Douglas Partners

Geotechnics / Environment / Groundwater

Integrated Practical Solutions

# Report on Geotechnical Investigation

Proposed New Primary School
Aprasia Ave, Googong

Prepared for
Hansen Yuncken Pty Ltd

Project 203634.00
May 2021

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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.

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# Report on Geotechnical Investigation
# Proposed New Primary School
# Aprasia Ave, Googong

## 1. Introduction

This Douglas Partners' report accompanies an Environmental Impact Statement (EIS) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) in support of an application for a State Significant Development (SSD-10326042).

The development is for a new primary school located on land bound by Gorman Drive, Aprasia Avenue, Wilkins Way and McPhail Way in Googong.

This report addresses the relevant Secretary's Environmental Assessment Requirements (SEARs), namely:

- Geotechnical Investigation and Reporting for the Environmental Impact Statement (EIS).

This report presents the results of a geotechnical investigation undertaken for the new primary school. The investigation was commissioned in an email dated 21 April 2021 by Paul Todhunter of Hansen Yuncken Pty Ltd and was undertaken in accordance with Douglas Partners' proposal 203634.00.P.001.Rev0 dated 7 May 2021.

It is understood that the proposed new primary school  comprises the construction of three, 2 level structures (2 home base buildings and an administration building), hall, canteen block, kiss and drop/carparking, sports courts and a play space.

It is understood that the report will be used to support the schematic design and detailed design phases, complete necessary due diligence and for inclusion in planning application submissions for the proposed development.

DP has also undertaken a contamination assessment with limited sampling which has been reported separately.

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

- Broad assessment the subsurface conditions at the site relevant to the proposed development, including the presence and depth of fill, depth to groundwater, if encountered and any geotechnical constraints to development.
- Site classification in accordance with AS2870 for each building.
- Recommendations on suitable footing systems, including allowable bearing pressure for spread footings and parameters for pile design, estimates of total and differential settlements for spread and piled footings.
- Advice on concrete exposure classification from soil and water aggressivity, if any.

- Comment on the likely excavation characteristics of materials encountered as part of the site investigation and reuse of excavated materials as engineered fill.
- Advice for permanent and temporary batter slopes and retaining walls.
- Recommendations on earthworks and subgrade preparation methods including recommendations on the placement of engineered fill.
- Geotechnical advice on design subgrade CBR and suitability of existing pavement for incorporation into the proposed design.

The investigation included the excavation of eleven test pits and laboratory testing of selected samples. The details of the field work and laboratory testing are presented in this report, together with comments and recommendations on the items listed above.

This report must be read in conjunction with the notes entitled About this Report which are included in Appendix A.

## 2. Proposed Development

The proposed development is for construction and operation of a new primary school Core 35 facilities in Googong that will accommodate up to 700 students.

The proposed development includes:

- A collection of 1-2 storey buildings containing 30 home base units, 3 special education learning units, canteen, hall, library and administrative facilities.
- On-site carpark with 60 spaces and on-street kiss-and-ride facilities.
- Outdoor sports court and play area.
- Integrated landscaping, fencing and signage.

It is understood that the anticipated foundation loads (dead + live) are up to approximately 1800 kN.

## 3. Site Description

The site is located at Aprasia Avenue, Googong, and is formally described as Lot 3 DP1179941 (refer to Figure 1). The site is irregular in shape and has an area of 28,118 m$^2$.

The site is located within the Queanbeyan-Palerang Regional Council local government area approximately 10 km south of the Queanbeyan Central Business District.

The site is bordered by Aprasia Avenue to the north, Gorman Drive to the southwest, Wilkins way to the east/southeast and McPhail way to the west.

Googong North Village Centre, which contains a childcare centre, supermarket, cafes and take-away food outlets, is located approximately 100m west of the site across McPhail Way. The site is otherwise surrounded by low density residential development.

Googong is a recently developed town, with the planning beginning in the early 2000s and the first residents taking up residence in 2014.

At the time of investigation, the site was moderately grassed and a gravel pad of about 325 $m^2$ was observed to the northwest of the site. Several moderately grassed stockpiles of about 20 $m^3$ – 30 $m^3$ were situated to the centre, northwest and southeast of the block. The site was observed to slope either side of a shallow ridge running southeast to northwest of the site with the highest point being at the centre of the block. Surface levels ranging from approximately 745 m to 736 m Australian Height Datum (AHD) were dispersed throughout the site. An approximate 1 m – 1.5 m high fill batter was observed to run along part of the northern and eastern boundaries. Figures 2 – 5 present the general conditions of the site at the time of investigation.

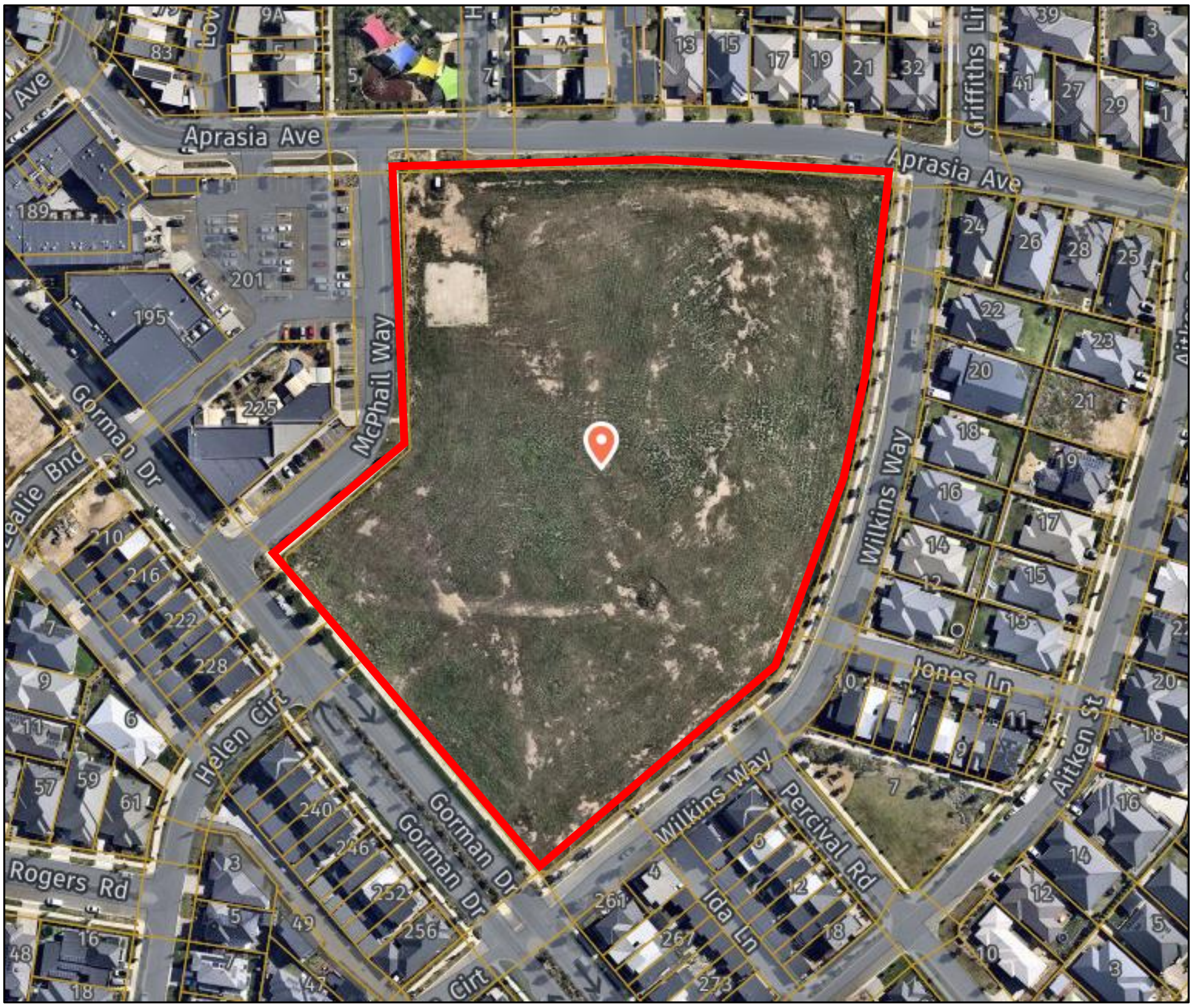



**Figure 1: Site Location ( Source: Nearmap)**

**Figure 2: General conditions of the site looking southeast.**

**Figure 3: General conditions of the site looking northwest.**

**Figure 4: General conditions of the site looking southwest.**

**Figure 5: General conditions of the site looking northeast.**

## 4. Regional Geology

Reference to the Canberra 1:100 000 Geological Series Sheet (BMR, 1992) indicates that the site is underlain by Colinton Volcanics (Svc) of the Late Silurian age. This was confirmed from the results in the field and from previous experience, the Googong area is generally comprised of dacitic crystal tuff and minor volcaniclastic sediments.

## 5. Field Work

### 5.1 Field Work Methods

The field work comprised the excavation of eleven test pits (Pits 1 - 11) using a Hitachi EX11 excavator (~8 tonne) fitted with a 300 mm wide bucket to depths of between 0.65 m and 2.5 m. Test pit locations were nominated by the structural engineers to the project Northrop Consulting Engineers Pty Ltd. It is noted that Pit 11 was excavated within a stockpile present in the middle of the site. The pits were logged onsite by a geotechnical engineer. Dynamic cone penetrometer tests (AS 1289 6.3.2:1997) were also undertaken from the surface adjacent to each test location to provide an indication of the in situ strength profile of the upper site soils.

The approximate test locations are shown on Drawing 1 (Appendix B). The approximate test location coordinates provided on each test pit log were determined on site using a hand-held GPS which is accurate only to about 3 – 5 m. The surface levels shown on the borehole logs to Australian Height Datum (AHD) and coordinates to Map Grid of Australia (MGA, Zone 55) were interpolated using provided survey drawings and as such, are approximate only and not to be relied on.

### 5.2 Field Work Results

Details of the subsurface conditions encountered are presented in the test pit logs included in Appendix C. The logs must be read in conjunction with the attached notes that define classification methods and terms used to describe the soils and rocks.

The succession of strata (not including Pit 11) is broadly summarised below:

**TOPSOIL FILL:** generally low plasticity, soft, moist, silty sandy Clay with a various mixture of sand and gravel in all pits to depths of between 0.1 m – 0.3 m.

**FILL:** generally low to medium plasticity, stiff to hard, moist to dry, silty/ silty sandy Clay in Pits 1 and 2 to depths of between 0.3 m – 0.4 m.

**CLAYEY SAND & SILTY CLAY:** generally medium dense to dense, dry to moist, clayey Sand and low to medium plasticity, hard, dry to moist, silty Clay with various mixture of gravel to depths of between 0.1 m – 0.4 m to 0.3 m – 1.4 m encountered in all pits except Pit 2.

**DACITE:** variably extremely low, extremely weathered dacite becoming low to medium strength, highly to moderately weathered with depth, below depths of 0.3 m – 1.4 m to the limit of investigation/refusal depths of 0.9 m – 2.5 m.

No free groundwater was observed in any of the other pits during excavation. It is noted, however, that the pits were immediately backfilled following excavation which precluded longer term monitoring of groundwater levels. Groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the investigation compared to at the time of construction.

## 6. Laboratory Testing

Laboratory testing was performed on selected samples in DP's laboratory and comprised the following:

- Two Atterberg limits and linear shrinkage tests;
- Two California bearing ratio (CBR) tests; and
- One particle size distribution test.

A further four samples were tested by Envirolab Services Pty Ltd for chemical aggressiveness.

The results of the laboratory testing are provided in detail in the test report sheets in Appendix D and are summarised in Tables 1 to 4 below.

**Table 1: Results of Plasticity Testing**

| Pit No. | Depth (m) | $W_F$ (%) | $W_L$ (%) | $W_P$ (%) | PI (%) | LS (%) | Field Description |
|---|---|---|---|---|---|---|---|
| 4 | 0.8 | 19.6 | 57 | 21 | 36 | 14.0 | Silty Clay |
| 7 | 0.4 | 22.3 | 66 | 25 | 41 | 13.5 | Silty Clay |

Where $W_F$ = Moisture content; $W_L$ = Liquid limit; $W_P$ = plastic limit; PI = Plasticity Index; LS = Linear shrinkage

**Table 2: Summary of Compaction & CBR Testing**

| Pit No. | Depth (m) | FMC (%) | OMC (%) | MDD (t/m³) | CBR (%) | Swell (%) | Field Description |
|---|---|---|---|---|---|---|---|
| 1 | 0.5 – 0.7 | 14.2 | 16.0 | 1.80 | 8.0 | 2.0 | Silty Clay |
| 8 | 0.5 – 0.7 | 16.6 | 18.0 | 1.71 | 2.5 | 2.5 | Silty Clay |

Where: FMC = Field moisture content; MDD = Maximum dry density (standard); OMC = Optimum moisture content; CBR = California bearing ratio

**Table 3: Result of Particle Size Distribution Tests**

| Pit No. | Sample Depth (m) | Percent Passing Sieve Size (%) | | | | Material |
|---|---|---|---|---|---|---|
| | | 6.7 mm | 2.36 mm | 0.425 mm | 0.075 mm | |
| 6 | 0.2 | 96 | 89 | 59 | 45 | Silty Clay |

**Table 4: Results of Soil Aggressivity Testing**

| Pit No. | Depth (m) | Field Description | pH | Chloride (mg/kg) | Sulphate (mg/kg) | Electrical Conductivity (µS/cm) | Resistivity (2) (ohm.cm) |
|---|---|---|---|---|---|---|---|
| 3 | 0.5 | Silty Clay | 7.0 | <10 | 20 | 47 | 21277 |
| 5 | 0.7 | Silty Clay | 7.7 | 81 | 57 | 120 | 8333 |
| 6 | 0.5 | Silty Clay | 5.7 | 570 | <10 | 430 | 2325 |
| 9 | 1.3 | Silty Clay | 6.2 | 66 | 37 | 90 | 11110 |
| Criteria for "Non-aggressive" Soil Conditions (low permeability soils or soils above the groundwater table) (1) | | | >5.5 (concrete) >5.0 (steel) | <5,000 (steel) | <5,000 (concrete) | - | >5,000 (steel) |

Notes:
(1) In accordance with AS 2159:2009
(2) Resistivity (ohm.cm) is the inverse of Electrical Conductivity (S/cm)

## 7. Comments

### 7.1 Site Preparation and Earthworks

#### 7.1.1 Stripping

Site preparation for the construction of road formations, controlled fill and future structures should include the removal of vegetation, uncontrolled fill, topsoil and other deleterious materials from the proposed construction areas. Based on the results of the investigation, a topsoil stripping depth up to about 0.3 m is expected. Undocumented filling (excluding stockpiles) was limited to 2 of the test pits (Pits 1 and 2) to less than 0.4 m. The depth and extent of undocumented filling away from test locations cannot be commented on.

Deeper excavations (such as in old gullies) are likely to occur should localised deeper topsoils or unsuitable materials/fill be encountered, if inclement weather precedes construction or if the contractor adopts inappropriate stripping methods.

It is recommended that inspection of stripped surfaces be undertaken by a suitably qualified geotechnical engineer to assess the need for further removal of unsuitable material or of any other remedial measures.

### 7.1.2 Trafficability

Following periods of wet weather, the natural surface across the site is likely to be boggy and effectively untrafficable to all but tracked construction vehicles. Some measures that can be undertaken to reduce the impact of wet weather on the earthworks construction include:

- retain grass cover wherever possible;
- provide cut surfaces with a slight but even cross-gradient to assist surface drainage;
- "seal" exposed fill surfaces at the end of each workday by running over with a smooth-wheeled roller;
- armour temporary access roads with rockfill;
- form swale drains at upslope locations to help intercept surface and near-surface seepage water and to redirect it into existing drainage gullies or dams, or to sediment retention ponds.

### 7.1.3 Excavation Conditions

The investigation has indicated subsurface conditions generally comprising topsoils, soils of variable composition overlying weathered bedrock at relatively shallow depths.

The topsoil, residual soils and extremely low to low strength bedrock could be expected to be removed using conventional earthmoving plant and as such no difficulties are anticipated. Large excavators with rock hammers, toothed buckets and/or rippers will be needed to remove low to medium strength (or greater) weathered rock in trenches and ripping with large dozers will be required for bulk excavations to the level of test pit refusal encountered in this investigation. The excavatability of the rock below test pit refusal depths will be largely dependent on the degree of fracturing and the dip of bedding within the rock mass. Low production rates must be envisaged particularly where shallow refusal was encountered with the likelihood of blasting to loosen the bedrock in areas of deep cut to assist the excavation.

Groundwater seepages into excavations are likely to occur from the sandy layers or through fractures in the bedrock after periods of rain and possibly in area of springs which cannot be detected until bulk earthworks. Seepage flows would readily be controllable by gravity draining to a collection sump or pond. Consideration should be given to installation of diversion drains across the site to minimise surface and subsurface water entering into the site.

### 7.1.4 Excavation Batters

For permanent excavations in topsoil, natural soils and weathered rock, maximum gradients of 3H:1V (horizontal: vertical) are recommended. In low to medium strength bedrock, maximum gradients of 1H:1V (horizontal: vertical) are recommended. To minimise surface erosion the batter should be protected with toe and spoon drains and vegetated as soon as possible after construction. For temporary excavations, maximum gradients of 1H:1V and 0.5H:1V are suggested for natural soils and low to medium strength rock respectively, subject to geotechnical inspection and assessment during excavation.

### 7.1.5 Reuse of Excavated Material

The upper clayey sand layer (underlying the topsoil zone) is considered to be unsuitable for engineering applications by itself. These soils may be difficult to handle and compact and will require careful moisture control. The soils can be placed in the verge, in landscape mounds or other non-structural applications or alternatively blended with the excavated clay soils and weathered rock.

After stripping and removal of topsoils and the upper clayey sand layer, it would be expected that most of the materials available from cutting on the site would be suitable for reuse as fill over the lower areas, provided time is available and weather conditions are suitable to adjust the moisture content to near optimum.

The weathered rock encountered in the test pits to the level of test pit refusal was logged as extremely low to medium strength and is considered suitable for reuse in all areas of controlled fill, embankment fill or possibly select fill subject to additional laboratory testing to confirm conformance to the specification. Rock particles greater than 75 – 100 mm in size will likely be present in the higher strength rock, which will require to be crushed (to less than 75 – 100 mm in size) or else removed and stockpiled for disposal or further processing.

As excavation proceeds below the level of pit refusal (should that be undertaken), it would be expected that cobble and boulder sized rock pieces would be removed, which would need to be crushed to a maximum particle size of 75 – 100 mm prior to use within fill areas. It is expected that minimal fines would be created during the crushing process and that blending with the overlying soil may be required to create a suitable fill material (i.e. well graded).

### 7.1.6 Filling Placement and Compaction

It is recommended that subgrade areas that are to support ground slabs and vehicular pavements should be prepared in accordance with the following general guidelines:

- Strip and excavate all existing fill, topsoil, roots, vegetation, moisture weakened soils and any other potentially deleterious materials (See Section 7.1.1).
- Obtain a preliminary inspection by a geotechnical engineer who should assess whether the exposed subgrade is suitable or whether further excavation or other treatment may be required;
- Tyne and homogenise the subgrade to at least 150 mm depth, adjust the moisture content of the mixed material to within about 2% Standard optimum moisture content (SOMC), and leave long enough or overnight to allow the soil to “cure”.
- Roll the tyned, moisture conditioned surface with at least six passes of a minimum 12 tonne deadweight roller with a final test roll pass in the presence of a geotechnical engineer. The subgrade surface should not exhibit excessive deformation or springing under test roll.
- Areas of prepared subgrade that are found to deform significantly under test rolling should be either excavated and replaced with compacted approved fill or improved by other method as advised by the geotechnical engineer. Depth of over-excavation should not exceed 500 mm depth without further geotechnical advice.
- Place and compact new fill in horizontal layers up to 150 mm compacted thickness. In confined working areas or in situations where compaction may be difficult to achieve, thinner layers may be

required. Uniformly moisture condition the fill material to within 2% of SOMC. Suggested compaction requirements for the fill are presented in Table 5.

**Table 5: Suggested Compaction Requirements**

| Purpose | Minimum Dry Density Ratio |
|---|---|
| Heavy floor load support | 98% Standard |
| Footing support | 100% Standard |
| Pavements : > 500 mm below subgrade level<br>< 500 mm below subgrade level | 98% Standard<br>100% Standard |

Full time supervision of fill placement and compaction testing to a Level 1 standard, as defined in AS 3798:2007 is required where structural loads are supported on compacted fill. A Level 1 report should be prepared at the completion of the works stating that the fill has been satisfactorily constructed and capable of supporting building slabs and light weight footings.

#### 7.1.7 Site Drainage

In undertaking earthworks operations on the site, it should be recognised that the drainage characteristics of the site may be significantly altered and that temporary and/or permanent measures may be required during and after construction to divert stormwater flow from the site. Unlined open spoon drains at least 0.5 m deep are expected to be effective in intercepting water from upslope areas entering the site. The need and location of subsoil drains can only be determined onsite during construction.

### 7.2 Pavement Design Considerations

Based on the results of the field investigation, laboratory testing and previous experience, Table 6 gives suggested design CBR values for the likely subgrade conditions.

**Table 6: Design CBR Values**

| Subgrade Material | Design CBR (%) |
|---|---|
| Silty Clay | 2.5 |
| Weathered Bedrock | 5.0 |

Subgrade replacement to a depth of approximately 300 mm using minimum CBR 15% material will be required where CBR values of less than 3% are exposed at subgrade level. In the event weathered rock is encountered prior to the base of the 300 mm over-excavation, the replacement depth may be reduced following inspection by a qualified geotechnical engineer.

It is recommended that fill of roadway embankments be undertaken using sandy clays/gravelly clays of low plasticity, clayey gravels or weathered rock.

All earthworks should be undertaken under close supervision and consultation with the geotechnical consultant in order to avoid any unnecessary over-excavation.

Prevailing weather conditions at the time of construction and the control that can be exercised over construction traffic will be critical in achieving satisfactory subgrade performance. If pavement construction does not immediately follow subgrade preparation (thus exposing the subgrade to weather and traffic), subgrade deterioration would be expected, thus requiring rectification. In conjunction with subgrade preparation procedures, consideration should also be given to installing temporary drainage systems prior to installation of the final works.

Surface and subsoil drainage should be installed and maintained to protect the pavement and subgrade. Subsoil drains should be located at a minimum of 0.5 m depth below subgrade level.

The standard of construction, the selection of materials and quality of workmanship for the roads should satisfy the requirements of the latest edition of Queanbeyan Palerang Regional Council specifications.

## 7.3 Site Classifications

Based on the fieldwork carried out during the current investigation, the natural subsurface profiles in areas of shallow bedrock would be expected to be Class S (slightly reactive) and Class M (moderately reactive) and where deeper soil profiles and high plasticity clays are present (e.g. Pit 9) would be expected to be Class M, and Class H1 (AS 2870:2011).

It is recommended that the site be reclassified/reassessed after earthworks involving cut and fill work has been completed.

## 7.4 Foundations

For preliminary sizing of footings including any future retaining walls, allowable base bearing pressures for the various soil strata encountered including controlled filling are given below:

- Controlled Filling: 150 kPa
- Very stiff clayey soils: 150 kPa
- Medium dense sandy soils: 150 kPa
- Extremely low to very low strength bedrock: 500 kPa
- Low strength bedrock: 1000 kPa
- Medium or greater strength bedrock (to be confirmed) 2500 kPa

All footing excavations should be inspected by a suitably qualified engineer prior to placement of reinforcing steel and pouring of concrete to confirm the design bearing pressures.

The settlement of a spread footing is dependent on the stiffness of the founding stratum, dimensions of the footing and the load applied. As a guide, a 1 m wide footing proportioned on the basis of the above parameters would experience settlement of less than about 10 mm to 20 mm (1% to 2% of the footing width) under application of the indicated allowable bearing pressures. Differential settlements between adjacent footings founded in similar strata are expected to be less than about 50% of the total settlement values.

### 7.5 Soil Aggressivity

The soil aggressivity test results are included in Appendix D and are summarised in Table 4 in Section 6. The results indicate that based on the soils/rock the exposure classification for concrete and steel is *Non-Aggressive*.

## 8. References

AS 1289.6.3.2. (1997). *Methods for testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - 9kg dynamic cone penetrometer test.* Reconfirmed 2013: Standards Australia.

AS 2870. (2011). *Residential Slabs and Footings.* Standards Australia.

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

BMR. (1992). *Geology of Canberra 1:100 000 Geological Series Sheet 8727.* Bureau of Mineral Resources.

## 9. Limitations

Douglas Partners (DP) has prepared this report for the Proposed New Primary School at Aprasia Ave, Googong in accordance with DP's proposal 203634.00.P.001 dated 9 April 2021 and acceptance received from Paul Todhunter via email dated 21 April 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Hansen Yuncken Pty Ltd 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.

**Douglas Partners Pty Ltd**

# Appendix A

## About This Report

## 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
This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## 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

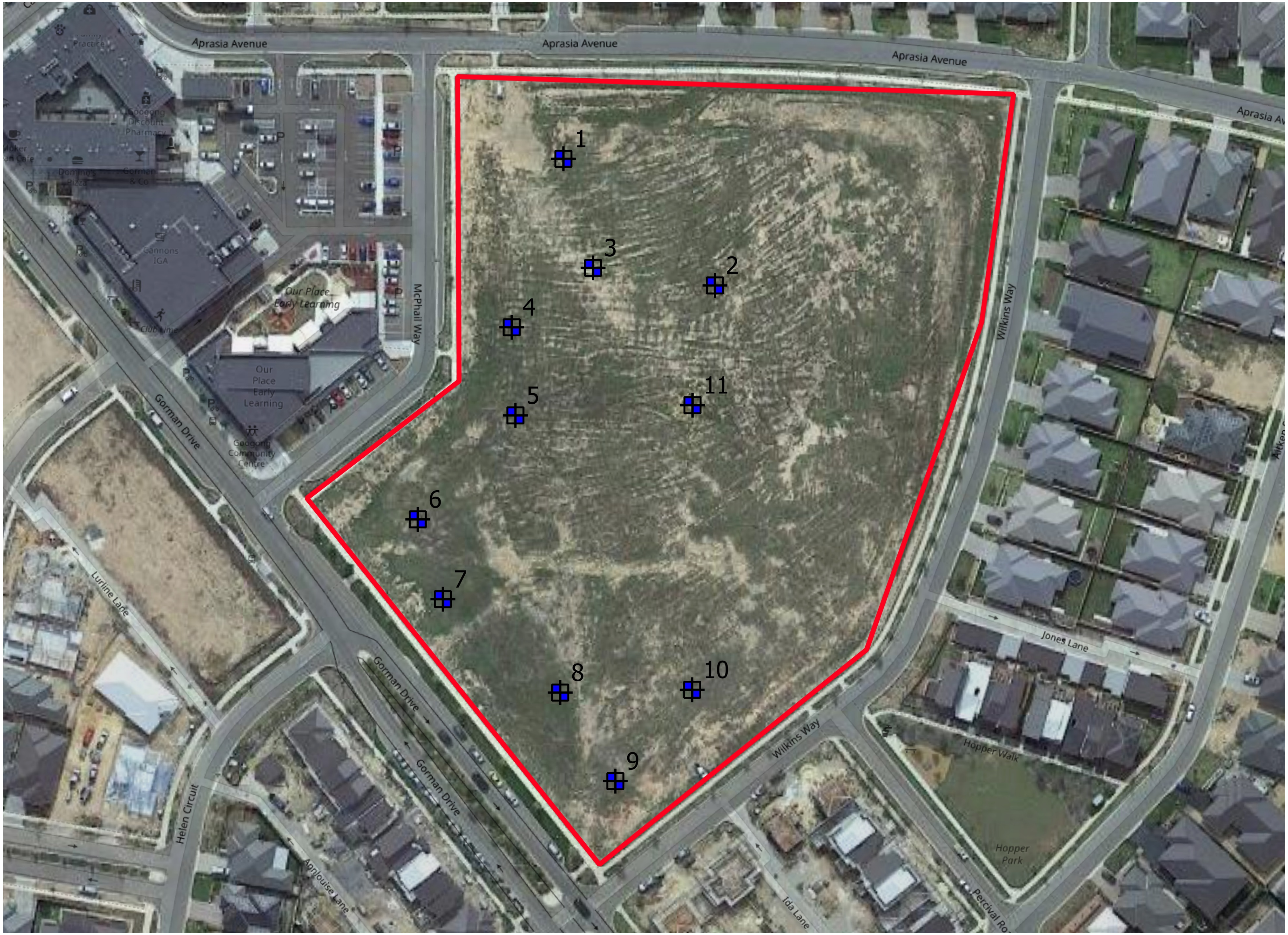
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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.

# Appendix B

Drawing 1 – Test Location Plan





Site Location

Legend

Test Pits

Site Boundary

Map hatch

Google Satellite

0 15 30 45 60 m

Drawing adapted from aerial imagery from Google Satelite dated 2019.

Test locations set out by client.

| | | | |
|---|---|---|---|
| **Douglas Partners** Geotechnics / Environment / Groundwater | CLIENT: Hansen Yuncken Pty Ltd | | TITLE: **Test Location Plan** |
| | OFFICE: Canberra | DRAWN BY: TBO | **Proposed New Primary School** |
| | SCALE: 1:200 @ A3 | DATE: 21.May.2021 | **Aprasia Ave, Googong** |

| | |
|---|---|
| Project: | 203634.00 |
| DRAWING No: | 1 |
| REVISION: | 0 |

DP.QGIS.A3LandScapeDrawingLayout.DftA

# Appendix C

Explanatory Notes
Test Pit Logs

## 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.

# Soil Descriptions

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## Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, 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

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## 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 - 2007. The terms used to describe rock strength are as follows:

| Term | Abbreviation | Point Load Index $Is_{(50)}$ MPa | Approximate 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 $Is_{(50)}$. 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 |
|---|---|---|
| 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 longer 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 |

# 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 |

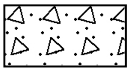
# *Symbols & Abbreviations*

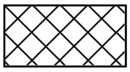
## Graphic Symbols for Soil and Rock

### General

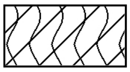
 Asphalt

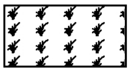
 Road base

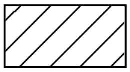
 Concrete

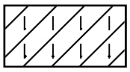
 Filling

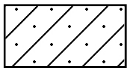
### Soils

 Topsoil

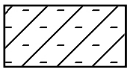
 Peat

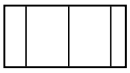
 Clay

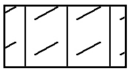
 Silty clay

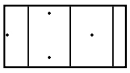
 Sandy clay

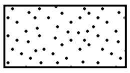
 Gravelly clay

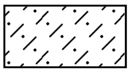
 Shaly clay

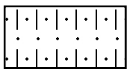
 Silt

 Clayey silt

 Sandy silt

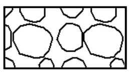
 Sand

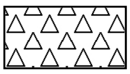
 Clayey sand

 Silty sand

 Gravel

 Sandy gravel

 Cobbles, boulders

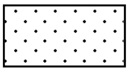
 Talus

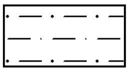
### Sedimentary Rocks

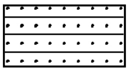
 Boulder conglomerate

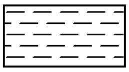
 Conglomerate

 Conglomeratic sandstone

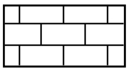
 Sandstone

 Siltstone

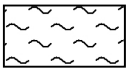
 Laminite

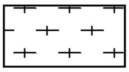
 Mudstone, claystone, shale

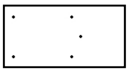
 Coal

 Limestone

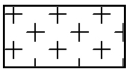
### Metamorphic Rocks

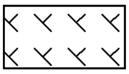
 Slate, phyllite, schist

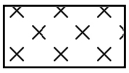
 Gneiss

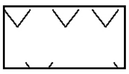
 Quartzite

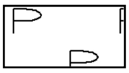
### Igneous Rocks

 Granite

 Dolerite, basalt, andesite

 Dacite, epidote

 Tuff, breccia

 Porphyry

# TEST PIT LOG

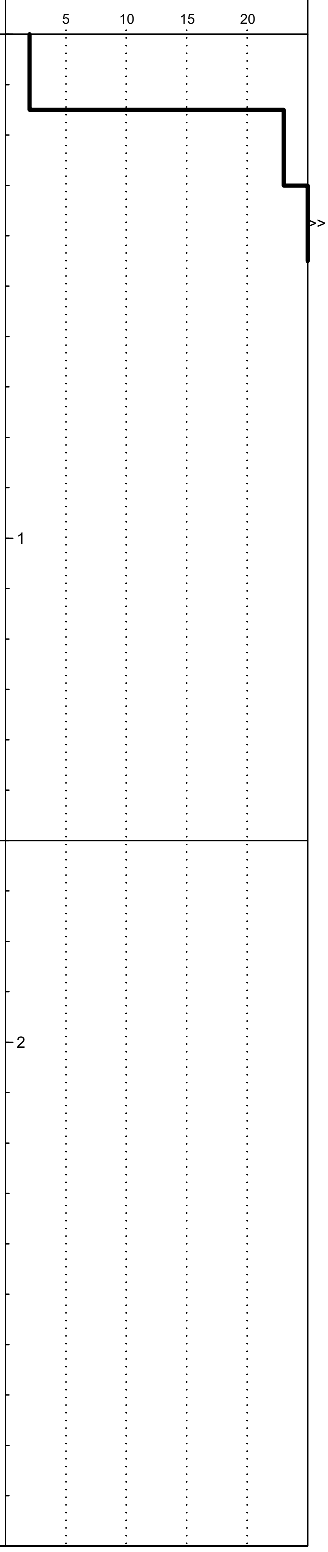
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 743.4 AHD
**EASTING:** 703172
**NORTHING:** 6077817

**PIT No:** 1
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| | 0.0 | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | |
| | 0.2 | FILL/Silty CLAY (CL/CI): low to medium plasticity, red-orange, mottled brown, trace fine to coarse grained sand, with gravel and cobbles up to 75mm in size, moist to dry, w<PL, very stiff to hard, FILL | | | | | | |
| 743 | 0.4 | Silty CLAY (CI): medium plasticity, yellow-pale brown, mottled grey, trace fine to coarse and, trace fine gravel, moist to dry, w<PL, hard, residual | | D | 0.4 | | | |
| | | | | E | 0.5 | | | |
| | | | | B | | | | |
| | | | | D E | 0.7 | | | |
| | 0.8 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | | | | | |
| | 1 | | | D E | 1.0 | | | |
| 742 | | -from 1.4m, low to medium strength, highly to moderately weathered | | D | 1.5 | | | |
| | 1.6 | Pit discontinued at 1.6m<br>-refusal | | | | | | |
| | 2 | | | | | | | |
| 741 | | | | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket
**LOGGED:** TBO
**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

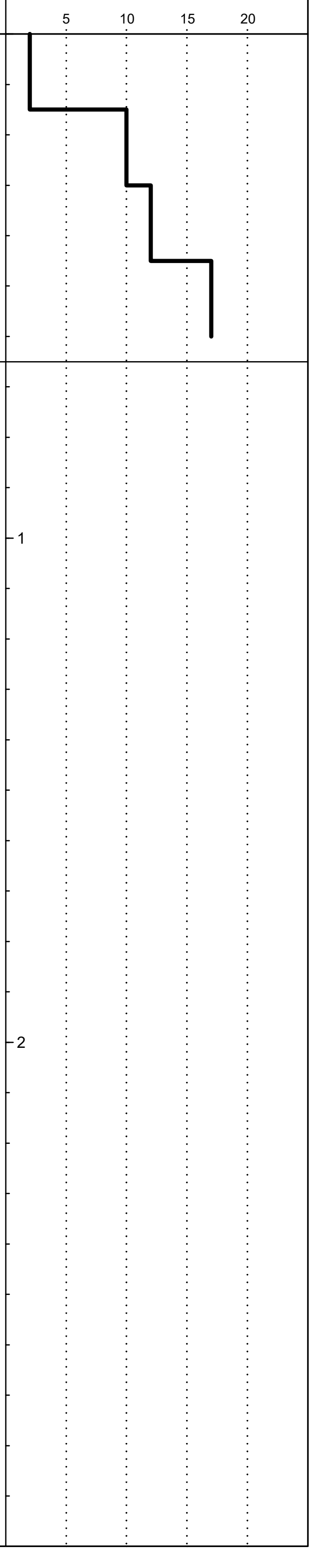
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 743. AHD
**EASTING:** 703215
**NORTHING:** 6077781

**PIT No:** 2
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| 743 | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | |
| | 0.15 | FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, with fine to coarse gravel, trace cobbles up to 75mm in size, moist, w<PL, stiff to very stiff, FILL | | D | 0.25 | | | |
| | 0.3 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | D | 0.4 | | | |
| | | | | E | 0.5 | | | |
| | | -from 0.55m, low to medium strength, highly to moderately weathered | | D | 0.6 | | | |
| | 0.65 | Pit discontinued at 0.65m<br>-refusal | | | | | | |
| 742 | 1 | | | | | | | |
| 741 | 2 | | | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 744.4 AHD
**EASTING:** 703180
**NORTHING:** 6077786

**PIT No:** 3
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Type | Depth | Sample | Results & Comments | Water | Dynamic Penetrometer Test (blows per 150mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | | |
| | 0.2 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, dry, dense, colluvial | | D | 0.3 | | | | |
| 744 | 0.3 | Silty CLAY (CL): low plasticity, orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | | E | 0.5 | | | | |
| | 0.6 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | D | 0.6 | | | | |
| | | -from 0.8m, highly to moderately weathered, low to medium strength | | B | 0.8 | | | | |
| | 0.9 | Pit discontinued at 0.9m<br>-refusal | | | | | | | |

**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 744.2 AHD
**EASTING:** 703157
**NORTHING:** 6077769

**PIT No:** 4
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Dynamic Penetrometer Test (blows per 150mm) |
|---|---|---|---|---|---|---|---|---|---|
| 744 | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | | |
| | 0.3 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, dry, dense, colluvial | | D | 0.4 | | | | |
| | 0.5 | Silty CLAY (CL): low plasticity, red-orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | | E | 0.5 | | | | |
| | | | | D | 0.8 | | | | |
| | 0.9 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | E | 1.0 | | | | |
| 743 | | -from 1.2m, low to medium strength, highly to moderately weathered | | D | 1.2 | | | | |
| | 1.3 | Pit discontinued at 1.3m<br>-refusal | | | | | | | |
| 742 | 2 | | | | | | | | |

**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 744.1 AHD
**EASTING:** 703158
**NORTHING:** 6077744

**PIT No:** 5
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Type | Depth | Sample | Results & Comments | Water | Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20 |
|---|---|---|---|---|---|---|---|---|---|
| 744 | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | | |
| | 0.15 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, dry, dense, colluvial | | | | | | | |
| | 0.25 | Silty CLAY (CL): low plasticity, red-orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | | E | 0.5 | | | | |
| | | | | D | 0.7 | | | | |
| | 0.8 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | | | | | | |
| | 1 | -from 1.0m, low to medium strength, highly to moderately weathered | | D<br>E | 1.0 | | | | 1 |
| 743 | | | | | | | | | |
| | 1.2 | Pit discontinued at 1.2m<br>-refusal | | D | 1.2 | | | | |
| | 2 | | | | | | | | 2 |
| 742 | | | | | | | | | |

**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

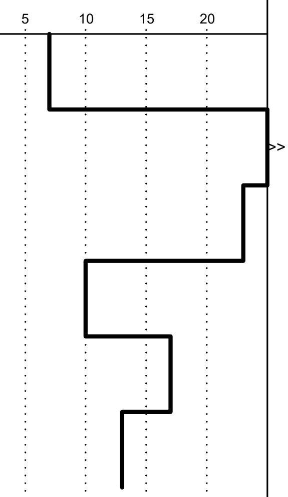
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 743.2 AHD
**EASTING:** 703131
**NORTHING:** 6077715

**PIT No:** 6
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Sampling Type | Sampling Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|
| | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | E | 0.1 | | | |
| 743 | 0.15 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, moist, dense, colluvial | D | 0.2 | | | |
| | 0.35 | Silty CLAY (CL): low plasticity, red-orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | D<br>E | 0.5 | | | |
| | 0.9 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | D<br>E | 1.0 | | | |
| 742 | | -from 1.3m, low to medium strength, highly to moderately weathered | D | 1.4 | | | |
| | 1.6 | Pit discontinued at 1.6m<br>-limit of investigation | | | | | |
| 741 | 2 | | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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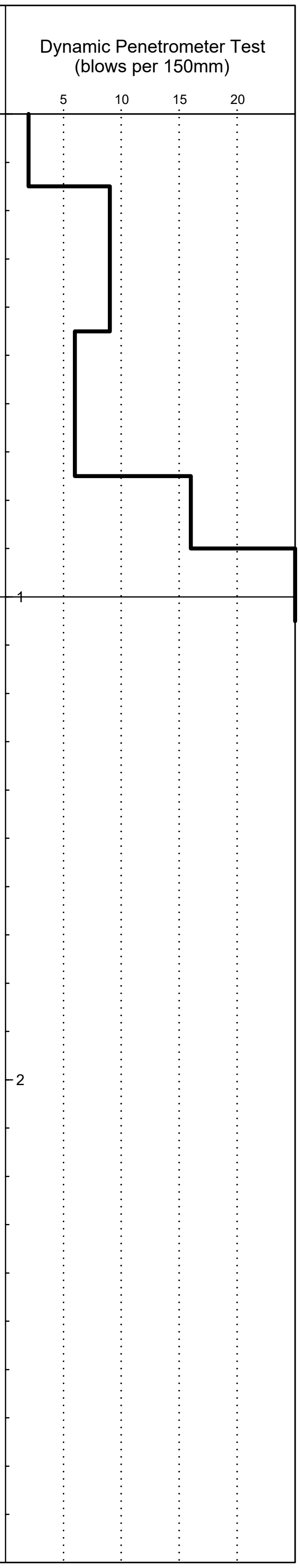
# TEST PIT LOG

**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 743.1 AHD
**EASTING:** 703138
**NORTHING:** 6077692

**PIT No:** 7
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| 743 | 0.1 | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | |
| | 0.3 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, moist, dense, colluvial | | D | 0.2 | | | |
| | 0.5 | Silty CLAY (CL): low plasticity, red-orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | | D | 0.4 | | | |
| | 1.0 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength<br>-from 0.6m, low to medium strength, highly to moderately weathered | | E | 0.5 | | | |
| | | | | D | 0.8 | | | |
| 742 | 1 | Pit discontinued at 1.0m<br>-limit of investigation | | E | 1.0 | | | |
| 741 | 2 | | | | | | | |




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

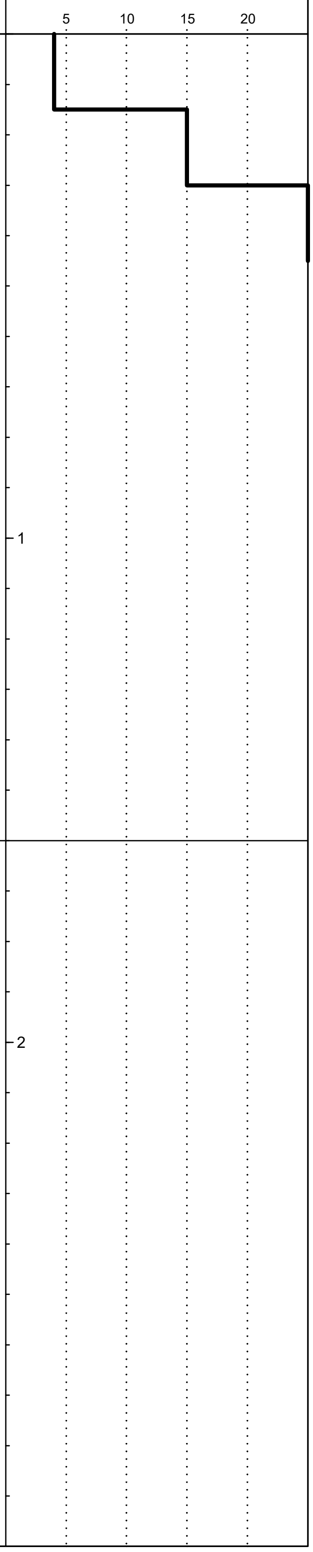
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 744.2 AHD
**EASTING:** 703171
**NORTHING:** 6077666

**PIT No:** 8
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| 744 | 0.1 | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | |
| | 0.2 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, moist to wet, loose-medium dense, colluvial | | | | | | |
| | | Silty CLAY (CL): low plasticity, red-orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual<br>-from 0.5m, yellow-pale brown | | D<br>E<br>B | 0.4<br>0.5 | | | |
| 743 | 0.7 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength<br>-from 1.0m, low to medium strength, highly to moderately weathered | | D<br>D<br>E<br>D | 0.7<br>1.0<br>1.3 | | | |
| 742 | 1.6 | Pit discontinued at 1.6m<br>-refusal | | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

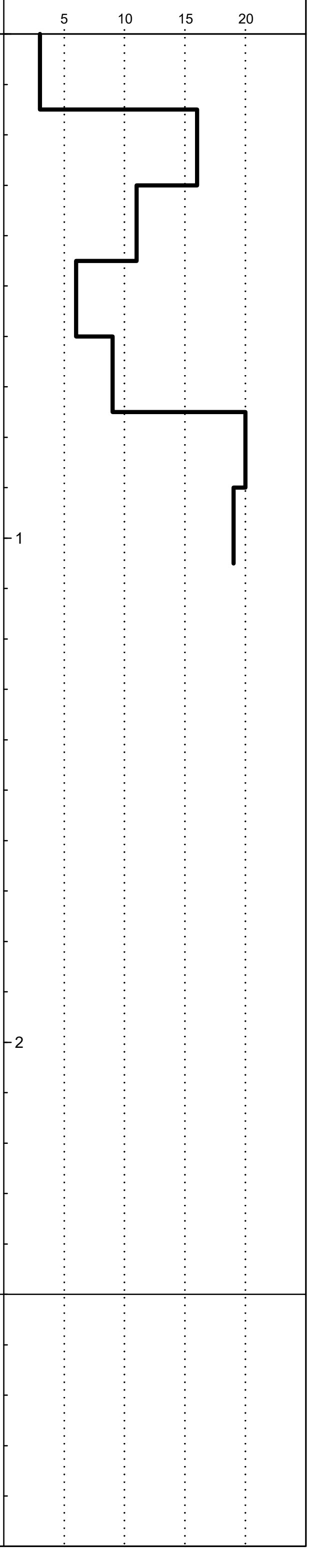
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 745.0 AHD
**EASTING:** 703187
**NORTHING:** 6077641

**PIT No:** 9
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|
| 745 | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | E | 0.1 | | | |
| | 0.1 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, dry, dense, colluvial | D | 0.2 | | | |
| | 0.4 | Silty CLAY (CI): medium plasticity, orange, mottled brown, trace rootlets, moist, w<PL, very stiff, residual | E | 0.5 | | | |
| 744 | 1 | -from 1.0m, yellow-pale brown, mottled red | D<br>E | 1.0 | | | |
| | | | D | 1.3 | | | |
| | 1.4 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | | | | |
| 743 | 2 | | E | 2.0 | | | |
| | | -from 2.3m, low strength, highly weathered | D | 2.3 | | | |
| | 2.5 | Pit discontinued at 2.5m<br>-limit of investigation | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket  **LOGGED:** TBO  **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

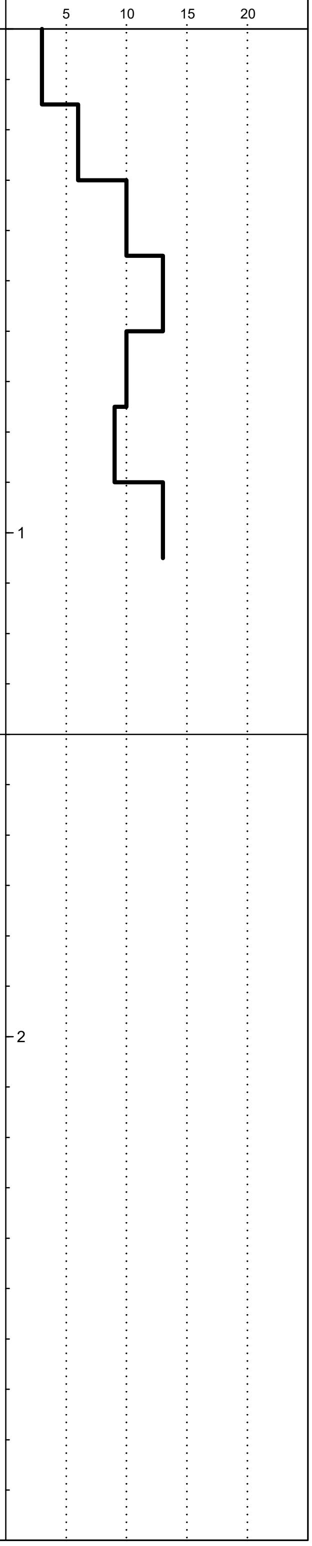
**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 745.7 AHD
**EASTING:** 703208
**NORTHING:** 6077667

**PIT No:** 10
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL FILL/Silty Sandy CLAY (CL): low plasticity, dark grey, fine to coarse grained sand, trace fine gravel, with rootlets, moist, soft, FILL | | E | 0.1 | | | |
| | 0.1 | Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, moist, dense, colluvial | | E | 0.3 | | | |
| | 0.25 | Silty CLAY (CL): low plasticity, orange, mottled brown, trace fine to coarse sand, trace fine gravel, moist to dry, w<PL, hard, residual | | B D | 0.4 | | | |
| | | | | E | 0.5 | | | |
| 745 | 0.6 | DACITE: fine to coarse grained, yellow-pale brown, mottled grey, dry to moist, extremely weathered, extremely low strength | | D | 0.8 | | | |
| | 1 | | | E | 1.0 | | | |
| | | -from 1.2m, low strength, highly weathered | | | | | | |
| | 1.4 | Pit discontinued at 1.4m<br>-refusal | | | | | | |
| 744 | | | | | | | | |
| | 2 | | | | | | | |
| 743 | | | | | | | | |

Dynamic Penetrometer Test (blows per 150mm)




**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket
**LOGGED:** TBO
**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# TEST PIT LOG

**CLIENT:** Hansen Yuncken Pty Ltd
**PROJECT:** Proposed New Public School
**LOCATION:** Aprasia Ave, Googong

**SURFACE LEVEL:** 745.0 AHD
**EASTING:** 703209
**NORTHING:** 6077747

**PIT No:** 11
**PROJECT No:** 203634.00
**DATE:** 7-5-2021
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20 |
|---|---|---|---|---|---|---|---|---|---|
| 745 | | FILL/Clayey SAND (SC): fine to coarse grained, grey-pale brown, low plasticity clays, trace fine gravel, moist, loose, FILL | | E | 0.1 | | | | |
| | | | | E | 0.5 | | | | |
| 744 | 1 | | | E | 1.0 | | | | 1 |
| | 1.2 | Pit discontinued at 1.2m -limit of investigation | | | | | | | |
| 743 | 2 | | | | | | | | 2 |

**RIG:** Hitachi EX11 mini-excavator fitted with a 300mm wide bucket **LOGGED:** TBO **SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Surface levels and coordinates are approximate only and must not be relied upon

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

**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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# Appendix D

Results of Laboratory Testing

# Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

| | |
|---|---|
| **Report Number:** | **203634.00-1** |
| **Issue Number:** | 2 - *This version supersedes all previous issues* |
| **Reissue Reason:** | *CBR Results Added.* |
| **Date Issued:** | 26/05/2021 |
| **Client:** | Hansen Yuncken Pty Ltd<br>PO Box 7514, Melbourne VIC 3004 |
| **Contact:** | Paul Todhunter |
| **Project Number:** | 203634.00 |
| **Project Name:** | Proposed New Public School |
| **Project Location:** | McPhail Way, Googong NSW |
| **Work Request:** | 5908 |
| **Sample Number:** | GU-5908A |
| **Date Sampled:** | 07/05/2021 |
| **Dates Tested:** | 11/05/2021 - 18/05/2021 |
| **Sampling Method:** | Sampled by Engineering Department<br>*The results apply to the sample as received* |
| **Sample Location:** | **Pit 4 , Depth: 0.8** |
| **Material:** | Silty Clay |

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|---|---|---|---|
| Sample History | Oven Dried | | |
| Preparation Method | Dry Sieve | | |
| Liquid Limit (%) | 57 | | |
| Plastic Limit (%) | 21 | | |
| **Plasticity Index (%)** | **36** | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---|---|---|---|
| Moisture Condition Determined By | AS 1289.3.1.1 | | |
| Linear Shrinkage (%) | 14.0 | | |
| Cracking Crumbling Curling | Curling | | |

| Moisture Content (AS 1289 2.1.1) | |
|---|---|
| Moisture Content (%) | 19.6 |

# Material Test Report

**Report Number:** **203634.00-1**
**Issue Number:** 2 - *This version supersedes all previous issues*
**Reissue Reason:** *CBR Results Added.*
**Date Issued:** 26/05/2021
**Client:** Hansen Yuncken Pty Ltd
PO Box 7514, Melbourne VIC 3004
**Contact:** Paul Todhunter
**Project Number:** 203634.00
**Project Name:** Proposed New Public School
**Project Location:** McPhail Way, Googong NSW
**Work Request:** 5908
**Sample Number:** GU-5908B
**Date Sampled:** 07/05/2021
**Dates Tested:** 11/05/2021 - 18/05/2021
**Sampling Method:** Sampled by Engineering Department
*The results apply to the sample as received*
**Sample Location:** **Pit 7 , Depth: 0.4**
**Material:** Silty Clay

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ilac-MRA NATA

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Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation 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 (%) | 66 | | |
| Plastic Limit (%) | 25 | | |
| **Plasticity Index (%)** | **41** | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---|---|---|---|
| Moisture Condition Determined By | AS 1289.3.1.1 | | |
| Linear Shrinkage (%) | 13.5 | | |
| Cracking Crumbling Curling | Curling | | |

| Moisture Content (AS 1289 2.1.1) | |
|---|---|
| Moisture Content (%) | 22.3 |

# Material Test Report

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Geotechnics / Environment / Groundwater

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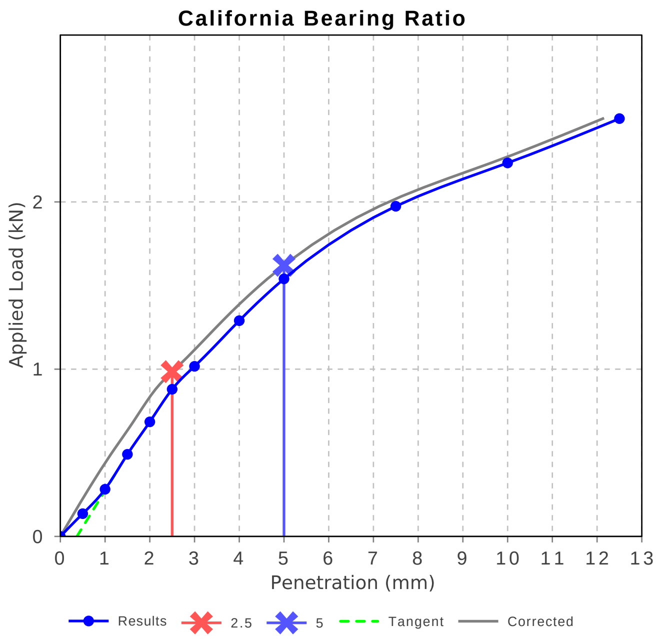
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

| | |
|---|---|
| **Report Number:** | **203634.00-1** |
| **Issue Number:** | 2 - *This version supersedes all previous issues* |
| **Reissue Reason:** | *CBR Results Added.* |
| **Date Issued:** | 26/05/2021 |
| **Client:** | Hansen Yuncken Pty Ltd |
| | PO Box 7514, Melbourne VIC 3004 |
| **Contact:** | Paul Todhunter |
| **Project Number:** | 203634.00 |
| **Project Name:** | Proposed New Public School |
| **Project Location:** | McPhail Way, Googong NSW |
| **Work Request:** | 5908 |
| **Sample Number:** | GU-5908C |
| **Date Sampled:** | 07/05/2021 |
| **Dates Tested:** | 11/05/2021 - 25/05/2021 |
| **Sampling Method:** | Sampled by Engineering Department |
| | *The results apply to the sample as received* |
| **Sample Location:** | **Pit 1 , Depth: 0.5-0.7** |
| **Material:** | Silty Clay |

| California Bearing Ratio (AS 1289 6.1.1 & 2.1.1) | | Min | Max |
|---|---|---|---|
| CBR taken at | 5 mm | | |
| CBR % | **8.0** | | |
| Method of Compactive Effort | Standard | | |
| Method used to Determine MDD | AS 1289 5.1.1 & 2.1.1 | | |
| Method used to Determine Plasticity | Visual Assessment | | |
| Maximum Dry Density (t/m$^3$) | 1.80 | | |
| Optimum Moisture Content (%) | 16.0 | | |
| Laboratory Density Ratio (%) | 100.0 | | |
| Laboratory Moisture Ratio (%) | 98.5 | | |
| Dry Density after Soaking (t/m$^3$) | 1.76 | | |
| Field Moisture Content (%) | 14.2 | | |
| Moisture Content at Placement (%) | 15.6 | | |
| Moisture Content Top 30mm (%) | 20.6 | | |
| Moisture Content Rest of Sample (%) | 16.9 | | |
| Mass Surcharge (kg) | 4.5 | | |
| Soaking Period (days) | 4 | | |
| Curing Hours | 25.6 | | |
| Swell (%) | 2.0 | | |
| Oversize Material (mm) | 19 | | |
| Oversize Material Included | Excluded | | |
| Oversize Material (%) | 0 | | |

| Moisture Content (AS 1289 2.1.1) | |
|---|---|
| Moisture Content (%) | 14.2 |



# Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
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Goulburn Laboratory
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Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

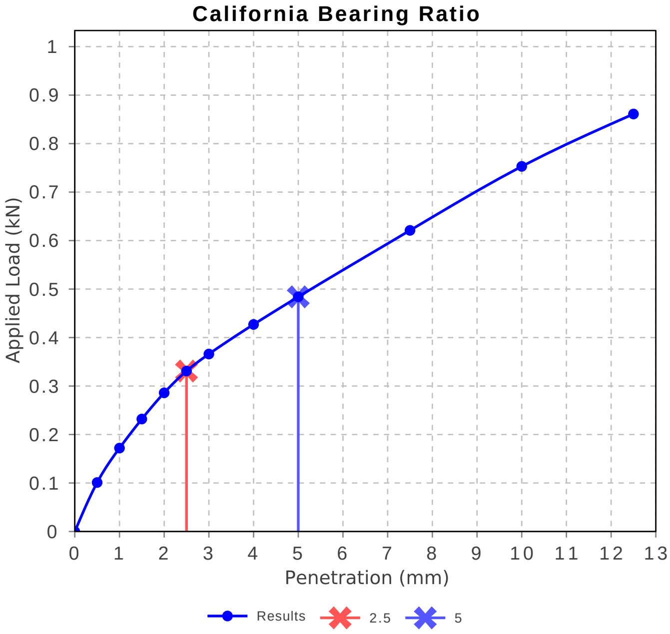
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

| | |
|---|---|
| **Report Number:** | **203634.00-1** |
| **Issue Number:** | 2 - *This version supersedes all previous issues* |
| **Reissue Reason:** | *CBR Results Added.* |
| **Date Issued:** | 26/05/2021 |
| **Client:** | Hansen Yuncken Pty Ltd<br>PO Box 7514, Melbourne VIC 3004 |
| **Contact:** | Paul Todhunter |
| **Project Number:** | 203634.00 |
| **Project Name:** | Proposed New Public School |
| **Project Location:** | McPhail Way, Googong NSW |
| **Work Request:** | 5908 |
| **Sample Number:** | GU-5908D |
| **Date Sampled:** | 07/05/2021 |
| **Dates Tested:** | 11/05/2021 - 25/05/2021 |
| **Sampling Method:** | Sampled by Engineering Department<br>*The results apply to the sample as received* |
| **Sample Location:** | **Pit 8 , Depth: 0.8-0.7** |
| **Material:** | Silty Clay |

| California Bearing Ratio (AS 1289 6.1.1 & 2.1.1) | | Min | Max |
|---|---|---|---|
| CBR taken at | 2.5 mm | | |
| CBR % | **2.5** | | |
| Method of Compactive Effort | Standard | | |
| Method used to Determine MDD | AS 1289 5.1.1 & 2.1.1 | | |
| Method used to Determine Plasticity | Visual Assessment | | |
| Maximum Dry Density (t/m$^3$) | 1.71 | | |
| Optimum Moisture Content (%) | 18.0 | | |
| Laboratory Density Ratio (%) | 100.0 | | |
| Laboratory Moisture Ratio (%) | 99.5 | | |
| Dry Density after Soaking (t/m$^3$) | 1.67 | | |
| Field Moisture Content (%) | 16.6 | | |
| Moisture Content at Placement (%) | 17.7 | | |
| Moisture Content Top 30mm (%) | 22.5 | | |
| Moisture Content Rest of Sample (%) | 19.3 | | |
| Mass Surcharge (kg) | 4.5 | | |
| Soaking Period (days) | 4 | | |
| Curing Hours | 43.3 | | |
| Swell (%) | 2.5 | | |
| Oversize Material (mm) | 19 | | |
| Oversize Material Included | Excluded | | |
| Oversize Material (%) | 0 | | |

| Moisture Content (AS 1289 2.1.1) | |
|---|---|
| Moisture Content (%) | 16.6 |



# Material Test Report

**Report Number:** **203634.00-1**
**Issue Number:** 2 - *This version supersedes all previous issues*
**Reissue Reason:** *CBR Results Added.*
**Date Issued:** 26/05/2021
**Client:** Hansen Yuncken Pty Ltd
PO Box 7514, Melbourne VIC 3004
**Contact:** Paul Todhunter
**Project Number:** 203634.00
**Project Name:** Proposed New Public School
**Project Location:** McPhail Way, Googong NSW
**Work Request:** 5908
**Sample Number:** GU-5908E
**Date Sampled:** 07/05/2021
**Dates Tested:** 11/05/2021 - 17/05/2021
**Sampling Method:** Sampled by Engineering Department
*The results apply to the sample as received*
**Sample Location:** **Pit 6, Depth: 0.2**
**Material:** Silty Clay

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Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
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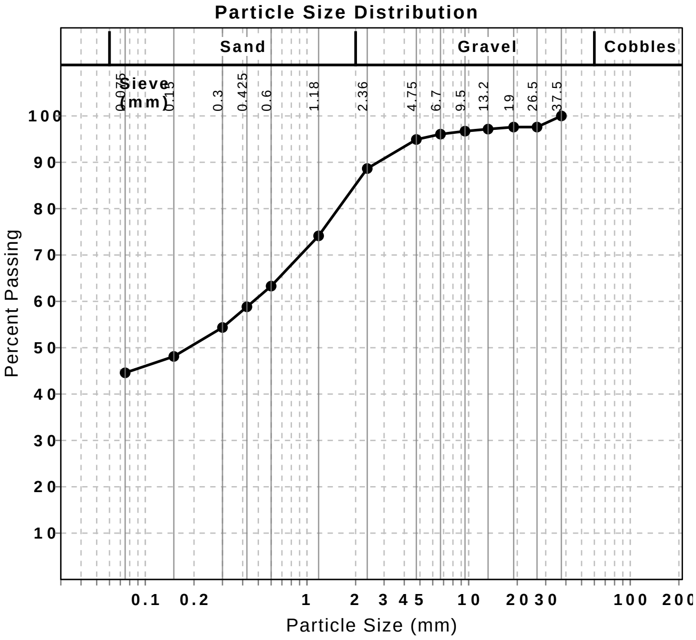
| Particle Size Distribution (AS1289 3.6.1) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sieve | Passed % | Passing Limits | | Retained % | Retained Limits | | |
| 37.5 mm | **100** | | | 0 | | |
| 26.5 mm | **98** | | | 2 | | |
| 19 mm | **98** | | | 0 | | |
| 13.2 mm | **97** | | | 0 | | |
| 9.5 mm | **97** | | | 0 | | |
| 6.7 mm | **96** | | | 1 | | |
| 4.75 mm | **95** | | | 1 | | |
| 2.36 mm | **89** | | | 6 | | |
| 1.18 mm | **74** | | | 15 | | |
| 0.6 mm | **63** | | | 11 | | |
| 0.425 mm | **59** | | | 4 | | |
| 0.3 mm | **54** | | | 4 | | |
| 0.15 mm | **48** | | | 6 | | |
| 0.075 mm | **45** | | | 4 | | |



**Envirolab Services Pty Ltd**
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# CERTIFICATE OF ANALYSIS 268780

## Client Details

| | |
|---|---|
| **Client** | Douglas Partners Canberra |
| **Attention** | Sasi Sasiharan |
| **Address** | Unit 2, 73 Sheppard St,, HUME, ACT, 2620 |

## Sample Details

| | |
|---|---|
| **Your Reference** | **203634.00, Googong Hume** |
| **Number of Samples** | 4 Soil |
| **Date samples received** | 12/05/2021 |
| **Date completed instructions received** | 12/05/2021 |

## Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

## Report Details

| | |
|---|---|
| **Date results requested by** | 19/05/2021 |
| **Date of Issue** | 18/05/2021 |

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**Results Approved By**
Diego Bigolin, Team Leader, Inorganics

**Authorised By**

Nancy Zhang, Laboratory Manager

| Soil Aggressivity | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 268780-1 | 268780-2 | 268780-3 | 268780-4 |
| Your Reference | UNITS | 3 | 5 | 6 | 9 |
| Depth | | 0.5m | 0.7m | 0.5m | 1.3m |
| Type of sample | | Soil | Soil | Soil | Soil |
| pH 1:5 soil:water | pH Units | 7.0 | 7.7 | 5.7 | 6.2 |
| Electrical Conductivity 1:5 soil:water | µS/cm | 47 | 120 | 430 | 90 |
| Chloride, Cl 1:5 soil:water | mg/kg | <10 | 81 | 570 | 66 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 20 | 57 | <10 | 37 |

| Method ID | Methodology Summary |
|---|---|
| **Inorg-001** | pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times. |
| **Inorg-002** | Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons. |
| **Inorg-081** | Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis.<br>Alternatively determined by colourimetry/turbidity using Discrete Analyser. |

| QUALITY CONTROL: Soil Aggressivity | | | | | Duplicate | | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-1 | [NT] |
| pH 1:5 soil:water | pH Units | | Inorg-001 | [NT] | [NT] | [NT] | [NT] | [NT] | 98 | [NT] |
| Electrical Conductivity 1:5 soil:water | µS/cm | 1 | Inorg-002 | <1 | [NT] | [NT] | [NT] | [NT] | 101 | [NT] |
| Chloride, Cl 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 95 | [NT] |
| Sulphate, SO4 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 96 | [NT] |

## Result Definitions

| | |
|---|---|
| **NT** | Not tested |
| **NA** | Test not required |
| **INS** | Insufficient sample for this test |
| **PQL** | Practical Quantitation Limit |
| **<** | Less than |
| **>** | Greater than |
| **RPD** | Relative Percent Difference |
| **LCS** | Laboratory Control Sample |
| **NS** | Not specified |
| **NEPM** | National Environmental Protection Measure |
| **NR** | Not Reported |

## Quality Control Definitions

| | |
|---|---|
| **Blank** | This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples. |
| **Duplicate** | This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable. |
| **Matrix Spike** | A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist. |
| **LCS (Laboratory Control Sample)** | This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample. |
| **Surrogate Spike** | Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples. |

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

## Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.