelopment works are likely to comprise the demolition of some buildings within the site and the construction of new teaching blocks. The proposed buildings are likely to be multi-storey, however, the locations, design loads and other design information of the structures are unknown to DP at this time. Once design details are known, the advice given within this report must be reassessed prior to finalisation.

7. Comments

7.1 General

The following comments are based on the surface and subsurface profiles encountered in the boreholes. Comments are provided in the following sections on development constraints related to geotechnical and geological factors to assist in the foundation design of the proposed new buildings. As detailed design of the proposed redevelopment works has not been undertaken, the comments given must also be considered as being preliminary in nature. Once details are available, they should be forwarded to DP for review to determine if comments given within this report are appropriate or require revision.

7.2 Subsurface Conditions

The following comments are based on the surface and subsurface profiles encountered during the investigation and the results of laboratory testing of selected samples collected at the borehole locations. The investigation findings have shown that subsurface conditions underlying the site generally comprise topsoil, concrete or asphaltic concrete to a depth of 0.07 – 0.2 m underlain by filling to depths of 0.7 – 2.4 m. The filling is underlain by generally stiff to hard silty clays to depths in the range of 2.0 – 3.5 m which in turn is underlain by bedrock comprising extremely low to medium strength, weathered shale of interbedded siltstone and sandstone which continued to the termination depths of the boreholes.

The bedrock from the cored boreholes has been classified in accordance with Reference 3 and depths/RLs of each rock class are summarised in Table 2.

Table 2: Depth/Level of Rock Classes

Bore	RL Depth (m)	Thickness (m)	Rock Class (Shale)
A Surface Level: 38.1m AHD	35.6 – 29.7	5.9	IV
	29.7 – 27.6	2.1	III
B Surface Level: 36.0m AHD	33.4 – 27.9	5.5	IV
	27.9 – 27.0	0.9	III
	27.0 – 25.5	1.5	II
C Surface Level: 34.6m AHD	30.1 – 27.8	2.3	IV
	27.8 – 26.4	1.4	III
	26.4 – 24.6	1.8	II
D Surface Level: 33.0m AHD	27.8 – 26.2	1.6	IV
	26.2 – 23.4	2.8	III
E Surface Level: 34.1m AHD	30.1 – 25.7	4.4	IV
	25.7 – 24.8	0.9	III
	24.8 – 24.3	0.5	II
F Surface Level: 34.9m AHD	31.1 – 29.5	1.6	IV
	29.5 – 26.6	3.3	III
	26.6 – 24.7	1.9	II

The cored borehole logs indicate that the rock structure is mainly governed by horizontal to sub-horizontal (0º – 10º) bedding and horizontal to steeply-inclined (0° – 45°) jointing observed mainly in fractured shale. The fracture spacings shown on the recovered core samples show 'highly fragmented' and weathered rock to depths of 7.0 – 8.3 m in the boreholes. Better quality shale was encountered in the boreholes at RL's 25.7 – 29.7 m AHD and identified as Class III shale as detailed in Pells et al – 1998 (Ref3).

7.3 Foundations

The results of the investigation indicate that good quality weathered rock will be expected at depths ranging from 7.0 – 8.3 m at the borehole locations, and hence, pending the required excavation depth, deep foundations in the form of bored piles would be suitable options to accommodate the loads of the proposed multi- storey buildings. The use of shallow footings may only be justified for the lightly loaded structures founded in controlled filling or stiff natural clay or if deep excavations for basement parking are proposed.

Based on the results of the field investigation and laboratory testing, retaining wall and building footings could be proportioned using the maximum design parameters presented in Table 3. The footing recommendations and design parameters for any given strata will need to be confirmed following completion of the design stage when final excavation depth, footing size and design loads are specified.

Table 3: Estimated Design Parameters

Material		Ultimate Base Bearing Pressures (kPa) (1)	Ultimate Shaft Adhesion Pressures (kPa) (2)	Allowable Base Bearing Pressures (kPa) (3)	Allowable Shaft Adhesion Pressures (kPa)	Allowable Lateral Resistance (kPa)
Controlled fill		-	-	100	-	-
Very stiff to hard clay		-	-	200	-	-
Shale	Class V	3000	100	700	70	200
	Class IV	6000	150	1000	100	300
	Class III	20000	750	3500	350	1200

Notes (1) The values are in accordance with Pells et al - 1998 (Ref3);

(2) Ultimate values occur at large settlements (generally >5% of the minimum footing width);

(3) Values can only be adopted for clean sockets of roughness category R2 or better. Values may need to be reduced to account for smear;

(4) Value for rock based on settlements of <1% of minimum footing width.

Base bearing and shaft adhesion values have also been provided for Limit State design. The geotechnical strength reduction factor Φg of 0.45 shall be applied in accordance with AS 2159-2009 (Ref 4), Table 4.3.2 based on the available information.

Reference should be made to the borehole logs (Appendix B) and Table 2 with respect to the depth/levels of the various bearing strata.

7.4 Earthworks

It is considered that some bulk earthworks, including the removal of existing structures and underlying moisture affected or unsuitable material will be expected. The final earthworks plans have not been finalized at the time of preparing this report. It can be inferred from the conceptual design drawing that a lower ground floor is incorporated in the proposed buildings. Filling is expected to be limited to grading the site surface for light demountable buildings, pavement construction and installation of services.

7.4.1 Site Preparation

It is recommended that all filling be placed and compacted in accordance with Level 1 requirements (AS 3798 – 2007, Ref 2). To prepare the site for the construction of new buildings, the following procedures are suggested:

- Stripping of vegetation and organic topsoils and pavement material. Topsoil may separately be stockpiled for use in landscaping or removed off site;
- Stripping of uncontrolled fill and unsuitable material within the footprint of the proposed buildings. Inspection of the stripped surface by a geotechnical engineer;
- Compaction of the exposed surface with at least of 8 passes of a 12 tonne (minimum dead weight) roller, followed by test rolling in the presence of a geotechnical engineer. Where soft spots are identified, they should be excavated and then backfilled using a suitable granular material. Additional filling may also be required to elevate building platforms. All filling should be placed in 250 mm (loose thickness) layers and compacted with placement moisture contents within the range of -2% to +2% of OMC in order to limit surface deflection during proof rolling;
- Surface drainage should be maintained at all times by adopting appropriate cross-falls across the site. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed surface.

Filling delivered to site must be approved by the geotechnical consultant prior to delivery to site. Highly reactive clay filling should be avoided.

Site observations and laboratory test results have indicated the presence of high plasticity silty clays in some areas which could be adversely affected by inclement weather. Whilst these soils are typically of a stiff to very stiff consistency when dry, they can rapidly lose strength during rainfall and subsequent partial saturation and result in difficult trafficability conditions.

Conventional sediment and erosion control measures should be implemented during the construction phase, with exposed surfaces to be topsoiled and vegetated as soon as practicable following the completion of earthworks.

7.4.2 Excavation

All topsoil, filling, natural soils and bedrock up to very low to low strength should be readily removed using a conventional medium sized excavator fitted with a toothed bucket possibly with some light ripping in the weathered bedrock. These conditions were generally encountered to depths of about 7.0 – 8.0 m within all borehole locations

The excavation is expected to include any moisture affected material within the footprint of demolished buildings and then extend further to the design level at the base of the lower ground level or any proposed basement level.

Where low to medium strength rock is encountered, these areas will, for the most part, be adequately removed during bulk earthworks using a large excavator with some light to medium ripping. However, larger plant may provide greater excavation efficiency particularly during drilling of pier foundations.

Medium to high strength rock will offer greater resistance to light ripping. These areas will require pneumatic/hydraulic hammering equipment in combination with rock sawing and/or grinding to achieve the required cut depths.

Due to the proximity of surrounding buildings and presence of filling at shallow depth, the vibration resulting from the excavation could cause damage to the underground services or brick structures. It is recommended, if the use of percussive equipment is required within 40 m of any vibration sensitive structures, vibration monitoring should be undertaken. If the monitoring indicates unacceptable levels of vibration, then the use of non-percussive (ie: rock sawing and ripping) excavation methods will be required. This requirement however, will need to be determined on site once the details of the bulk earthworks and proposed excavation equipment are known.

Anticipated equipment required for excavations are given as a guide only. Rock strength and quality are expected to vary within the footprint of the proposed buildings. Assessment of excavation difficulties are best determined by intending contractors based on inspection of the core samples, the equipment they have at their disposal and the experience of the operators. For information on soil and rock types and indicative strength, reference must be made to the individual logs which are included in Appendix B.

7.4.3 Reuse of Excavated Materials

Generally, the filling, natural clays and bedrock of up to low strength encountered during the investigation, will be suitable for reuse as engineered filling within the site. The material should not contain any particle sizes greater than 150 mm as these may cause inadequate compaction, and should not contain silts due to their propensity for saturation and erosion. It is expected that the extremely weathered or low strength rock should readily break down beneath the weight of the rollers. However, bedrock of medium strength or higher may potentially need to be crushed using a rock crusher.

Topsoil and other deleterious materials will not be suitable as a fill material but could be stockpiled for potential use in landscaping or alternatively, removal from site.

7.4.4 Batter Slopes

While cut slopes within the clays may often stand vertically and unsupported (provided no nearby structures are present) for short periods of time, they will rapidly lose strength upon exposure to weather. A maximum batter slope of 1(H):1(V) is recommended for unsurcharged temporary slopes in stiff clays. The maximum batter slope should be reduced to 3(H):1(V) for temporary batters in uncontrolled filling.

Where the slopes are to be vegetated to prevent erosion, a maximum final batter slope of 3(H):1(V) is recommended. If batters greater than 4 m in height are required, the inclusion of a 2 m wide intermediate bench in mid-height is recommended to reduce the effects of scour and erosion.

Where filling batters are formed, similar parameters to those recommended for cut slopes can be adopted. However, it is recommended that whilst the slope is being formed, the batters should be over-filled in near-horizontal lifts and cut back to form the design grades.

7.5 Excavation Support

Once bulk excavations are required, temporary or permanent batters at recommended batter angles may not be feasible due to insufficient space for batters adjacent of the excavation.

The design of shoring will therefore be required for subsurface materials as batters steeper that those suggested in Section 7.4 are not expected to remain stable for a long period of time. The design should take account of the lateral loads due to adjacent structures.

Pending the final excavation depth, the following options may be adopted for retaining the excavations in this project. The feasible options would include either anchored soldier piles (drilled at maximum 2.4 m spacings) with close shuttering / shotcrete infill panels or contiguous piling. In the absence of details of adjacent footings being available, contiguous piles should be used for excavations adjacent to neighbouring buildings. Contiguous piling is the cheapest form of concrete pile wall, however, is not a water retaining structure and may not be suitable for any material due to gaps between piles.

Excavation of panels for a shotcreting at anchored soldier piles option should be staged to allow a hit and miss approach with the first panel extending no more than 1.0 m below the base of the adjacent building foundation, including the reinforcement overlap. The next row of panels should not exceed 1.5 m with subsequent panels not exceeding 2 m in height.

Drainage is normally provided behind shotcrete walls. The sprayed concrete wall should provide adequate structural support, however it may be appropriate to install a false wall (single brickwork or block work) for aesthetic purposes and to avoid dampness. Care should be exercised in construction to ensure that anchors are installed progressively with excavation (and stressed up) and that the shotcreting is carried out at regular intervals to limit the exposed sections. The first row of anchors should be installed as high as possible and stressed up to 80% of its working load prior to excavation of the next row of panels.

A high capacity piling rig will be required to penetrate the high strength rock. Otherwise, the piers may refuse in the high strength rock, well above the excavation levels and additional anchors may need to be installed in the toe of each pier to provide support/restraint of the structure and rock mass.

As a result of moderately to steeply-inclined jointing especially in fractured shale and presence of highly weathered overburden material there is a potential for 'wedge-type' failures within the batters. Therefore, allowance will need to be made for the support of the fractured rock where contiguous walling is not installed. The support requirements will depend on a number of factors including extent of disturbance during excavation; orientation (bearing), persistence (lateral continuity) and spacing (horizontal separation) of jointing; clay infilling of open jointing; and groundwater. As such, detailed design should be reviewed and verified by DP to ensure the allowance has been made for variable subsurface strata encountered.

As a guide, in addition to the soldier piles, preliminary design of infilled panel sections should allow for the application of a steel mesh-reinforced shotcrete layer with a minimum nominal thickness of 150 mm where permanent support is required or 75 mm for temporary support. Due to the highly fractured nature of the rock stratum, the installation of rock bolts may be considered to support the temporary excavations batters based on inspections carried out by an engineering geologist. The final required bolt lengths can only be determined following assessment of fracture characteristics observed in the face.

Earth pressures acting on multi-anchored shoring structures and retaining walls can be estimated on the basis of a trapezoidal pressure distribution (ie: triangular to 0.25 H, uniform from 0.25 H to 0.75 H and triangular decreasing to zero from 0.75 H to H) with depth using appropriate values of bulk density and active (Ka) or 'at rest' (Ko) lateral earth pressure coefficients as set out in Table 4.

Table 4: Suggested Lateral Earth Pressure Design Parameters – Retaining Structures

Retained Material	**Bulk Density (kN/m^3)**	**K_0**	**Ka**	
			Short Term	**Long Term**
Stiff to hard clay and extremely weathered rock	20	0.6	0.25	0.3
Very low strength shale	22	0.45	0.3	0.35
Medium strength or greater shale	22	-	10 kPa*	10 kPa*

* A uniform pressure of 10 kPa should be adopted for the support of the medium strength shale to account for possible defects, but subject to inspection during the early stages of excavation to confirm bedding/jointing and revision of lateral restraint, if appropriate.

'At rest' pressure coefficients are appropriate where support must be provided to boundaries and where movement intolerant services or adjacent structures are present. Surcharge lateral pressure due to any adjacent structure will also need to be taken into account where the footings found on low strength or weaker rock or unfavourably orientated jointing is encountered.

The current investigation is not suggesting any indication of the groundwater table to the limit of investigation. In the event that, a tanked basement is required for this project, full hydrostatic pressure should be allowed for in design. As such, densities of the retained soils can be appropriately reduced to the buoyant values. Where applicable, superimposed surcharge loads due to adjacent driveways and developments should also be accommodated in the design of such structures.

Where appropriate, lateral restraint may also be developed by embedding piles below the base of the excavation and developing passive pressure. Suggested ultimate passive resistance values are given in Table 5 and may be adopted below one pile diameter beneath the bulk excavation level and should incorporate a factor of safety to limit wall movement.

Table 5: Suggested Ultimate Passive Pressure Values

Material	**Ultimate Passive Pressure (kPa)**
Extremely low and very low strength siltstone	300
Low strength shale	1200
Medium or greater strength shale	4000

Where engineer-designed retaining walls are proposed, the following measures should be incorporated into the design:

- Backfilling of the void between the wall and the slope using imported, free draining granular material connected into a drainage pipe at the base of the wall;
- Capping of the backfill (where exposed) with compacted clay or concrete to prevent surface runoff entering the backfill;
- Provision of an open drain to collect and divert surface runoff from ponding above the wall;
- For horizontal backfill or retained soils, design based on an average bulk unit weight for retained material of 20 kN/m^3 and on a triangular earth pressure distribution based on an active earth pressure coefficient of (K_a) 0.3 for compacted filling and natural clay where no movement sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall;
- Where there are movement sensitive structures located within the abovementioned critical zone, an at rest pressure coefficient (K_0) of 0.6 should be adopted; and
- If hydrostatic pressures are allowed, soil densities could be reduced to the buoyant values.

If an adequate drainage medium is not provided behind the retaining wall, then hydrostatic pressures must be incorporated within the design with soil parameters reduced to their buoyant values.

7.6 Earthquake Actions – Sub-soil Class

The site stratigraphy comprises minor filling and topsoil underlain by stiff to hard silty clays, overlying bedrock at depths ranging from 2.2 m to 4.5 m within the footprint of the proposed structure. Therefore, the site's sub-soil class when assessed in accordance with AS 1170.4 – 2007 (Ref 5) is considered a rock site and a classification of Class B_e is suggested.

8. Summary

The investigation included the drilling of six cored boreholes to a maximum depth of 10.4 m within the proposed school site at the locations nominated by the client. The boreholes have indicated that subsurface conditions underlying the site generally comprise variable depths of filling and topsoil overlying silty clay and clay of very stiff to hard consistency. Rock was encountered in all boreholes on first contact at depths of between within the range 2.2 m to 4.5 m.

Bearing capacity recommendations are provided in Section 7.3. The site preparation, earthworks and excavation support recommendations are to be undertaken in accordance with Sections 7.4 and 7.5.

Consideration must be given to the preliminary nature of the investigation and potential for variability in the subsurface condition across the site. Once design is suitably advanced, DP must review the plans to determine if the comments given within are appropriate or if additional investigations are required.

9. References

1. Geology of 1:100 000 Sydney Geological Series Sheet No 9130, Dept of Mineral Resources, (1983).
2. AS 3798 – 2007, "Guidelines on Earthworks for Commercial and Residential Developments".
3. Foundations on Shales and Sandstones in the Sydney Region, Pells *et al*, Australian Geomechanics Journal (1998).
4. Australian Standard AS 2159 – 2009 "*Piling – Design and Installation*".
5. AS 1170.4 – 2007, "Structural Design Actions – Part 4: Earthquake Actions in Australia".
6. AS 1170.4 – 1993, "Structural Design Actions – Part 4: Earthquake Actions in Australia".

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Darlington Public School in accordance with DP's proposal dated 13 September 2018 and acceptance received from Ms Luen Samonte. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Gardner Wetherill & Associates Pty Ltd for this project only and for the purposes as described in the report. It should not be used or relied upon for other projects 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 subsurface 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. Subsurface 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.

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 report did not include the assessment of surface or subsurface 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.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report
Drawing 1

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.

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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.

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

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.

Symbols & Abbreviations

Douglas Partners

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

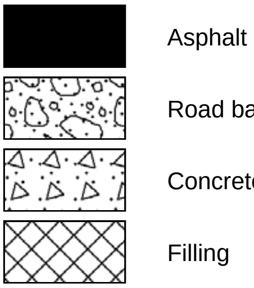
Other

fg	fragmented
bnd	band
qtz	quartz

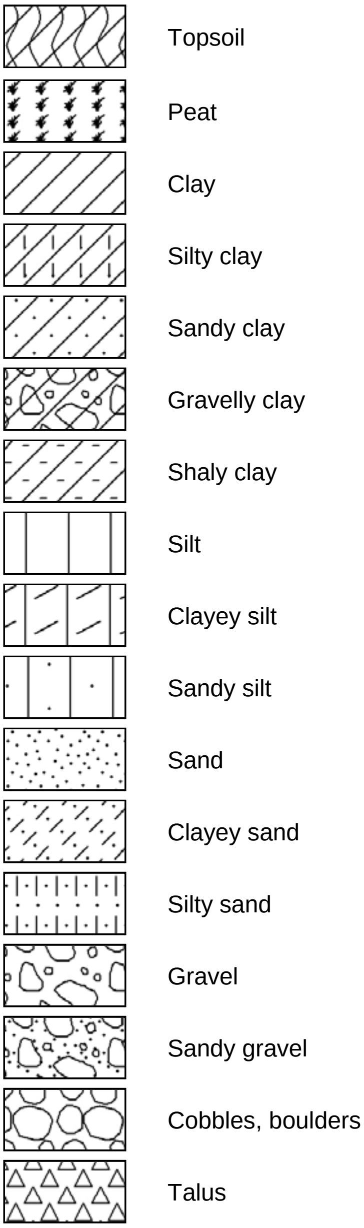
Symbols & Abbreviations

Graphic Symbols for Soil and Rock

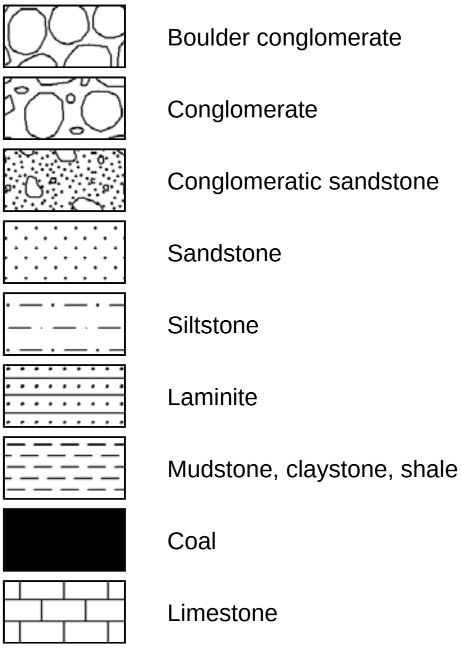
General



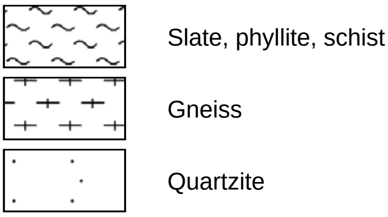
Soils



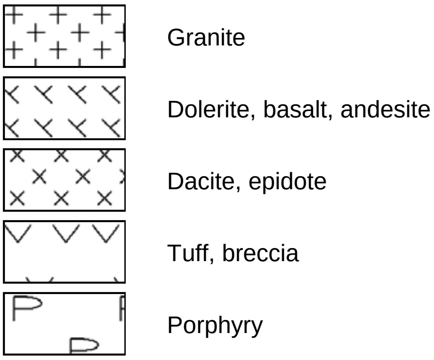
Sedimentary Rocks



Metamorphic Rocks



Igneous Rocks



Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Descriptions

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and 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 test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

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

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

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 some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or better. 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

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Geotechnics / Environment / Groundwater

CLIENT: Gardner Wetherill & Associates
OFFICE: Macarthur
DRAWN BY: JHB
SCALE: As shown
DATE: 07.02.2019

TITLE: **Borehole Locations - Goetechnical Investigation**
Proposed Upgrade Works
Darlington Public School, Darlington NSW

N
MGA

PROJ. #: 92277.01
DRAWING No: 1
REVISION: 0

Appendix B

Borehole Logs (A – F)

Douglas Partners Pty Ltd

Proposed Upgrade Works
Darlington Public School, Darlington

BORE: A DEPTH: 2.50m – 10.44m PROJECT: 92277.01 Jan/Feb 2019

BOREHOLE LOG

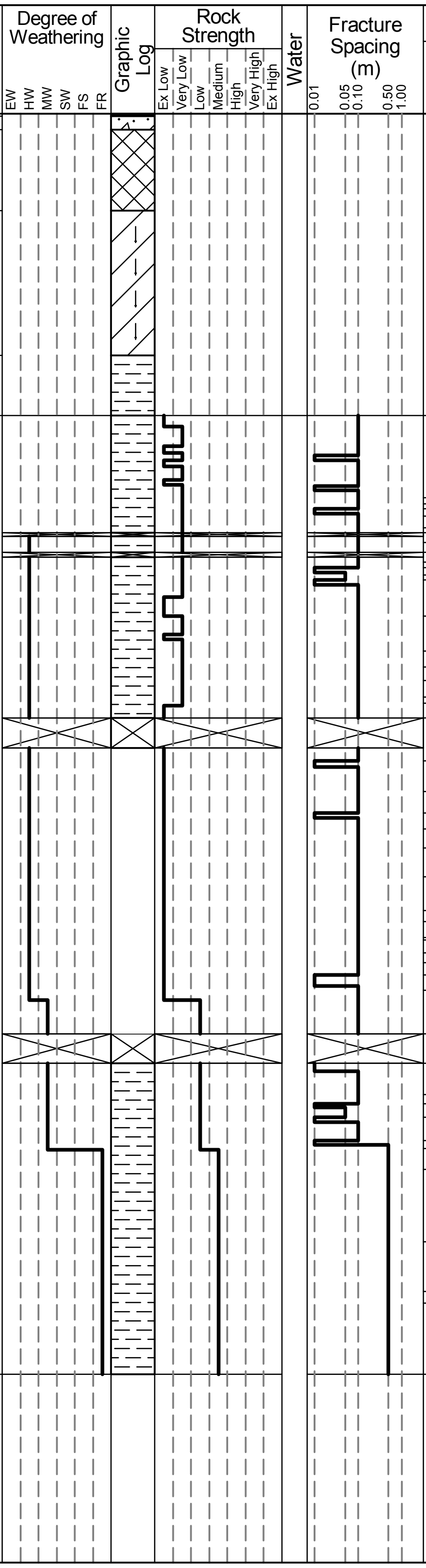
CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove
and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 38.1 mAHD
EASTING: 332579
NORTHING: 6248317
DIP/AZIMUTH: 90°/--

BORE No: A
PROJECT No: 92277.01
DATE: 14/1/2019
SHEET 1 OF 2

RL: 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27
Depth (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Depth (m)	Description of Strata
0.02	ASPHALTIC CONCRETE
0.13	CONCRETE
0.8	FILLING - dark grey and brown medium to coarse grained silty sand with some clay and gravel - sandstone boulder 150mm thick
	SILTY CLAY - stiff, grey mottled yellow-brown and red silty clay with some ironstone gravel and extremely low strength, extremely weathered shale bands, MC~PL
2.0	SHALE - very low strength, highly weathered, grey, red and yellow brown iron indurated shale
2.5	SHALE - very low to low strength, highly weathered, fractured, red, grey and brown shale with iron indurated bands and extremely low strength, extremely weathered bands
3.5	
3.67	
7.86	- becoming medium strength, fresh, slightly fractured, dark grey interbedded siltstone and quartz-lithic sandstone below 8.3m
10.44	Bore discontinued at 10.44m - limit of investigation



Discontinuities

B - Bedding J - Joint
S - Shear F - Fault

- 2.83m: fg 40mm
- 3.08m: fg 40mm
- 3.18m: J, sh, cu, sm, fe stn
- 3.23m: Cs 20mm
- 3.27m: fg 40mm
- 3.33m: Cs 20mm
- 3.43m: B, sh, pl, vr, fe stn
- 3.47m: CORE LOSS: 30mm
- 3.55m: B, sh, pl, ir, fe stn
- 3.63m: CORE LOSS: 40mm
- 3.71m: J, sh, pl, ro, fe stn
- 3.76m: fg 40mm
- 3.82m: J, sh, cu, ro, clay inf
- 3.86m: fg 40mm
- 4.16m: J, sv, un, ro, fe stn 130mm
- 4.45m: J, sv, un, ro, fe stn
- 4.58m: B, sh, pl, sm, fe stn
- 4.69m: J, 45°, cu, sm, clay co
- 4.83m: J, 45°, cu, ro, clay co
- 4.88m: J, sv, un, ro, fe stn 120mm
- 5m: CORE LOSS: 250mm
- 5.36m: fg 50mm
- 5.61m: J, sh, pl, sm, fe stn
- 5.79m: fg 40mm
- 5.92m: J, sv, cu, ro, fe stn 110mm
- 6.08m: J, sh, cu, ro, clay co
- 6.32m: J, sv, cu, ro, fe stn 120mm
- 6.6m: B, sh, pl, sm, fe stn
- 6.69m: B, sh, pl, sm, fe stn
- 6.82m: B, sh, pl, sm, fe stn
- 6.84m: J, sv, cu, ro, fe stn 80mm
- 6.95m: Cs 50mm
- 7.03m: J, 45°, cu, ro, fe stn

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
D			
D			
S			4,4,7 N = 11
S			12,22,25/30mm refusal
C	89	0	PL(A) = 0.27
C	81	0	PL(A) = 0.23
C	97	0	PL(A) = 0.19
C	83	0	PL(A) = 0.02
C	100	13	PL(A) = 0.03 PL(A) = 0.17
C	83	61	PL(A) = 0.14 PL(A) = 0.31
C	100	100	PL(A) = 0.39 PL(A) = 0.27

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m
TYPE OF BORING: 150mm diameter SFA to 2.5m, then NMLC coring to 10.44m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 38.1 mAHD
EASTING: 332579
NORTHING: 6248317
DIP/AZIMUTH: 90°/--

BORE No: A
PROJECT No: 92277.01
DATE: 14/1/2019
SHEET 2 OF 2

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 F - Fault	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
26								7.13m: fg 90mm 7.26m: J, sv, cu, ro, fe stn 100mm 7.62m: CORE LOSS: 240mm 7.86m: fg 70mm 8.12m: J, sh, pl, ro, fe stn 8.2m: fg 30mm 8.31m: fg 40mm 8.5m: fg 40mm 8.57m: J, 45°, cu, sm, clay 8.74m: J, sv, cu, ro, cln 230mm 9.34m: J, 45°, cu, sm, cln 9.75m: J, sv, pl, sm, cln 50mm 9.85m: J, 45°, cu, sm, cln				
25	13											
24	14											
23	15											
22	16											
21	17											
20	18											
19	19											
18	20											
17	21											
16	22											
15	23											

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m
TYPE OF BORING: 150mm diameter SFA to 2.5m, then NMLC coring to 10.44m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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

Douglas Partners Pty Ltd

Proposed Upgrade Works
Darlington Public School, Darlington

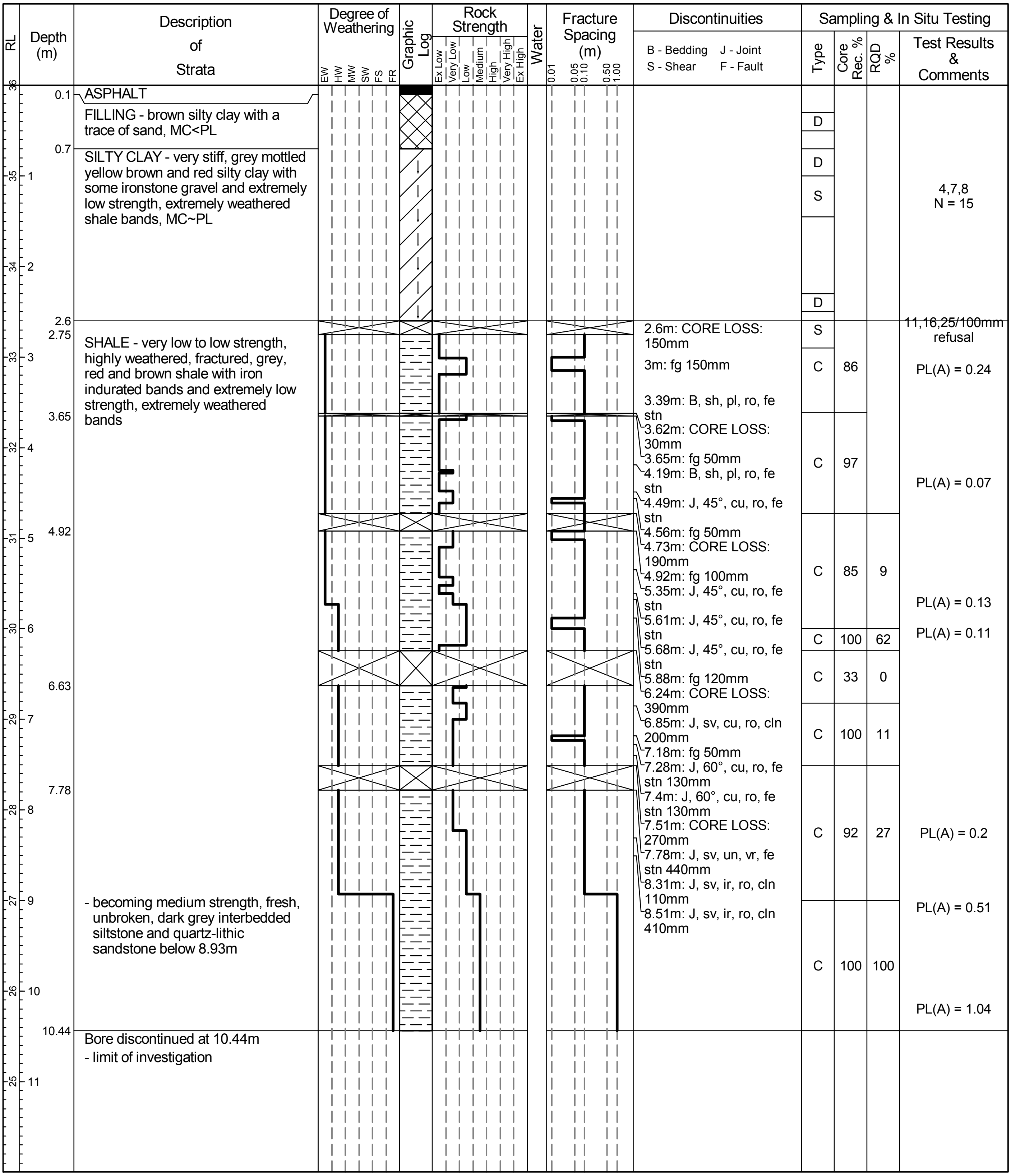
BORE: B DEPTH: 2.60m – 10.44m PROJECT: 92277.01 Jan/Feb 2019

BOREHOLE LOG

CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 36.0 mAHD
EASTING: 332571
NORTHING: 6248290
DIP/AZIMUTH: 90°/--

BORE No: B
PROJECT No: 92277.01
DATE: 15/1/2019
SHEET 1 OF 1



Depth (m)	Description of Strata	Discontinuities	Type	Core Rec. %	RQD %	Test Results & Comments
0.1	ASPHALT					
0.7	FILLING - brown silty clay with a trace of sand, MC<PL		D			
	SILTY CLAY - very stiff, grey mottled yellow brown and red silty clay with some ironstone gravel and extremely low strength, extremely weathered shale bands, MC~PL		D			
			S			4,7,8 N = 15
2.6			D			
2.75	SHALE - very low to low strength, highly weathered, fractured, grey, red and brown shale with iron indurated bands and extremely low strength, extremely weathered bands	2.6m: CORE LOSS: 150mm	S			11,16,25/100mm refusal
		3m: fg 150mm 3.39m: B, sh, pl, ro, fe stn	C	86		PL(A) = 0.24
3.65		3.62m: CORE LOSS: 30mm 3.65m: fg 50mm 4.19m: B, sh, pl, ro, fe stn 4.49m: J, 45°, cu, ro, fe stn	C	97		PL(A) = 0.07
4.92		4.56m: fg 50mm 4.73m: CORE LOSS: 190mm 4.92m: fg 100mm 5.35m: J, 45°, cu, ro, fe stn 5.61m: J, 45°, cu, ro, fe stn	C	85	9	PL(A) = 0.13
		5.68m: J, 45°, cu, ro, fe stn	C	100	62	PL(A) = 0.11
		5.88m: fg 120mm 6.24m: CORE LOSS: 390mm	C	33	0	
6.63		6.85m: J, sv, cu, ro, cln 200mm 7.18m: fg 50mm	C	100	11	
7.78		7.28m: J, 60°, cu, ro, fe stn 130mm 7.4m: J, 60°, cu, ro, fe stn 130mm 7.51m: CORE LOSS: 270mm 7.78m: J, sv, un, vr, fe stn 440mm 8.31m: J, sv, ir, ro, cln 110mm	C	92	27	PL(A) = 0.2
	- becoming medium strength, fresh, unbroken, dark grey interbedded siltstone and quartz-lithic sandstone below 8.93m	8.51m: J, sv, ir, ro, cln 410mm	C	100	100	PL(A) = 0.51 PL(A) = 1.04
10.44	Bore discontinued at 10.44m - limit of investigation					

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m

TYPE OF BORING: 150mm diameter SFA to 2.5m, wash boring to 2.6m, then NMLC coring to 10.44m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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

Douglas Partners Pty Ltd

Proposed Upgrade Works
Darlington Public School, Darlington

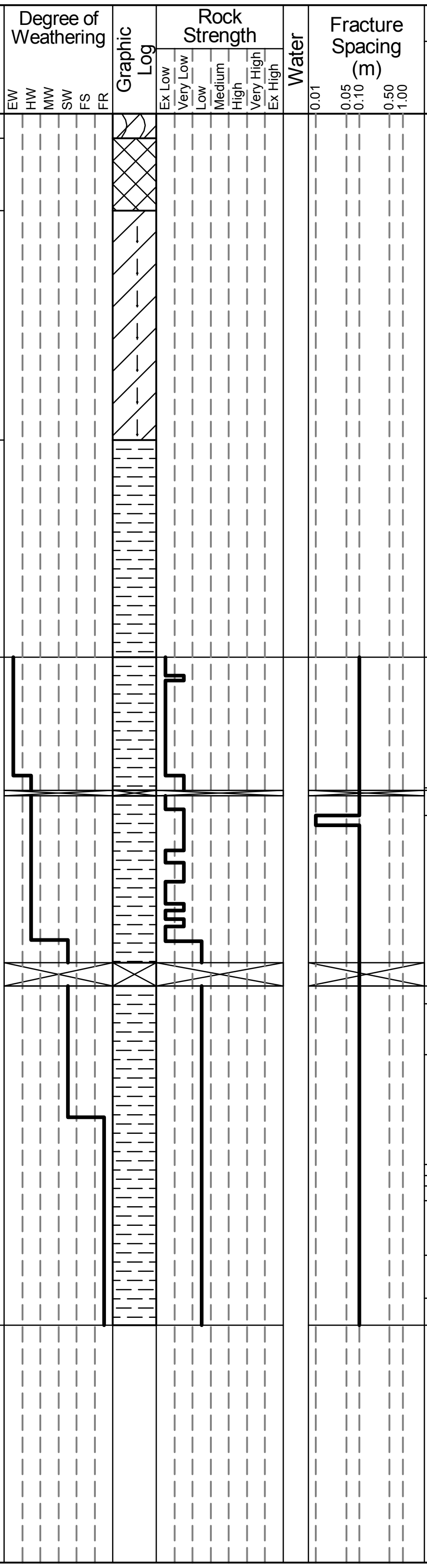
BORE: C DEPTH: 4.50m – 10.03m PROJECT: 92277.01 Jan/Feb 2019

BOREHOLE LOG

CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 34.6 mAHD
EASTING: 332592
NORTHING: 6248292
DIP/AZIMUTH: 90°/--

BORE No: C
PROJECT No: 92277.01
DATE: 16/1/2019
SHEET 1 OF 1



Depth (m)	Description of Strata
0.2	TOPSOIL - dark brown clayey silt with some rootlets, moist
0.8	FILLING - dark brown silty clay with a trace of sand, MC<PL
2.7	SILTY CLAY - very stiff, red brown silty clay with a trace of ironstone gravel, MC~PL - becoming grey mottled red and brown below 1.1m - with extremely low strength, extremely weathered shale bands below 2.2m
4.5	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands
5.65	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands
7.22	
10.03	- becoming fresh, unbroken, dark grey interbedded siltstone and quartz-lithic sandstone below 8.31m
	Bore discontinued at 10.03m - limit of investigation

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)

- 5.48m: B, sh, pl, ro, clay co
- 5.58m: Cs 20mm
- 5.6m: CORE LOSS: 50mm
- 5.81m: fg 80mm
- 7.03m: CORE LOSS: 190mm
- 7.22m: J, 60°, cu, ro, fe stn 130m
- 7.37m: J, 60°, cu, sm, fe stn 120mm
- 7.79m: J, 45°, cu, ro, fe stn
- 8.55m: J, 60°, cu, cm, cln
- 8.7m: J, 80°, cu, sm, cln 140mm
- 8.79m: J, 60°, pl, sm, cln 100mm
- 8.88m: J, 60°, pl, sm, cln 100mm
- 9m: J, sv, pl, sm, cln 80mm
- 9.45m: J, 45°, pl, sm, cln
- 9.81m: J, 60°, pl, sm, cln 110mm

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
D			
D			
S			4,5,6 N = 11
S			3,6,10 N = 16
S			9,19,25/140mm refusal
C	100	0	PL(A) = 0.08
C	96	18	PL(A) = 0.06 PL(A) = 0.05
C	84	48	PL(A) = 0.21
C	100	89	PL(A) = 0.54
C	100	78	PL(A) = 0.94

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m
TYPE OF BORING: 110mm diameter SFA to 2.5m, wash boring to 4.5m, then NMLC coring to 10.03m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Douglas Partners Pty Ltd

Proposed Upgrade Works
Darlington Public School, Darlington

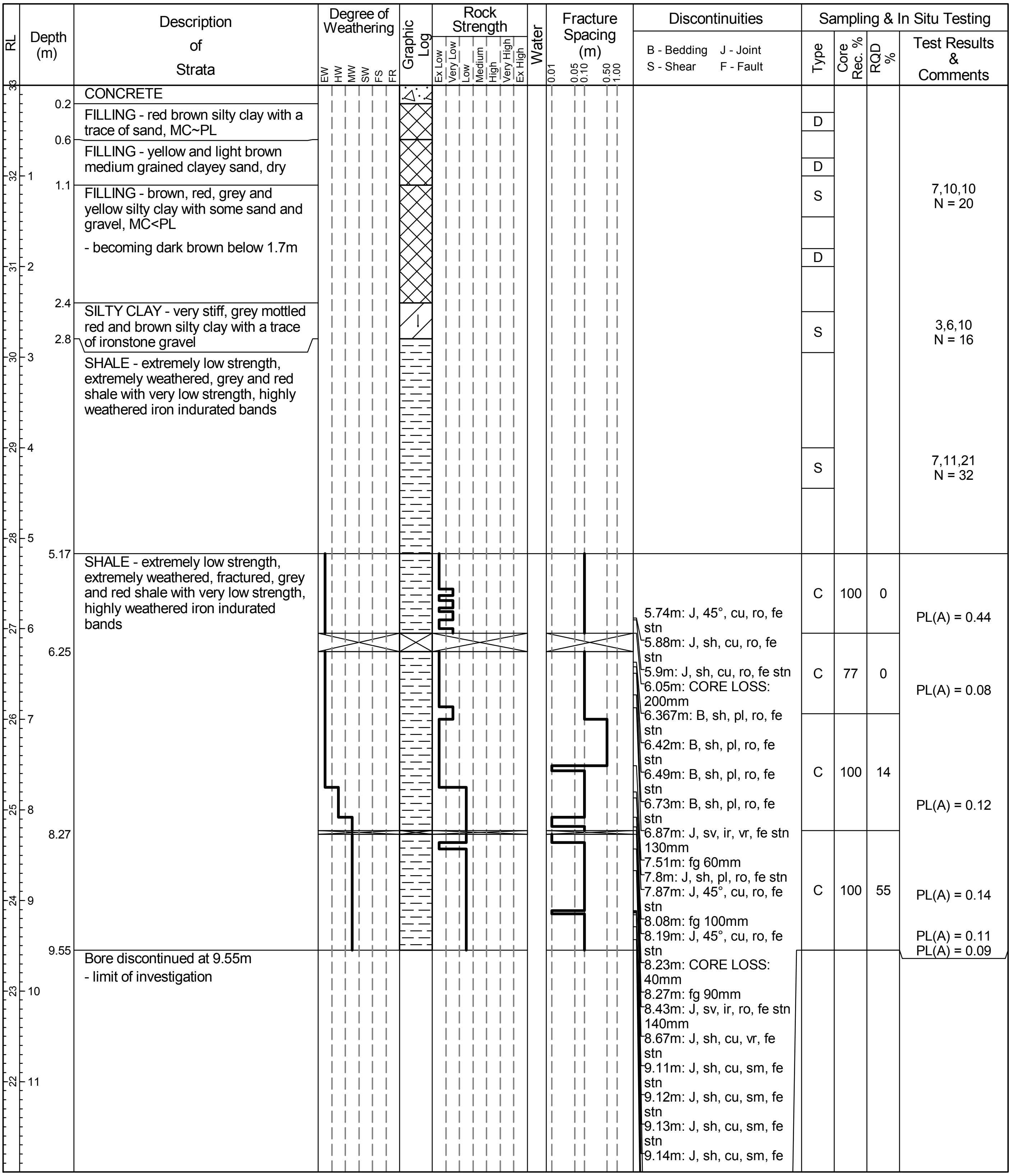
BORE: D DEPTH: 5.17m – 9.55m PROJECT: 92277.01 Jan/Feb 2019

BOREHOLE LOG

CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 33.0 mAHD
EASTING: 332574
NORTHING: 6248260
DIP/AZIMUTH: 90°/--

BORE No: D
PROJECT No: 92277.01
DATE: 17/1/2019
SHEET 1 OF 2



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
0.2	CONCRETE					
0.6	FILLING - red brown silty clay with a trace of sand, MC~PL		D			
1.1	FILLING - yellow and light brown medium grained clayey sand, dry		D			
2.4	FILLING - brown, red, grey and yellow silty clay with some sand and gravel, MC<PL - becoming dark brown below 1.7m		S D			7,10,10 N = 20
2.8	SILTY CLAY - very stiff, grey mottled red and brown silty clay with a trace of ironstone gravel		S			3,6,10 N = 16
5.17	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands		S			7,11,21 N = 32
6.25 8.27 9.55	SHALE - extremely low strength, extremely weathered, fractured, grey and red shale with very low strength, highly weathered iron indurated bands	5.74m: J, 45°, cu, ro, fe stn 5.88m: J, sh, cu, ro, fe stn 5.9m: J, sh, cu, ro, fe stn 6.05m: CORE LOSS: 200mm 6.367m: B, sh, pl, ro, fe stn 6.42m: B, sh, pl, ro, fe stn 6.49m: B, sh, pl, ro, fe stn 6.73m: B, sh, pl, ro, fe stn 6.87m: J, sv, ir, vr, fe stn 130mm 7.51m: fg 60mm 7.8m: J, sh, pl, ro, fe stn 7.87m: J, 45°, cu, ro, fe stn 8.08m: fg 100mm 8.19m: J, 45°, cu, ro, fe stn 8.23m: CORE LOSS: 40mm 8.27m: fg 90mm 8.43m: J, sv, ir, ro, fe stn 140mm 8.67m: J, sh, cu, vr, fe stn 9.11m: J, sh, cu, sm, fe stn 9.12m: J, sh, cu, sm, fe stn 9.13m: J, sh, cu, sm, fe stn 9.14m: J, sh, cu, sm, fe	C C C C	100 77 100 100	0 0 14 55	PL(A) = 0.44 PL(A) = 0.08 PL(A) = 0.12 PL(A) = 0.14 PL(A) = 0.11 PL(A) = 0.09
	Bore discontinued at 9.55m - limit of investigation					

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 5.17m

TYPE OF BORING: Concrete coring to 0.2m, 110mm diameter SFA to 2.5m, wash boring to 5.17m, then NMLC coring to 9.55m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 33.0 mAHD
EASTING: 332574
NORTHING: 6248260
DIP/AZIMUTH: 90°/--

BORE No: D
PROJECT No: 92277.01
DATE: 17/1/2019
SHEET 2 OF 2

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 F - Fault	Sampling & In Situ Testing Type	Core Rec. %	RQD %	Test Results & Comments
21								stn 9.16m: J, sv, ir, ro, cln 60mm 9.29m: B, sh, pl, ro, fe stn 9.43m: B, sh, pl, ro, fe stn				
20	13											
19	14											
18	15											
17	16											
16	17											
15	18											
14	19											
13	20											
12	21											
11	22											
10	23											

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 5.17m

TYPE OF BORING: Concrete coring to 0.2m, 110mm diameter SFA to 2.5m, wash boring to 5.17m, then NMLC coring to 9.55m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Proposed Upgrade Works
Darlington Public School, Darlington

BORE: E DEPTH: 4.00m – 9.80m PROJECT: 92277.01 Jan/Feb 2019

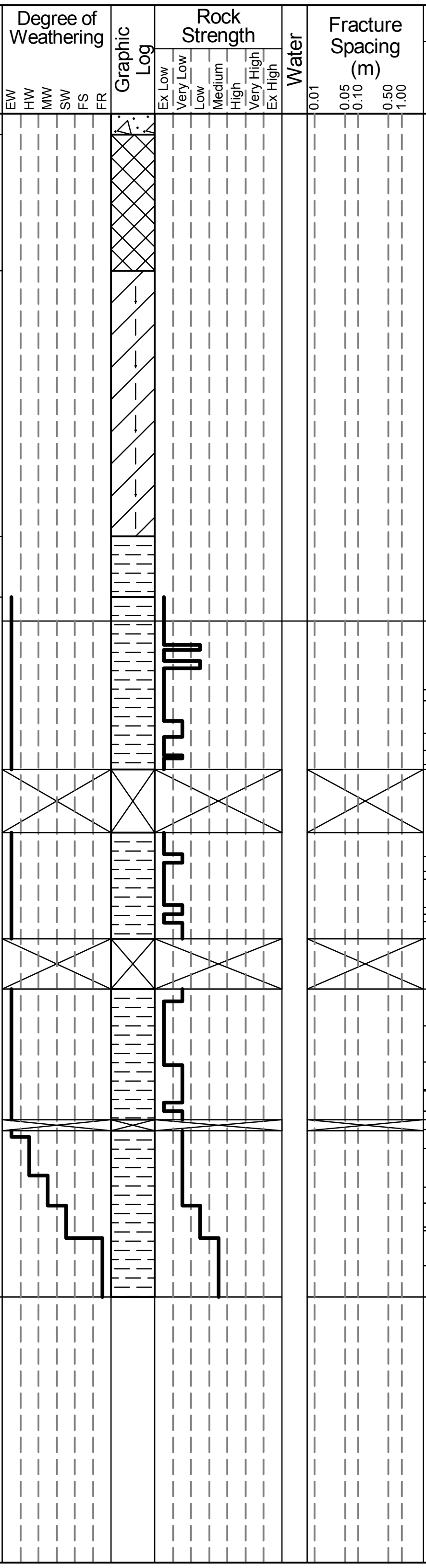
BOREHOLE LOG

CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 34.1 mAHD
EASTING: 332550
NORTHING: 6248228
DIP/AZIMUTH: 90°/--

BORE No: E
PROJECT No: 92277.01
DATE: 18/1/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata
34	0.17	CONCRETE
		FILLING - brown, red and grey silty clay with a trace of ironstone gravel, MC~PL
33	1.3	SILTY CLAY - very stiff, grey mottled red and brown silty clay with a trace of ironstone gravel, MC~PL - with extremely low strength, extremely weathered iron indurated shale bands below 2.7m
31	3.5	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands
30	4.0	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands
28	5.95	
	7.25	
	8.42	- becoming medium strength, slightly weathered, slightly fractured interbedded siltstone and quartz lithic sandstone below 9.04m
24	9.8	- becoming fresh below 9.31m Bore discontinued at 9.8m - limit of investigation



Discontinuities

B - Bedding J - Joint
S - Shear F - Fault

4.16m: J, sv, ir, vr, clay inf 40mm
4.6m: J, sh, pl, ro, clay inf
4.77m: Cs 20mm
4.86m: J, 80°, ir, ro, clay inf 100mm
5.13m: J, sh, cu, ro, fe stn
5.27m: J, sh, cu, ro, fe stn
5.39m: J, sh, cu, ro, fe stn
5.43m: CORE LOSS: 520mm
6.15m: Cs 20mm
6.27m: fg 60mm
6.34m: J, 60°, cu, ro, fe stn 110mm
6.57m: J, sh, cu, ro, fe stn
6.63m: J, 45°, cu, ro, fe stn
6.69m: J, sv, ir, vr, fe stn 140mm
6.83m: CORE LOSS: 420mm
7.25m: fg 100mm
7.55m: J, 45°, cu, ro, fe stn
7.85m: J, sv, ir, vr, fe stn 20mm
8.08m: J, 45°, cu, sm, fe stn
8.09m: J, sv, ir, ro, fe stn 100mm
8.26m: fg 50mm
8.33m: CORE LOSS: 90mm
8.41m: fg 70mm
8.57m: fg 230mm
8.89m: B, sh, pl, ro, cln
9.02m: fg 30mm
9.22m: B, h, pl, sm, cln
9.25m: B, h, pl, sm, cln
9.54m: J, 45°, cu, sm, cln

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
D			
D			
S			4,5,7 N = 12
D			
S			5,8,13 N = 21
S			23,25/50mm,- refusal
C	100	0	PL(A) = 0.51 PL(A) = 0.06 PL(A) = 0.02
C	64	0	PL(A) = 0.56
C	73	0	PL(A) = 0.08
C	92	63	PL(A) = 0.13 PL(A) = 0.48

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Concrete coring to 0.17m, 110mm diameter SFA to 2.5m, wash boring to 4.0m, then NMLC coring to 9.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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

Douglas Partners Pty Ltd

Proposed Upgrade Works
Darlington Public School, Darlington

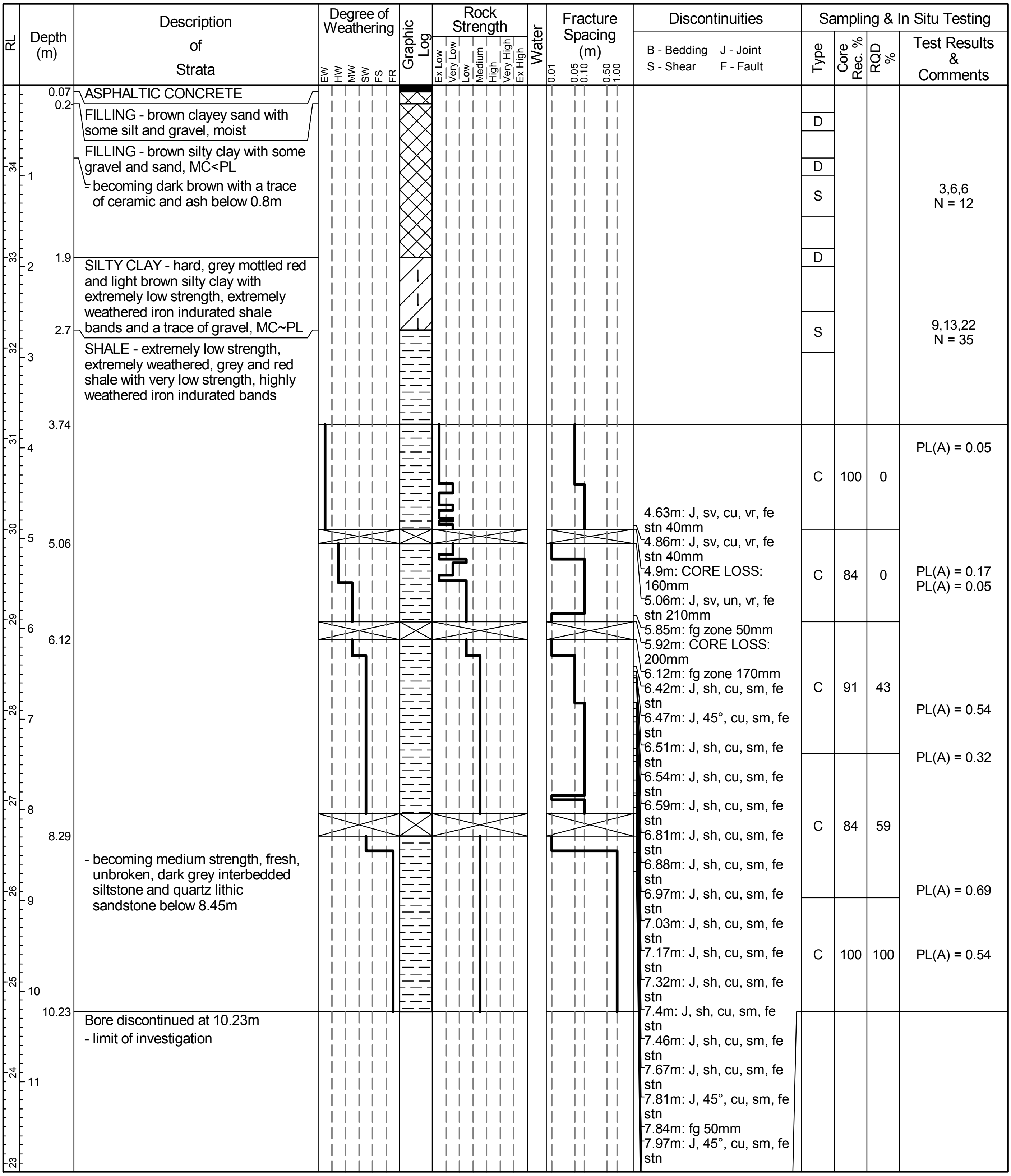
BORE: F DEPTH: 3.74m – 10.23m PROJECT: 92277.01 Jan/Feb 2019

BOREHOLE LOG

CLIENT: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 34.9 mAHD
EASTING: 332545
NORTHING: 6248280
DIP/AZIMUTH: 90°/--

BORE No: F
PROJECT No: 92277.01
DATE: 17/1/2019
SHEET 1 OF 2



Depth (m)	Description of Strata
0.07	ASPHALTIC CONCRETE
0.2	FILLING - brown clayey sand with some silt and gravel, moist
	FILLING - brown silty clay with some gravel and sand, MC<PL - becoming dark brown with a trace of ceramic and ash below 0.8m
1.9	SILTY CLAY - hard, grey mottled red and light brown silty clay with extremely low strength, extremely weathered iron indurated shale bands and a trace of gravel, MC~PL
2.7	SHALE - extremely low strength, extremely weathered, grey and red shale with very low strength, highly weathered iron indurated bands
3.74	
5.06	
6.12	
8.29	- becoming medium strength, fresh, unbroken, dark grey interbedded siltstone and quartz lithic sandstone below 8.45m
10.23	Bore discontinued at 10.23m - limit of investigation

Discontinuities

B - Bedding J - Joint
S - Shear F - Fault

4.63m: J, sv, cu, vr, fe stn 40mm
4.86m: J, sv, cu, vr, fe stn 40mm
4.9m: CORE LOSS: 160mm
5.06m: J, sv, un, vr, fe stn 210mm
5.85m: fg zone 50mm
5.92m: CORE LOSS: 200mm
6.12m: fg zone 170mm
6.42m: J, sh, cu, sm, fe stn
6.47m: J, 45°, cu, sm, fe stn
6.51m: J, sh, cu, sm, fe stn
6.54m: J, sh, cu, sm, fe stn
6.59m: J, sh, cu, sm, fe stn
6.81m: J, sh, cu, sm, fe stn
6.88m: J, sh, cu, sm, fe stn
6.97m: J, sh, cu, sm, fe stn
7.03m: J, sh, cu, sm, fe stn
7.17m: J, sh, cu, sm, fe stn
7.32m: J, sh, cu, sm, fe stn
7.4m: J, sh, cu, sm, fe stn
7.46m: J, sh, cu, sm, fe stn
7.67m: J, sh, cu, sm, fe stn
7.81m: J, 45°, cu, sm, fe stn
7.84m: fg 50mm
7.97m: J, 45°, cu, sm, fe stn

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
D			
D			
S			3,6,6 N = 12
D			
S			9,13,22 N = 35
C	100	0	PL(A) = 0.05
C	84	0	PL(A) = 0.17 PL(A) = 0.05
C	91	43	PL(A) = 0.54
C	84	59	PL(A) = 0.32 PL(A) = 0.69
C	100	100	PL(A) = 0.54

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m
TYPE OF BORING: 110mm diameter SFA to 2.5m, wash boring to 3.74m, then NMLC coring to 10.23m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Gardner Wetherill & Associates
PROJECT: Proposed Upgrade Works
LOCATION: Darlington Public School, Cnr Golden Grove and Abercrombie Streets. Darlington, NSW

SURFACE LEVEL: 34.9 mAHD
EASTING: 332545
NORTHING: 6248280
DIP/AZIMUTH: 90°/--

BORE No: F
PROJECT No: 92277.01
DATE: 17/1/2019
SHEET 2 OF 2

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 F - Fault	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
								8.04m: CORE LOSS: 250mm 8.29m: fg 160mm 8.47m: J, sv, pl, sm, cln 130mm 8.68m: J, 45°, cu, sm, cln				
22	13											
21	14											
20	15											
19	16											
18	17											
17	18											
16	19											
15	20											
14	21											
13	22											
12	23											
11												

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m

TYPE OF BORING: 110mm diameter SFA to 2.5m, wash boring to 3.74m, then NMLC coring to 10.23m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

J.T. Purcell

Approved Signatory: John Purcell
Lab technician

NATA Accredited Laboratory Number: 828

Report Number: **92277.01-1**
Issue Number: 1
Date Issued: 30/01/2019
Client: Gardner Wetherill & Associates
Level 2, Suite 201, St Leonards NSW 2065
Contact: Luen Samonte
Project Number: 92277.01
Project Name: Proposed Upgrade Works
Project Location: Darlington Public School, Darlington
Work Request: 557
Sample Number: 19-557A
Date Sampled: 14/01/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 21.0%
Sample Location: **BH A (1.0m - 1.45m)**
Material: SILTY CLAY - grey mottled yellow brown and red silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	68		
Plastic Limit (%)	23		
Plasticity Index (%)	**45**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	14.0		
Cracking Crumbling Curling	None		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92277.01-1**
Issue Number: 1
Date Issued: 30/01/2019
Client: Gardner Wetherill & Associates
Level 2, Suite 201, St Leonards NSW 2065
Contact: Luen Samonte
Project Number: 92277.01
Project Name: Proposed Upgrade Works
Project Location: Darlington Public School, Darlington
Work Request: 557
Sample Number: 19-557B
Date Sampled: 14/01/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 23.4%
Sample Location: **BH B (1.0m - 1.45m)**
Material: SILTY CLAY - grey mottled yellow brown and red silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	24		
Plasticity Index (%)	**42**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	Curling		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
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Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician

NATA Accredited Laboratory Number: 828

Report Number:	**92277.01-1**
Issue Number:	1
Date Issued:	30/01/2019
Client:	Gardner Wetherill & Associates Level 2, Suite 201, St Leonards NSW 2065
Contact:	Luen Samonte
Project Number:	92277.01
Project Name:	Proposed Upgrade Works
Project Location:	Darlington Public School, Darlington
Work Request:	557
Sample Number:	19-557C
Date Sampled:	14/01/2019
Sampling Method:	Sampled by Engineering Department
Remarks:	Field moisture content = 25.8%
Sample Location:	**BH C (1.0m - 1.45m)**
Material:	SILTY CLAY - red brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	72		
Plastic Limit (%)	23		
Plasticity Index (%)	**49**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.5		
Cracking Crumbling Curling	None		

Material Test Report

Douglas Partners
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Report Number: **92277.01-1**
Issue Number: 1
Date Issued: 30/01/2019
Client: Gardner Wetherill & Associates
Level 2, Suite 201, St Leonards NSW 2065
Contact: Luen Samonte
Project Number: 92277.01
Project Name: Proposed Upgrade Works
Project Location: Darlington Public School, Darlington
Work Request: 557
Sample Number: 19-557D
Date Sampled: 14/01/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 14.9%
Sample Location: **BH F (1.0m - 1.45m)**
Material: FILLING - brown silty clay filling

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NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician

NATA Accredited Laboratory Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	41		
Plastic Limit (%)	23		
Plasticity Index (%)	**18**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	8.0		
Cracking Crumbling Curling	None		