ABN 64 002 841 063

Intrusive Geotechnical Investigation Report

Proposed Upgrades to Kingswood Public School

46-54 Second Avenue, Kingswood

Report No 20429/11-AA Updated

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Document Information

Document Title	Intrusive Geotechnical Investigation Report
Site Address	46-54 Second Avenue, Kingswood
Job No	20429/11
Report No	20429/11-AA Updated
Client	NSW Department of Education
Client Address	GPO Box 33, Sydney NSW 2001

Document Control

Rev	**Date**	**Revision Detail/Status**	**Author**	**Reviewer**	**Approver**
0	28/01/2025	Initial Issue	Indra Jworchan		Indra Jworchan
1	28/02/2025	Updated	Indra Jworchan		Indra Jworchan

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Job No: 20429/11
Our Ref: 20429/11-AA Updated
28 February 2025

NSW Department of Education
GPO Box 33
SYDNEY NSW 2001

Dear Sir/Madam

re: **Upgrades to Kingswood Public School (ID 2312)**
46-54 Second Avenue, Kingswood
Intrusive Geotechnical Investigation (IGI) Report

Please find herewith report on an Intrusive Geotechnical Investigation carried out for the proposed upgrades to Kingswood Public School at 46-54 Second Avenue, Kingswood. This report has been prepared to support a Review of Environmental Factors (REF) for the proposed activity.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

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EXECUTIVE SUMMARY

NSW Department of Education is proposing upgrades to Kingswood Public School. The proposed activity for upgrades includes construction of a single storey building, learning common areas, multi-purpose spaces, covered walkways and removal of ten portable classrooms. This Intrusive Geotechnical Investigation (IGI) report has been prepared to support a Review of Environmental Factors (REF) for the proposed activity and indicates the following:

- The subsurface profile across Kingswood PS comprises a sequence of topsoil/fill and residual soils underlain by bedrock shale. The thickness of fill is variable. Although bedrock was not encountered in all boreholes, the depth to bedrock is anticipated to vary from about 3.0m to 4.5m from existing ground surface.
- The depth to groundwater across the site is likely to be in excess of 4.0m from existing ground surface under normal climatic conditions. It should however be noted that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors not evident during drilling.
- A Geotechnical Model constituting two Geotechnical Units is suggested for the proposed upgrade works in Kingswood Public School. Unit 1 is residual soil and Unit 2 is bedrock.
- Residual soils across the site are reactive. However, these soils may be selectively used in controlled fill after removal of deleterious materials (such as topsoil, organic matter, very high plasticity clay, silt etc) and moisture conditioning.
- The soils likely to be disturbed or excavated during the proposed upgrade works are likely to be saline, especially at depths exceeding 1.0m. Therefore, earthworks for proposed upgrade will have to be carried out in accordance with a Saline Soil Management Plan presented in Attachment C.
- Site preparation for proposed upgrade works is likely to involve excavation and fill operations. Excavations can be achieved using conventional earthmoving equipment such as excavators and dozers and fill should be placed in controlled manner. It is unlikely that the excavation works will encounter significant groundwater inflow. Minor groundwater inflow or seepage, if encountered, can be handled with conventional sump and pump method.
- Cut and fill slopes during and after proposed upgrade works should be battered for stability or retained with engineered retaining structures. For excavations within residual soils and controlled fill, recommended batter slopes for short term (temporary) stability is 1.0 vertical to 1.0 horizontal and that for long term (permanent) stability is 1.0 vertical to 2.5 horizontal.
- If batter slopes steeper than those recommended above are required, the batter slopes should be retained with engineered retaining structures. Appropriate retaining structures for the proposed development are anticipated to include gravity walls or cantilever walls or gravity walls designed for earth pressure parameters provided in this report.
- At the completion of earthworks, the building platforms for future buildings are anticipated to vary from controlled fill to residual soils.
- Appropriate footings for the proposed buildings and retaining structures comprise shallow (pad or strip) footings founded on controlled fill or residual soils, or deep footings socketed into bedrock. Deep footings (bored piers, screw piles etc) may be preferable if footings are required to withstand significant lateral and uplift loads. It is anticipated that the allowable bearing pressures for shallow footings founded in controlled fill and residual soils will vary from 100kPa to 200kPa. The allowable bearing pressure for deep footings socketed into bedrock is 700kPa or more.

- The sites for the proposed upgrade works are assessed to have a "Very Low Risk" of slope instability to the property at existing conditions. It is also our assessment that the risk of slope instability across the site can be maintained at "Very Low" so that the sites will be suitable for proposed upgrade works from slope stability considerations provided earthworks and construction of proposed structures are carried out in accordance with recommendations provided in this report.
- Although reactive and saline soils may impose some constraints on proposed upgrade works, the limitations are minor and can be addressed if earthworks are carried out in accordance with the Soil Management Plan provided in this report.

Based on above discussion, it is our assessment that the potential geotechnical risks at the site for the proposed activities are minor and can be addressed if earthworks and design of proposed structures are carried out in accordance with recommendation provided in this report. Furthermore, it is our assessment that the potential impact from the proposed activities on the locality, community and/or the environment is insignificant.

In conclusion, the site is assessed to be suitable for proposed activity provided earthworks and designs of ground floor slabs and footings of proposed school buildings/structures are carried out in accordance with recommendations provided in this report.

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Attachment B:	Laboratory Test Results
Attachment C	Saline Soil Management Plan

ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	**Description**
ASS	Acid Sulphate Soil
COLA	Covered Outdoor Learning Area
CSM	Conceptual Site Model
DoE	Department of Education
EC	Electrical Conductivity
ECe	Equivalent Electrical Conductivity
EFSG	Educational Facilities Standards and Guidelines
ESP	Exchangeable Sodium Percentage
GLS	General Learning Spaces
IGI	Intrusive Geotechnical Investigation
PGDR	Preliminary Geotechnical Desktop Report
PS	Public School
REF	Reference Environmental Factors
SMP	Soil Management Plan
SSMP	Saline Soil Management Plan
SINSW	School Infrastructures NSW
SPT	Standard Penetration Test
SWMS	Safe Work Method Statement

1.0 INTRODUCTION AND DECLARATION

This Intrusive Geotechnical Investigation (IGI) report has been prepared to accompany a Review of Environmental Factors (REF) for the Department of Education (DoE) for upgrades to Kingswood Public School (the activity) under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP TI).

This document has been prepared in accordance with the Guidelines for Division 5.1 assessments (the Guidelines) by the Department of Planning, Housing and Infrastructure.

This report examines and takes into accounts the relevant environmental factors in the Guidelines and Environmental Planning and Assessment Regulations 2021 under Section 170, Section 171 and Section 171A of the EP&A Regulation.

2.0 PROPOSED ACTIVITIES

The proposed activity for upgrades to Kingswood Public School includes:

- One (1) new single storey classroom building comprising eight (8) general learning spaces (GLS), two (2) learning commons areas, two (2) multi-purpose spaces and a verandah along the eastern side of the building;
- The construction of a covered walkway that will provide a connection between the proposed classroom building and an existing covered outdoor learning area (COLA) to the northeast of the proposed building; and
- Removal of existing portable classroom buildings containing ten (10) classrooms.

This report supports REF and provides (1) assessment of subsurface conditions across the site; and (2) geotechnical recommendations on site preparation and the design of the proposed upgrade activity. The IGI was completed in accordance with Australian Standard AS1726 (Reference 1).

3.0 SITE DESCRIPTION

The project site is located at 46-54 Second Avenue, Kingswood, and is legally described as Lot 172 in Deposited Plan (DP) 839785. Kingswood Public School is located on the southern side of Second Avenue.

Most of existing school infra-structures, such as buildings and car parks, are located in the northern portion of the site. The open areas in the remaining portions are grass covered with scattered mature trees.

Ground surface across the site is dipping toward the northwest direction at about 1 to 2 degrees. The ground surface elevation varies from about 42.0m AHD in the northwest corner to about RL58.0m in the southeastern corner. Figure 2 shows surface elevation contours across the site.

Figure 1 on the following page shows the location of the site.

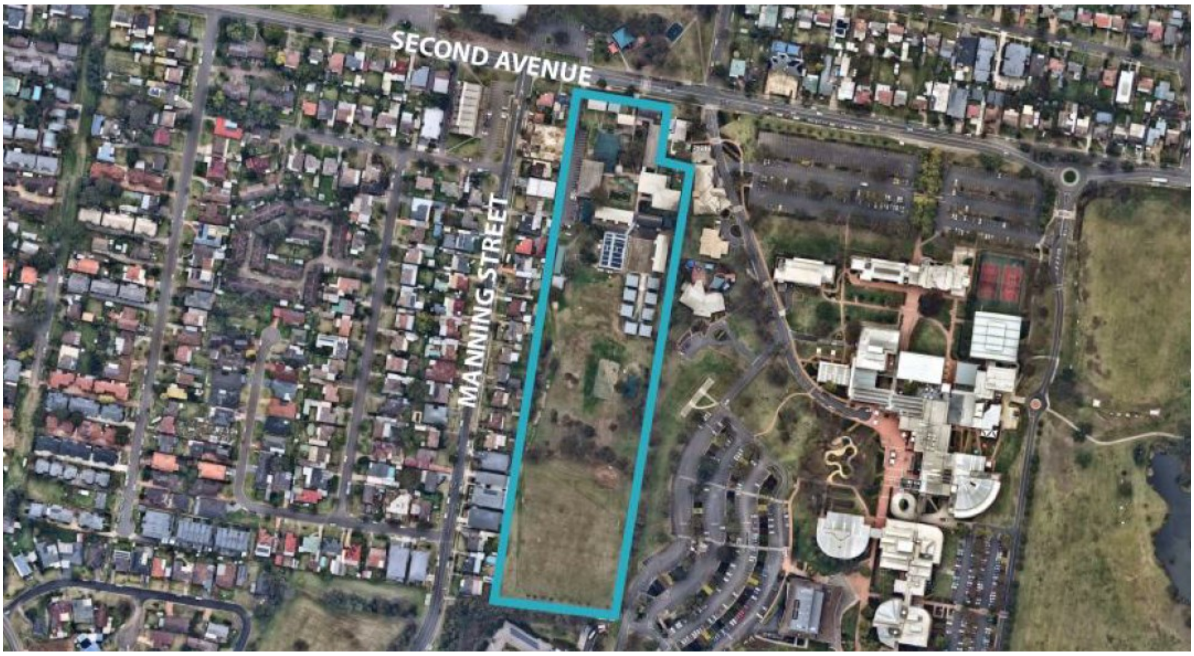


Figure 1 – Location of Kingswood Public School

4.0 BACKGROUND INFORMATION

4.1 Regional Geology and Soil Landscape

Based on the Geological Map of Penrith (Reference 2), bedrock at the site is anticipated to be Bringelly Shale, belonging to the Wianamatta Group of rocks and comprising shale, carbonaceous claystone, laminite, fine to medium grained lithic sandstone, and rare coal.

The Soil Landscape Map of Penrith (Reference 3) indicates that the landscape at the site belongs to the Luddenham Group, which is characterised by undulating to rolling low hills on Wianamatta Group shale, often associated with Minchinbury Sandstone, with local relief of 50m to 80m, ground surface slopes of 5% to 20%, narrow ridges, hillcrests and valleys. Soil in this group is likely to be up to 1.5m deep, highly plastic, moderately reactive, locally impermeable and susceptible to high erosion hazards.

4.2 Preliminary Geotechnical Desktop Study

Review of PGDR (Reference 4) indicates the following:

- The sub-surface profile across the site comprises a sequence of topsoil/fill and residual soil underlain by bedrock. Topsoil/fill comprises low plasticity silty clay and residual soil comprises high plasticity silty clay. Depth to bedrock across the site is anticipated to be about 4.0m from the existing ground surface.
- The depth to groundwater levels is likely to be more than about 4.0m from existing ground surface.
- The Kingswood PS site has moderate salinity potential (Reference 5). Therefore, earthworks (disturbance or excavation of soils) for proposed development works should be carried out in accordance with a Saline Soil Management Plan to manage impact from saline soils to proposed upgrade works and vice versa.

- There are no known or probabilities of occurrences of acid sulphate soils across Kingswood PS and the risk of acid sulphate occurrence is ”Low” (Reference 6). Therefore, earthworks for proposed development works can be carried out without an approved Acid Sulphate Soil Management Plan.
- Potential presence of erodible and reactive soils should be considered in design of proposed upgrade works. However, no area of high geotechnical risks was confirmed.
- A Geotechnical Model is Geotechnical Units is suggested for the proposed development (upgrade works) in Kingswood Public School.

From geotechnical engineering considerations, there are no significant geotechnical risks on proposed upgrade works in Kingswood PS. Therefore, it is our assessment that the site is suitable for proposed upgrade works provided site preparation and designs of activity are carried out in accordance with recommendations in this report.

4.3 Intrusive Geotechnical Investigation

4.3.1 Field Works

Field works for IGI were carried out on 27 September 2023 and consisted of the following:

- Reviewing geological and soil landscape maps and PGDR relevant to the site to obtain general idea on geotechnical conditions across the site.
- Reviewing services plans obtained from “Before You Dig Australia” to locate existing services across the site.
- Carrying out a walkover survey to assess existing site conditions and nominate five borehole locations uniformly distributed in accessible portions within the footprint of proposed building or immediate vicinity.
- Scanning proposed borehole locations with aim of avoiding damages to existing underground services during field works for IGI.
- Drilling five (5) boreholes (BH1 to BH5) using an auger mounted on an excavator. These boreholes were terminated at auger refusal in bedrock or depth of about 4.0m from existing ground surface, whichever occurs first. Approximate borehole locations are indicated on Drawing No 20429/7-AA1 presented in Attachment A. Borehole logs are also presented in Attachment A.
- Conducting Dynamic Cone Penetrometer (DCP) tests adjacent to boreholes to assess strength of subsurface soils. DCP tests were terminated at depths of about 0.8m to 1.8m. DCP test results are included in appropriate borehole logs.
- Measuring depths to groundwater level or seepage in boreholes where encountered.
- Collecting representative soil samples from boreholes for visual assessment and laboratory testing.
- Backfilling the boreholes with recovered materials after logging and sampling.

Field works were supervised by a Field Engineer from this company, responsible for walk over survey, nominating borehole locations, conducting DCP tests, sampling, and preparation of field logs.

4.3.2 Subsurface Profile

Sub-surface profiles encountered in boreholes are detailed in the borehole logs presented in Appendix A and summarised below in Table 1.

Table 1 - Sub-surface Profiles encountered in Boreholes

Borehole No	Ground Surface RL (m AHD)	Termination Depth (m)	Depth for Topsoil/ Fill (m)	Depth for Residual Soil (m)	Depth to Bedrock (m)
BH1	48.6	4.0	0.0-1.0	1.0->4.0	-
BH2	48.4	4.0	0.0-0.8	0.8->4.0	-
BH3	47.5	4.0	0.0-0.2	0.2-3.8	3.8
BH4	47.0	4.0	0.0-0.8	0.8->4.0	-
BH5	47.6	3.6	0.0-0.3	0.3-3.3	3.3

Table 1 indicates that the subsurface profiles across the footprint of the proposed new building comprises a sequence of topsoil/fill and residual soils underlain by bedrock. The thickness of fill is variable. Although bedrock was not encountered in all boreholes, the depth to bedrock is anticipated to vary from about 3.0m to 4.5m from existing ground surface. The subsurface materials may in general be described as follows:

Topsoil/Fill	Silty CLAY, Gravelly CLAY, low to medium plasticity, brown, moist, with some gravel and roots
Residual Soil	Silty CLAY, medium to high plasticity, red mottle pale grey, moisture content generally lower than plastic limit, stiff to very stiff
	Shaley CLAY, low to medium plasticity, grey, brown, moisture content generally lower than plastic limit, hard
Bedrock	SHALE, extremely to distinctly weathered, very low to low strength

Groundwater level was not encountered in all boreholes up to their termination depths of 3.6m to 4.0m from existing ground surface. Therefore, we anticipate the depth to regional groundwater across the site to be more than 4.0m. However, it should be noted that the groundwater levels might vary due to rainfall and other factors not evident during field work.

4.3.3 Laboratory Tests

Representative soil samples recovered from boreholes were tested in the NATA accredited laboratories in accordance with relevant Australian Standards, to determine the Atterberg limits and chemical properties including Electrical Conductivity (EC), pH, chloride and resistivity. Detailed laboratory test results are presented in Appendix B and summaries of test results are presented in the following Tables 2 and 3.

Table 2 - Results of Shrink Swell Index Tests

Borehole No	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH5	0.3-0.6	55.0	20.0	35.0	12.5

Table 3 - Results of Chemical Properties Tests

Borehole No	Sample Depth (m)	EC (µS/cm)	pH	Chloride (ppm)	Resistivity (ohm-m)
BH2	0.3-0.5	160	6.2	77	220
BH2	0.8-1.0	240	4.8	310	280
BH4	0.8-1.0	690	4.4	990	320
BH4	3.0-3.2	620	4.8	870	290
BH5	0.6-0.8	320	4.8	410	250
BH5	3.3-3.5	690	4.7	910	320

4.3.4 Recommended Geotechnical Model for the Site

Based on borehole information detailed above, a Geotechnical Model constituting two Geotechnical Units and detailed below in Table 4 is suggested for the proposed upgrade works in Kingswood PS. Each Geotechnical Unit represents a specific nature of soil and/or bedrock encountered across the site.

Table 4 - Recommended Geotechnical Model

Geotechnical Unit	Material Description	Indicative Depth to Top of Unit (m)
Unit 1	Residual Soils/Controlled Fill	0.0
Unit 2	Bedrock - Shale	3.0-4.5

It is noted that the residual soils are overlain generally by 0.3m to 1.0m thick topsoil/fill. Topsoil was minor. We anticipate the topsoil and existing fill within footprints of proposed structures will be removed or replaced with controlled fill placed in accordance with recommendations provided below in this report or additional tests will be carried out to confirm existing fill is controlled fill. Controlled fill may be considered to belong to Unit 1. Indicative strength parameters, in terms of cohesion and internal friction angle, as well as modulus for each Geotechnical Unit are presented below in Table 5.

Table 5 - Effective Strength Parameters and Modulus

Geotechnical Units	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (deg)	Young's Modulus (MPa)	Poisson's Ratio
Unit 1	19.0	5.0	27.0	25.0	0.30
Unit 2	21.0	300.0	30.0	100.0	0.25

4.3.5 Soil Salinity

Soil salinity is generally assessed by measuring Electrical Conductivity (EC) of a soil sample made up of 1:5 soil water suspension. Thus, determined EC is multiplied by a factor varying from 6 to 23, based on the texture of the soil sample, to obtain Corrected Electrical Conductivity designated as ECe (Reference 8). Alternatively, ECe may be directly measured in soil saturation extracts.

Soils are classified as saline if ECe of the saturated extracts exceed 4.0dS/m. The criteria for assessment of soil salinity classes are shown in the following Table 6 (Reference 7).

Table 6 –Criteria for Soil Salinity Classification

Classification	EC_e (dS/m)	Comments
Non-saline	<2	Salinity effects mostly negligible
Slightly saline	2 – 4	Yields of very sensitive crops may be affected
Moderately saline	4 – 8	Yields of many crops affected
Very saline	8 – 16	Only tolerant crops yield satisfactorily
Highly saline	>16	Only a few tolerant crops yield satisfactorily

Electrical conductivity (EC) values for representative soil samples are summarised in Table 3. For clayey soils encountered across the site an appropriate multiplying factor is assumed to vary from 9 to 10. Therefore, ECe values for representative soil samples are estimated to vary from 1.6dS/m to 6.9dS/m. Generally, soils from depths exceeding 1.0m are assessed to be saline. However, soil likely to be disturbed or excavated during proposed development works should be considered to be saline. Therefore, earthworks for the proposed development works should be carried out in accordance with the Saline Soils Management Plan presented in Attachment C.

4.3.6 Exposure Classification

Australian Standard AS2870 (Reference 8) provides guidelines to assess soil aggressivity and Exposure Classification for saline and acid/sulphate soils. Table 7 below provides salinity and Exposure Classifications based on EC_e, and Table 8 provides Exposure Classification based on acidic and sulphate soils.

Table 7 – Exposure Classifications for Saline Soils

Electrical Conductivity, EC_e (dS/m)	Exposure Classification	Salinity Classification
<2	A1	Non-saline
2 – 4	A1	Slightly saline
4 – 8	A2	Moderately saline
8 – 16	B1	Very saline
>16	B2	Highly saline

Table 8 – Exposure Classifications for Sulphate Soils

Sulphate expressed as SO_3		pH	Exposure Classification*	
In Soil (ppm)	In Groundwater (ppm)		Soil Condition A	Soil Condition B
<5000	<1000	>5.5	A2	A1
5000-10000	1000-3000	4.5-5.5	B1	A2
10000-20000	3000-10000	4.0-4.5	B2	B1
>20000	>10000	<4.0	C2	B2

*Soil Condition A = high permeability soils (e.g. sands and gravels) which are below groundwater
*Soil Condition B = low permeability soils (e.g. silts and clays) and all soils above groundwater

As stated above, soils across the school are clayey and therefore appropriate “Soil Condition” for predominant clayey soils is assessed to be “Condition B”. Therefore, based on laboratory test results presented in Tables 3 and guidelines on Exposure Classifications presented in Tables 7 and 8, the Exposure Classifications for proposed building site is assessed to be Classes A1 to A2. Therefore, we recommend that the proposed upgrade works use construction materials (such as concrete, bricks) and construction methods appropriate for Exposure Class A2.

4.3.7 Aggressivity Classification

Australian Standard AS2159 (Reference 9) provides Aggressivity Classifications of soil and groundwater applicable to iron/steel and concrete piles that may be used for proposed upgrade works. The Aggressivity Classifications applicable to iron/steel piles is provided below in Table 9 and Aggressivity Classification applicable to concrete piles is provided in Table 10.

Table 9 – Aggressivity Classification for Steel

Chloride		pH	Resistivity (ohm cm)	Soil Condition A*	Soil Condition B#
In Soil (ppm)	In Water (ppm)				
<5000	<1000	>5.0	>5000	Non-aggressive	Non-aggressive
5000-20000	1000-10000	4.0-5.0	2000-5000	Mild	Non-aggressive
20000-50000	10000-20000	3.0-4.0	1000-2000	Moderate	Mild
>50000	>20000	<3.0	<1000	Severe	Moderate

Table 10 – Aggressivity Classification for Concrete

Sulphate expressed as SO_4		pH	Chloride in Water (ppm)	Soil Condition A	Soil Condition B
In Soil (ppm)	In Groundwater (ppm)				
<5000	<1000	>5.5	<6000	Mild	Non-aggressive
5000-10000	1000-3000	4.5-5.5	6000-12000	Moderate	Mild
10000-20000	3000-1000	4.0-4.5	12000-30000	Severe	Moderate
>20000	>10000	<4.0	>30000	Very Severe	Severe

As discussed above soils across the site are clayey and therefore Soil Condition B is appropriate. Based on laboratory test results presented in Table 3 and guidelines on Aggressivity Classifications presented in Tables 9 and 10, the proposed building site is assessed to be Non-aggressivity to Moderately Aggressive to steel piles and Non-aggressive to Mildly Aggressive to concrete piles. Resistivity is dominant for steel piles and pH is dominant for concrete piles. Therefore, we recommend that the steel and concrete piles supporting proposed structures are designed to suit Moderately Aggressive and Mildly Aggressive sites respectively (Reference 9).

4.3.8 Soil Reactivity

Liquid limit and plastic limit of a representative residual soil sample are estimated to be 55.0% and 20.0% respectively and linear shrinkage is 12.5%. Therefore, it is our assessment that soils across the site are reactive and therefore susceptible to shrink and swell movements.

4.3.9 Excavation Conditions

Proposed upgrade works across the school is anticipated to involve some cut (including removal of uncontrolled fill and unsuitable foundation materials) and fill operations. Although details on depth of excavations are not provided, we anticipate proposed excavations will not be deeper than about 1.5m from existing ground surface. Therefore, the materials to be excavated are anticipated to comprise topsoil, fill and residual soils. Bedrock excavation is not anticipated.

Therefore, it is our assessment that the excavations for the proposed upgrade works can be achieved using conventional earthmoving equipment such as excavators and dozers.

Based on site observation during field work, we do not anticipate significant groundwater inflow during excavations to depths of about 1.5m. Minor groundwater inflow, if any, could be managed by a conventional sump and pump method. However, trafficability problems could arise locally during wet weather or if water is allowed to pond at the site.

Ground vibration during excavation works is generally represented by maximum peak particle velocity. It is anticipated that the existing structures/buildings in the vicinity of the site can tolerate ground vibration of about 5.0mm/s to 10.0mm/s. We also anticipate that the proposed excavations will result in ground vibrations that are likely to be within tolerable limits for stability of existing structures in the vicinity of the site.

4.3.10 Fill Placement

Site preparation for proposed upgrade works may involve placement of replacement of existing fill and placement of additional fill. The fill should be placed in a controlled manner, and we recommend the following procedures for placement of controlled fill.

- Strip existing topsoil and stockpile separately for possible future uses or dispose off the site. Topsoil may be used in landscaping.
- Undertake field density tests or Dynamic Cone Penetrometer (DCP) tests in existing fill, where exposed, to ascertain existing fill is compacted adequately to be suitable as foundation materials. If existing fill is conformed to be uncontrolled fill, strip existing fill to expose residual soils and stockpile separately for possible future uses or dispose off the site. Fill materials may selectively be used in controlled fill.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed controlled fill and/or residual soils to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill/crushed sandstone, compacted as described below.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill materials on proof rolled surface. Fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). Controlled fill should preferably comprise non-reactive fill (e.g. crushed sandstone), with a maximum particle size not exceeding 75mm, or low plasticity clay. The residual soils and bedrock obtained from excavations within the site may also be selectively used in controlled fill, after crushing to sizes finer than 75mm, moisture conditioning, and removal of unsuitable materials.

- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798 (Reference 11). It should be noted that a Geotechnical Inspection and Testing Authority will generally only provide certification on quality of entire compacted fill if Level 1 supervision and testing is carried out.

4.3.11 Batter Slopes and Retaining Structures

As described above, site preparation for the proposed upgrade works will involve cut and fill operations. Cuts are likely to be limited in residual soils. The cut and fill slopes should be battered for stability or retained by engineered retaining structures. If cut and fill slopes are to be battered for stability, we recommend the following batter slopes:

- For short-term stability in controlled fill and residual soils = 1 vertical to 1 horizontal
- For long-term stability in controlled fill and residual soils = 1 vertical to 2.5 horizontal

It is also recommended that batter slopes are provided with adequate surface and sub-surface drainage, and the crest of the batter slope is at least 1.0m away from the property boundaries.

However, if cut and fill slopes steeper than those recommended above are required for whatever reason, these slopes should be retained by engineered retaining structures. Appropriate retaining structures for the proposed upgrade works are anticipated to comprise cantilever walls and gravity walls. The pressure distribution on such walls is assumed to be triangular in shape and estimated as follows:

$$p_h = \gamma kH$$

Where,

p_h = Horizontal pressure (kN/m^2)
γ = Total unit weights of retained materials (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)

For design of flexible retaining structures where some lateral movement is acceptable, an active earth pressure coefficient (k_a) is recommended. However, if it is critical to limit the horizontal deformation, use of an earth pressure coefficient at rest (k_0) is recommended. Recommended earth pressure coefficients for the design of retaining structures are presented below:

- Total Unit Weigh = 19.0kN/m^3
- Coefficient of active earth pressure = 0.35
- Coefficient of at rest earth pressure = 0.55
- Coefficient of passive pressure (k_p) = 2.75

The above coefficients are based on the assumptions that the ground level behind the retaining structure is horizontal, and the retained material is effectively drained. Additional earth pressures resulting from surcharge load (buildings, infrastructures, etc) on retained materials and groundwater pressure, if any should also be allowed for in design of retaining structures. The design of any retaining structure should also be checked for bearing capacity, overturning, sliding and overall stability of the slope.

4.3.12 Site Classification

Australian Standard AS2870 (Reference 8) suggests that a building site is classified based on thickness of clayey foundation soils and reactivity (shrink swell movements) of foundation soils. Site preparation for the proposed upgrade works is anticipated to involve some cut and fill operations. Therefore, the thickness of clayey foundation soils as well as thickness and nature of controlled fill within proposed building footprint at the completion of earthworks are not known at this stage. However, reactivity of fill materials is anticipated to be better or at least as good as residual soils across the site.

Table 2 indicates that the residual soils are reactive. Therefore, it is our assessment that the residual soils across the site and fill, comprising residual soils and crushed shale obtained from excavation within the site, is likely to be reactive.

Based on assessed shrink swell value and thickness of foundation soil, it is our assessment that the building site for proposed upgrade works in Kingswood PS will belong to Class H1 in accordance with Australian Standard AS2870 (Reference 8). However, suggested site classification should be confirmed by sampling and testing of foundation soils after construction of building platform is completed.

Recommended site classification is based on the following assumptions:

1. Topsoil and fill are removed or replaced with controlled fill.
2. The construction requirements, site maintenance and performance expectations set out in Australian Standard AS2870 (Reference 8) are acceptable.

4.3.13 Floor Slabs

We anticipate foundation materials at ground floor levels of proposed building for proposed upgrade works will include controlled fill or residual soils. Under such circumstances, ground floor slabs for the proposed building may be designed and constructed as ground bearing slabs, or suspended slabs supported by footings designed in accordance with recommendations provided in this report.

Ground bearing floor slabs may be designed to suit Site Class H1 in accordance with Australian Standard AS2870 (Reference 8). Alternatively, we recommend a Modulus of Subgrade Reaction value of 20kPa/mm for design of ground-bearing slabs on controlled fill and residual soils.

4.3.14 Footings

Loading conditions for the proposed buildings/structures are not known at this stage. However, we consider that appropriate footings would comprise shallow footings (pad and strip footings) founded on controlled fill, residual soils or deep footings (bored piers or screw piles) founded on bedrock. Deep footings would be preferable if footings are required to support high vertical loads as well as significant lateral and uplift pressures. The recommended allowable bearing pressures for design of shallow and deep footings are presented in the following Table 12.

Table 11 – Recommended Bearing Pressures

Founding Material	Founding Depth from Existing Ground Surface (m)	Ultimate Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Unit 1 Controlled Fill/Residual Soil	0.5-1.5	300.0	Ignore	100.0	Ignore
Unit 1 Residual Soil	1.5-2.0	500.0	30.0	200.0	5.0
Unit 2 Bedrock	3.0-4.5	2000.0	150.0	700.0	70.0

The following should be noted:

- The ultimate bearing pressure and shaft adhesion are based on the ultimate capacities mobilised at large displacements, about 5.0% to 10.0% of pile diameter or minimum footing width. These values assume a clean rock socket with a roughness Category of R2 or better (Reference 12).
- The allowable bearing pressure and shaft adhesion are based on the capacities mobilised at displacements of about 1.0% of pile diameter or minimum footing width.
- The ultimate and allowable bearing pressures for Unit 2 are based on the assumptions that the piers are socketed at last 0.3m into appropriate rock units.
- Differential settlements are estimated to be about halves the estimated total settlements.
- The shaft adhesions against uplift pressures are halves the shaft adhesions for compressive loads presented in above table.
- For limit state design, geotechnical strength reduction factor ϕ_g of 0.50 is recommended in accordance with AS2159 (Reference 9). However, reduction factor ϕ_g can be increased up to 0.7 to 0.8 if pile design is verified by analyses of pile load tests and sufficient construction monitoring is carried out.

It is preferable that the footings are founded on similar foundation. As depths of bedrock with the recommended allowable bearing pressures is anticipated to vary across the site, the founding depths of footings to be constructed will also vary. Therefore, an experienced Geotechnical Engineer should confirm bearing pressures at founding levels during construction, on the basis of assessment made during footing excavation or pier hole drilling.

4.3.15 Slope Stability Assessment

Site factors such as slope angles, depth of insitu soils, strengths of sub-surface materials, and concentrations of water generally govern the stability of a site. "Practice Note Guidelines for Landslide Risk Management", prepared by Australian Geomechanics Society (Reference 13), recommends that the landslide (slope failure) risk at a site is assessed on the basis of the likelihood of a landslide (slope failure) event and the consequences of that event.

Applying the above guidelines, the risk of landslide (slope failure) across the site at its existing conditions is assessed as follows:

- Qualitative Measures of Likelihood - For the existing site conditions, it is our assessment that an event of a landslide (slope failure) is “Rare”, which means slope failures are conceivable but under exceptional circumstances, with indicative annual probability of $\approx 10^{-5}$.

- Qualitative Measures of Consequences to Property - It is our assessment that the consequences of landslide (slope failure) in the site to the property would be "Minor", resulting in limited damage to part of structures, and/or part of the site requiring some reinstatement/stabilisation works.

Based on the above Qualitative Measures, the site for the proposed upgrades is assessed to have a "Very Low Risk" to the property. The definitions of the risk levels are provided in Reference 13 and an abstract is presented below.

Risk Level		**Implication**
VH	Very High Risk	Extensive detailed investigation and research, planning and implementation of treatment options, essential to reduce risk to acceptable levels; may be too expensive and not practical.
H	High Risk	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M	Moderate Risk	Tolerable, provided treatment plan is implemented to maintain or reduce risks. May be accepted. Might require investigation and planning of treatment options.
L	Low Risk	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	Very Low Risk	Acceptable. Manage by normal slope maintenance procedures.

Based on a “Very Low " risk to property, it is considered that the site is assessed to be suitable for proposed upgrade works providing site preparation works and construction of proposed buildings/structures do not increase the risk of slope instability. Therefore, risk of slope instability does not impose any limitation of proposed upgrade works.

5.0 POTENTIAL GEOTECHNICAL RISKS

Based on anticipated site conditions, the potential geotechnical constraints or risks on proposed upgrade works include the following:

- The risk of variability in the thickness of fill and depth to bedrock.
- The risk of occurrence of saline soils.
- The risk of presence of reactive soils

Boreholes distributed across the site encountered fill. The thickness of fill across the site varies from about 0.2m to 1.0m from the existing ground surface. Likewise, the depth to bedrock across the site varies from about 3.5m to 4.0m. It will be preferably that footings of proposed buildings are founded on similar foundation materials. Therefore, designer of building should consider impacts of these variabilities on design and costing of the buildings.

Laboratory tests indicate that the soils across the site are reactive and saline. Therefore, designer of the upgrade works should consider and manage impacts from reactive and saline soils.

6.0 MITIGATION MEASURES FOR GEOTECHNICAL RISKS

The potential geotechnical constraints or risk on proposed upgrades to Kingswood PS include variability in the depth to bedrock and presence of reactive and salinity soils.

The geotechnical risks associated with variabilities in thickness and nature of fill and depth to bedrock can be addressed by conducting additional investigation or inspection during construction stage. However, structural design can be based on currently available information which can be confirmed during construction stage.

The risk associated with reactive soils can be addressed if the ground floor slabs and pavement are designed to suit the reactivity of the site and ground maintenance is carried out in accordance with Australian Standard AS2970 (Reference 8).

Likewise, impacts from saline soil can be addressed if earthworks are carried out in accordance with a Saline Soil Management Plan (SSMP) presented in Attachment C.

Table 13 in the following page presents recommended mitigation measures to address these geotechnical risks so that the residual risks are “Low” and the site is suitable for the proposed upgrade works.

7.0 SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

Based on nature of potential geotechnical risks at the site, it is our assessment that the potential impacts of proposed activities can be appropriately mitigated or managed in accordance with the recommended mitigation measures presented in Table 13. Once recommended remedial measures are implemented, the residual geotechnical risk at the site will be “Low”. Therefore, from geotechnical engineering consideration, it is determined that the extent and nature of potential impacts from the proposed activities are “Low” and will not have significant impact on the locality, community and/or the environment.

Table 12 – Recommended Mitigation Measures to Manage Geotechnical Risks

Mitigation Number/Names	**When Mitigation Measures are to be Complied With**	**Mitigation Measures**	**Reason for Mitigation Measure**
Geotechnical Risk - Variability in Depth to Bedrock	Design & Construction Stage Relevant Sections in the Report 4.3.2, 4.3.4 & 4.3.14	Design of footings/piers can be based on the geotechnical recommendation provided in this report. But site inspection should be carried out during construction stage to ascertain the depth to bedrock and allowable bearing pressures for design of footings. The designer should recognise variability in thickness of soils, including fill, and the depth to bedrock and ascertain that the designs of activities are appropriate to site conditions. It is preferable that the footings of proposed structures are founded on bedrock. However, its impact on project costing should be considered.	To reduce the risk or uncertainties due to variation in thickness of soils and depth to bedrock so that actual founding depths for footings or piers supporting buildings and other major structures are known. This means appropriate, economical and reliable foundation design can be achieved and potential variation claims during construction stage can be minimised.
Geotechnical Risk- Reactive Soil	Design, Construction & Operation Relevant Sections in the Report 4.3.2, 4.3.8, 4.3.12 & 4.3.14	Design of floor slabs and pavement can be based on Class H1 site in accordance with geotechnical recommendations provided in this report. The designer should recognise that the shrink swell movements and therefore site classification for a building site depends on thickness and reactivity of soil within the footprint of that building site Therefore, the designer should ascertain site classification for every building footprint by conducting additional testing after construction of building platform.	To reduce the risk or uncertainties due to variation in thickness and reactivity of soils so that appropriate, economical and reliable design of building slabs and pavements can be achieved, and potential variation claims during construction stage can be minimised.

Mitigation Number/Names	**When Mitigation Measures are to be Complied With**	**Mitigation Measures**	**Reason for Mitigation Measure**
Geotechnical Risk-Saline Soil	Design and Construction Relevant Sections in the Report 4.3.5, & Attachment C	Earthworks, including disturbance and excavation of soils, during proposed activity should be carried out in accordance with the Saline Soil Management Plan (SSMP) presented in Appendix C to manage and minimise impacts from saline soils to the proposed activity and vice versa. The designer should recognise that the subsurface soils across the site are saline and potentially dispersive. The cost for management of saline soil should be considered in project costing. It is possible that non-saline soil may be encountered in some portions of the site. Unless additional testing is carried out to delineate non-saline soil, disturbance, and excavation of localised non-saline soils should also be carried out in accordance with SSMP.	To manage adverse impacts from saline and dispersive soils to the proposed activity and vice versa and to reduce variation claims during construction stage

8.0 CONCLUSIONS

Based on results of PGDS and IGI, it is our assessment that the 46-54 Second Avenue, Kingswood, is suitable for proposed upgrade to Kingswood PS from geotechnical engineering considerations provided: (1) geotechnical constraints imposed by variability in depth to bedrock and presence of reactive, saline and erodible soils are addressed in accordance with mitigation measures provided in this report; and (2) site preparation and design of floor slabs and footings of proposed buildings and other structures are carried out in accordance with geotechnical recommendations provided in this report. From geotechnical engineering considerations, the extent and nature of potential impacts from the proposed activities are "Low" and will not have significant impact on the locality, community and/or the environment.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Principal Geotechnical Engineer

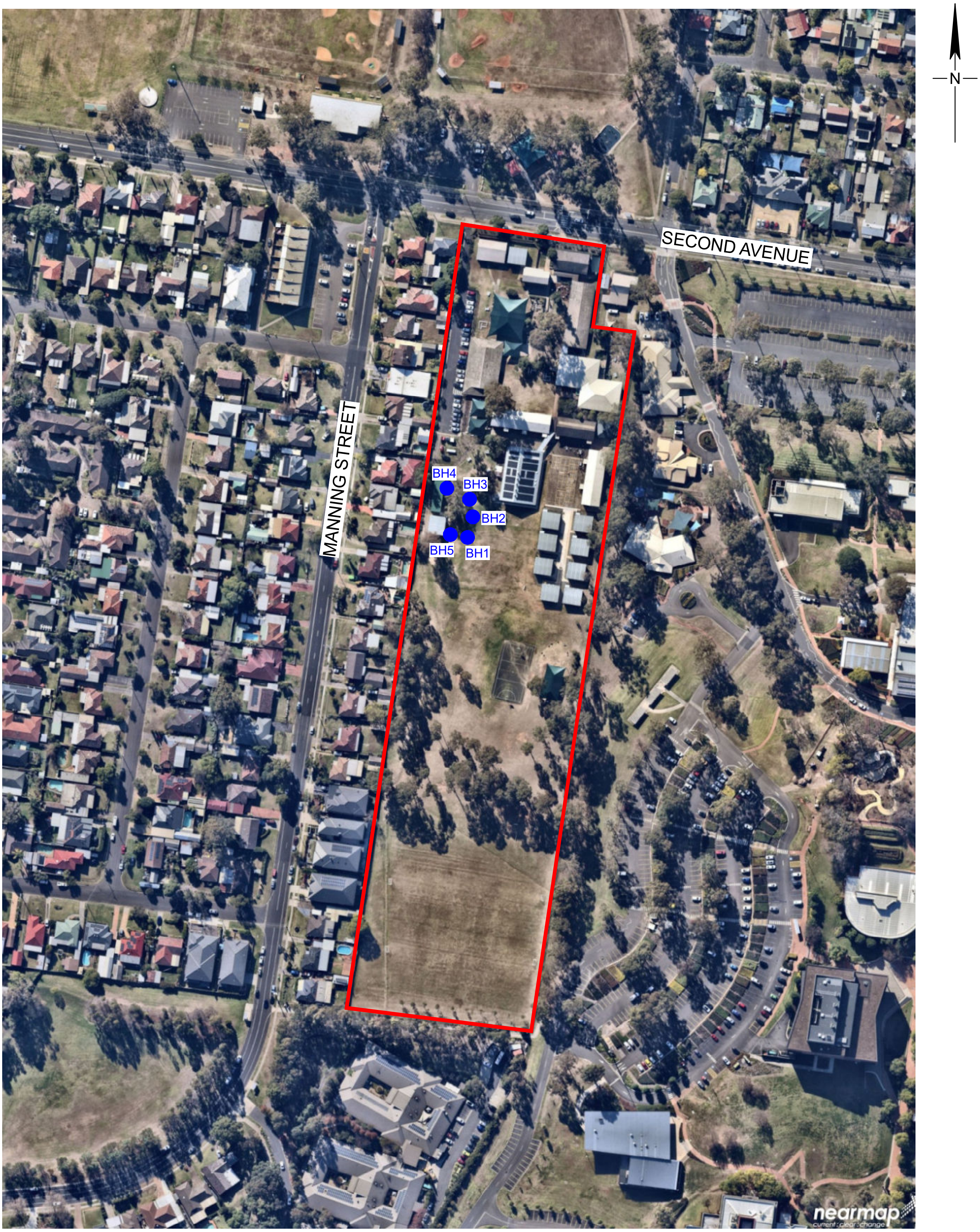
9.0 LIST OF REFERENCES

1. Australian Standard AS1726-2017, Geotechnical Site Investigation 2017.
2. Geology of Penrith 1:100,000 Sheet (9030) – Geological Survey of New South Wales, Department of Minerals and Energy 1991.
3. Soil Landscape of Penrith 1:100,000 Sheet (9030) – Soil Conservation Service Survey of NSW 1989.
4. Geotechnique Pty Ltd, Preliminary Geotechnical Desktop Study Report, Kingswood Public School, 46-54 Second Avenue, Kingswood, Report No 20429/5-AA, 24 October 2023.
5. Department of Infrastructure, Planning and Natural Resources, Salinity Potential in Western Sydney (scale approximately 1:140,000), 2002.
6. NSW Department of Land and Water Conservation, Acid Sulphate Soil Risk Map of Liverpool (Edition 2, 1:25,000) 1997.
7. Lillicrap, A and McGhie, S., Site Investigation for Urban Salinity, Department of Land and Water Conservation, 2002.
8. Australian Standard AS2870-2011, Residential Slabs and Footings, 2011.
9. Australian Standard AS2159-2009, Piling – Design and Installation, 2009.
10. Australian Standard AS3798-2007, Guidelines on Earthworks for Commercial and Residential Developments, 2007.
11. Pells, P. J. N, State of Practice for the Design of Socketed Piles in Rocks, Proceeding 8th Australian New Zealand Conference on Geomechnics, Hobart, pp 1-307-327.
12. Australian Geomechanics Society Landslide Taskforce, Landslide Practice Note Working Group - "Practice Note Guidelines for Landslide Risk Management", March 2007.
13. Landcom, Managing Urban Stormwater : Soils and Construction, Vol 1, Parramatta, 2004.
14. Landcom, Managing Urban Stormwater : Soils and Construction, Vol 2A Installation of Services, Parramatta, 2008.

ATTACHMENT A

Drawing No 20429/7-AA1 Plan Showing Locations of Boreholes

Borehole Logs



Imagery © NearMap.com

LEGEND

— Site Boundary

● Borehole

0 30 60 90 120 150m

Scale 1:3000

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School Infrastructure NSW
Contract No DDWO 0513/23
Kingswood Public School (2312)
Second Avenue, Kingswood

Borehole Locations

Drawing No: 20429/7-AA1
Job No: 20429/7
Drawn By: MH
Date: 24 October 2023
Checked By: IJ

File No: 20429-7
Layers: 0, AA1

engineering log - borehole

Client : NSW Department of Education - School Infrastructure **Job No. :** 20429/7
Project : Contract No DDWO 05135/23 **Borehole No. :** BH1
Location : Kingswood Public School **Date :** 27/09/2023
Logged/Checked by: JH

drill model and mounting : 5.5 Tonne Excavator **slope :** deg. **R.L. surface :** 48.599
hole diameter : 250 mm **bearing :** deg. **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					CONE 5 14 15 10 8 6 5 20r	0			FILL: Silty Clay, low to medium plasticity, brown, trace of root fibres	M≤PL			Well compacted
				DS		0.5							
						1		CI-CH	Silty CLAY, medium to high plasticity, brown	M≤PL	St		Residual
				DS		1.5		CI-CH	Silty CLAY, medium to high plasticity, grey	M≤PL	St		
						2							
						2.5							Trace of ironstone
						3							
						3.5							
	DRY												
						4			Borehole BH1 terminated at 4.0m due to limit of reach				
						4.5							

engineering log - borehole

Client : NSW Department of Education - School Infrastructure **Job No. :** 20429/7
Project : Contract No DDWO 05135/23 **Borehole No. :** BH2
Location : Kingswood Public School **Date :** 27/09/2023
Logged/Checked by: JH

drill model and mounting : 5.5 Tonne Excavator **slope :** **deg.** **R.L. surface :** 48.410
hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			FILL: Silty Clay, low to medium plasticity, brown, trace of gravel	M≤PL			Well compacted
				DS		0.5							
				DS				CI-CH	Silty CLAY, medium to high plasticity, brown	M≤PL	St		Residual
						1							
									Silty CLAY, medium to high plasticity, grey				
						1.5							
						2							
						2.5							Trace of ironstone fragments
						3							
						3.5							
	DRY												
						4			Borehole BH2 terminated at 4.0m due to limit of reach				
						4.5							

engineering log - borehole

Client : NSW Department of Education - School Infrastructure **Job No. :** 20429/7
Project : Contract No DDWO 05135/23 **Borehole No. :** BH3
Location : Kingswood Public School **Date :** 27/09/2023
Logged/Checked by: JH

drill model and mounting : 5.5 Tonne Excavator **slope :** deg. **R.L. surface :** 47.548
hole diameter : 250 mm **bearing :** deg. **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					CONE 5 10	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of rootlets				
					8 9 9 8 6 6 4 6	0.5		CI-CH	Silty CLAY, medium to high plasticity, orange	M≤PL	St		Residual
				DS	4 3 4 4 6 5 6	1 1.5			Silty CLAY, medium to high plasticity, grey				
						2 2.5 3 3.5							Trace of ironstone
	DRY			DS					SHALE, grey, extremely to distinctly weathered, low strength				Bedrock
						4 4.5			Borehole BH3 terminated at 4.0m, due to limit of reach				

engineering log - borehole

Client : NSW Department of Education - School Infrastructure
Project : Contract No DDWO 05135/23
Location : Kingswood Public School
Job No. : 20429/7
Borehole No. : BH4
Date : 27/09/2023
Logged/Checked by: JH

drill model and mounting : 5.5 Tonne Excavator
slope : **deg.**
R.L. surface : 46.965
hole diameter : 250 **mm**
bearing : **deg.**
datum : AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0 0.5	▩		FILL: Silty Clay, low to medium plasticity, brown, trace of gravel				
				DS		1 1.5 2 2.5	▨	CI-CH	Silty CLAY, medium to high plasticity, grey	M≤PL	St-VSt		Residual
	DRY			DS		3 3.5	▤		Shaley CLAY, low to medium plasticity, brown to grey	M≤PL	St		
						4 4.5			Borehole BH4 terminated at 4.0m due to limit of reach				

engineering log - borehole

Client :	NSW Department of Education - School Infrastructure	**Job No. :**	20429/7
Project :	Contract No DDWO 05135/23	**Borehole No. :**	BH5
Location :	Kingswood Public School	**Date :**	27/09/2023
		Logged/Checked by:	JH

drill model and mounting : 5.5 Tonne Excavator **slope :** **deg.** **R.L. surface :** 47.570

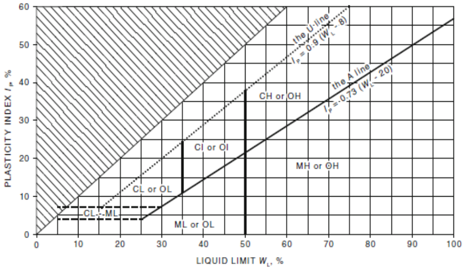
hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					CONE 12 17 16	0			FILL: Gravelly Clay, low plasticity, brown				
				U_{50} DS	12 8 6 5 3 3 3 3 5 4 4 7 14 13 15r	0.5 1 1.5 2 2.5 3		CI-CH	Silty CLAY, medium to high plasticity, grey	M≤PL	F-St		Residual
	DRY			DS		3.5			SHALE, brown to grey, distinctly weathered, medium strength				Bedrock
						4 4.5			Borehole BH5 terminated at 3.6m due to refusal to bedrock.				

Log Symbols & Abbreviations (Non-cored Borehole Log)

<table>
<tr><th>Log Column</th><th>Symbol/Value</th><th>Description</th></tr>
<tr><td>Drilling Method</td><td>V-bit
TC-bit
RR
DB
BB</td><td>Hardened steel ‘V’ shaped bit attached to auger
Tungsten Carbide bit attached to auger
Tricone (Rock Roller) bit
Drag bit
Blade bit</td></tr>
<tr><td>Groundwater</td><td>Dry
▼
▶</td><td>Groundwater not encountered to the drilled or auger refusal depth
Groundwater level at depths shown on log
Groundwater seepage at depths shown on log</td></tr>
<tr><td>Environment Sample</td><td>GP
G
P</td><td>Glass bottle and plastic bag sample over depths shown on log
Glass bottle sample over depths shown on log
Plastic bag sample over depths shown on log</td></tr>
<tr><td>PID Reading</td><td>100</td><td>PID reading in ppm</td></tr>
<tr><td>Geotechnical Sample</td><td>DS
DB
U_{50}</td><td>Disturbed Small bag sample over depths shown on log
Disturbed Bulk sample over depths shown on log
Undisturbed 50mm tube sample over depths shown on log</td></tr>
<tr><td>Field Test</td><td>N=10
3,5,5</td><td>Standard Penetration Test (SPT) ‘N’ value. Individual numbers indicate blows per 150mm penetration.</td></tr>
<tr><td></td><td>N=R
10,15/100</td><td>‘R’ represents refusal to penetration in hard/very dense soils or in cobbles or boulders.
The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal</td></tr>
<tr><td></td><td>DCP/PSP
5
6
R/10</td><td>Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. ‘R/10’ represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.</td></tr>
<tr><td>Classification</td><td>GP
GW
GM
GC
SP
SW
SM
SC
ML
MI
MH
CL
CI
CH</td><td>Poorly Graded GRAVEL
Well graded GRAVEL
Silty GRAVEL
Clayey GRAVEL
Poorly graded SAND
Well graded SAND
Silty SAND
Clayey SAND
SILT / Sandy SILT / clayey SILT, low plasticity
SILT / Sandy SILT / clayey SILT, medium plasticity
SILT / Sandy SILT / clayey SILT, high plasticity
CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity
CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity
CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity</td></tr>
<tr><td>Moisture Condition
Cohesive soils</td><td>M<PL
M=PL
M>PL</td><td>Moisture content less than Plastic Limit
Moisture content equal to Plastic Limit
Moisture content to be greater than Plastic Limit</td></tr>
<tr><td>Cohesionless soils</td><td>D
M
W</td><td>Dry - Runs freely through hand
Moist - Tends to cohere
Wet - Tends to cohere</td></tr>
<tr><td>Consistency
Cohesive soils</td><td>VS
S
F
St
VSt
H</td><td><table>
<tr><th>Term</th><th>Undrained shear strength, C_u (kPa)</th><th>Hand Penetrometer (Qu)</th></tr>
<tr><td>Very Soft</td><td>≤12</td><td><25</td></tr>
<tr><td>Soft</td><td>>12 & ≤25</td><td>25 – 50</td></tr>
<tr><td>Firm</td><td>>25 & ≤50</td><td>50 – 100</td></tr>
<tr><td>Stiff</td><td>>50 & ≤100</td><td>100 – 200</td></tr>
<tr><td>Very Stiff</td><td>>100 & ≤200</td><td>200 – 400</td></tr>
<tr><td>Hard</td><td>>200</td><td>>400</td></tr>
</table></td></tr>
<tr><td>Density Index
Cohesionless soils</td><td>VL
L
M
D
VD</td><td><table>
<tr><th>Term</th><th>Density Index, I_D (%)</th><th>SPT ‘N’ (blows/300mm)</th></tr>
<tr><td>Very Loose</td><td>≤15</td><td>≤5</td></tr>
<tr><td>Loose</td><td>>15 & ≤35</td><td>>5 & ≤10</td></tr>
<tr><td>Medium Dense</td><td>>35 & ≤65</td><td>>10 & ≤30</td></tr>
<tr><td>Dense</td><td>>65 & ≤85</td><td>>30 & ≤50</td></tr>
<tr><td>Very Dense</td><td>>85</td><td>>50</td></tr>
</table></td></tr>
<tr><td>Hand Penetrometer</td><td>100
200</td><td>Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log</td></tr>
<tr><td>Remarks</td><td>
Residual
Alluvium
Colluvial
Aeolian
Marine</td><td>Geological origin of soils
Residual soils above bedrock
River deposited Alluvial soils
Gravity deposited Colluvial soils
Wind deposited Aeolian soils
Marine Soils</td></tr>
</table>

AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification					
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63											
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
		Fine 0.075	SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
			SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**						
					None to low	Slow to rapid	Low		More than 35% passing 0.075mm	Below 'A' line			
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				

Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	**Symbol / Abbreviation**	**Description**		
Core Size		Nominal Core Size (mm)		
	NQ	47		
	NMLC	52		
	HQ	63		
Water Loss	——◀	Complete water loss		
	——◁	Partial water loss		
Weathering (AS1726:2017)	RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported	
	XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible	
	HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.	
	MW	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock	
	SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock	
	FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes	
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'		
Strength (AS1726:2017)		**Term**	**Point Load Strength Index (I_{s50}, MPa)**	
	VL	Very Low	≥0.03	≤0.1
	L	Low	>0.1	≤0.3
	M	Medium	>0.3	≤1
	H	High	>1	≤3
	VH	Very High	>3	≤10
	EH	Extremely High	>10	
Defect Spacing		**Description**	**Spacing (mm)**	
		Extremely closely spaced	<20	
		Very closely spaced	20 to 60	
		Closely spaced	60 to 200	
		Medium spaced	200 to 600	
		Widely spaced	600 to 2000	
		Very widely spaced	2000 to 6000	
		Extremely widely spaced	>6000	
Defect Description (AS1726:2017) Type				
	Pt	Parting		
	Jo	Joint		
	Sh	Sheared Surface		
	Sz	Sheared Zone		
	Ss	Sheared Seam		
	Cs	Crushed Seam		
	Is	Infilled Seam		
	Ews	Extremely Weathered Seam		
Macro-surface geometry	St	Stepped		
	Cu	Curved		
	Un	Undulating		
	Ir	Irregular		
	Pl	Planar		
Micro-surface geometry	Vro	Very Rough		
	Ro	Rough		
	Sm	Smooth		
	Po	Polished		
	Sl	Slickensided		
Coating or infilling	cn	clean		
	sn	stained		
	vn	veneer		
	cg	coating		

AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)								
More than 20	20	Grain Size Description				At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix Breccia Irregular rock fragments in a finer matrix		LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	SALINE ROCKS Halite Anhydrite
	2									
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals Quartzite Quartz grains and siliceous cement Arkose Many feldspar grains Greywacke Many rock chips			Calcarenite		Cemented volcanic ash TUFF	Gypsum
	0.2		Medium							
	0.06		Fine							
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF	
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF	
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone						COAL LIGNITE
				Granular cemented – except amorphous rocks						
				SILICEOUS		CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid						

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)		Rocks with massive structure and crystalline texture (mostly igneous)						Grain size (mm)
Grain size description		MARBLE QUARTZITE Granulite HORNFELS Amphibolite Serpentine	Grain size description	Pegmatite		GABBRO	Pyrosenite	More than 20 20
COARSE	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands Migmatite Irregularly foliated: mixed schists and gneisses		COARSE	GRANITE These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite	Diorite		Peridorite	6 2
MEDIUM	SCHIST Well developed undulose foliation; generally much mica		MEDIUM	Micorgranite These rocks are sometimes phorphyritic and are then described as porphyries	Microdiorite	Dolerite		0.6 0.2 0.06
FINE	PHYLLITE Slightly undulose foliation; sometimes 'spotted' SLATE Well developed plane cleavage (foliation)		FINE	RHYOLITE These rocks are sometimes phorphyritic and are then described as porphyries	ANDESITE	BASALT		0.002 Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystallin e
CRYSTALLINE				Pale<--->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

ATTACHMENT B

Laboratory Test Results

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

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Order Number	**20429/7**
Samples	6

LABORATORY DETAILS

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SGS Reference	**SE254713 R0**
Date Received	29/9/2023
Date Reported	12/10/2023

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

		YINGYING ZHANG
Dong LIANG	**Shane MCDERMOTT**	**Ying Ying ZHANG**
Metals/Inorganics Team Leader	Inorganic/Metals Chemist	Laboratory Technician

Conductivity and TDS by Calculation - Soil [AN106] Tested: 12/10/2023

			BH2 SOIL 0.3-0.5 27/9/2023	BH2 SOIL 0.8-1.0 27/9/2023	BH4 SOIL 0.8-1.0 27/9/2023	BH4 SOIL 3.0-3.2 27/9/2023	BH5 SOIL 0.6-0.8 27/9/2023
PARAMETER	**UOM**	**LOR**	**SE254713.001**	**SE254713.002**	**SE254713.003**	**SE254713.004**	**SE254713.005**
Conductivity of Extract (1:5 as received)	µS/cm	1	160	240	690	620	320
Salinity (by calculation)*	mg/kg	5	590	910	2600	2300	1200
Resistivity of extract (1:5 as received)*	ohm m	0.1	62	42	14	16	31

			BH5 SOIL 3.3-3.5 27/9/2023
PARAMETER	**UOM**	**LOR**	**SE254713.006**
Conductivity of Extract (1:5 as received)	µS/cm	1	690
Salinity (by calculation)*	mg/kg	5	2500
Resistivity of extract (1:5 as received)*	ohm m	0.1	14

Moisture Content [AN002] Tested: 10/10/2023

PARAMETER	UOM	LOR	BH2 SOIL 0.3-0.5 27/9/2023 SE254713.001	BH2 SOIL 0.8-1.0 27/9/2023 SE254713.002	BH4 SOIL 0.8-1.0 27/9/2023 SE254713.003	BH4 SOIL 3.0-3.2 27/9/2023 SE254713.004	BH5 SOIL 0.6-0.8 27/9/2023 SE254713.005
% Moisture	%w/w	1	10.7	14.2	13.9	13.1	15.8

PARAMETER	UOM	LOR	BH5 SOIL 3.3-3.5 27/9/2023 SE254713.006
% Moisture	%w/w	1	11.1

pH in soil (1:2) [AN101] Tested: 11/10/2023

PARAMETER	UOM	LOR	BH2 SOIL 0.3-0.5 27/9/2023 SE254713.001	BH2 SOIL 0.8-1.0 27/9/2023 SE254713.002	BH4 SOIL 0.8-1.0 27/9/2023 SE254713.003	BH4 SOIL 3.0-3.2 27/9/2023 SE254713.004	BH5 SOIL 0.6-0.8 27/9/2023 SE254713.005
pH (1:2)	pH Units	-	6.2	4.8	4.4	4.8	4.8

PARAMETER	UOM	LOR	BH5 SOIL 3.3-3.5 27/9/2023 SE254713.006
pH (1:2)	pH Units	-	4.7

Conductivity (1:2) in soil [AN106] Tested: 11/10/2023

PARAMETER	UOM	LOR	BH2 SOIL 0.3-0.5 27/9/2023 SE254713.001	BH2 SOIL 0.8-1.0 27/9/2023 SE254713.002	BH4 SOIL 0.8-1.0 27/9/2023 SE254713.003	BH4 SOIL 3.0-3.2 27/9/2023 SE254713.004	BH5 SOIL 0.6-0.8 27/9/2023 SE254713.005
Conductivity (1:2) @25 C*	µS/cm	1	410	710	1500	1200	730
Resistivity (1:2)*	ohm cm	-	2500	1400	680	800	1400

PARAMETER	UOM	LOR	BH5 SOIL 3.3-3.5 27/9/2023 SE254713.006
Conductivity (1:2) @25 C*	µS/cm	1	1500
Resistivity (1:2)*	ohm cm	-	680

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography [AN245] Tested: 11/10/2023

PARAMETER	UOM	LOR	BH2 SOIL 0.3-0.5 27/9/2023 SE254713.001	BH2 SOIL 0.8-1.0 27/9/2023 SE254713.002	BH4 SOIL 0.8-1.0 27/9/2023 SE254713.003	BH4 SOIL 3.0-3.2 27/9/2023 SE254713.004	BH5 SOIL 0.6-0.8 27/9/2023 SE254713.005
Chloride	mg/kg	0.25	77	310	990	870	410
Sulfate	mg/kg	0.5	220	280	320	290	250

PARAMETER	UOM	LOR	BH5 SOIL 3.3-3.5 27/9/2023 SE254713.006
Chloride	mg/kg	0.25	910
Sulfate	mg/kg	0.5	320

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:2 and the pH determined and reported on the extract after 1 hour extraction (pH 1:2) or after 1 hour extraction and overnight aging (pH (1:2) aged). Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN106	Resistivity of the extract is reported on the extract basis and is the reciprocal of conductivity. Salinity and TDS can be calculated from the extract conductivity and is reported back to the soil basis.
AN245	Anions by Ion Chromatography: A water sample or extract is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

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STATEMENT OF QA/QC PERFORMANCE

SE254713 R0

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Project	**20429/7 Kingswood Public School Second A**
Order Number	**20429/7**
Samples	6

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SGS Reference	**SE254713 R0**
Date Received	29 Sep 2023
Date Reported	12 Oct 2023

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Extraction Date	Conductivity (1:2) in soil	6 items
	Conductivity and TDS by Calculation - Soil	6 items
	pH in soil (1:2)	6 items
	Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography	6 items
Analysis Date	Conductivity (1:2) in soil	6 items
	Conductivity and TDS by Calculation - Soil	6 items

SAMPLE SUMMARY

Sample counts by matrix	6 Soil	Type of documentation received	COC
Date documentation received	5/10/2023@11:48A	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	24.5°C
Sample container provider	Client	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes		

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH2	SE254713.001	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†
BH2	SE254713.002	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†
BH4	SE254713.003	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†
BH4	SE254713.004	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†
BH5	SE254713.005	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†
BH5	SE254713.006	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	04 Oct 2023	11 Oct 2023†

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH2	SE254713.001	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†
BH2	SE254713.002	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†
BH4	SE254713.003	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†
BH4	SE254713.004	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†
BH5	SE254713.005	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†
BH5	SE254713.006	LB293281	27 Sep 2023	29 Sep 2023	04 Oct 2023	12 Oct 2023†	04 Oct 2023	12 Oct 2023†

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH2	SE254713.001	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023
BH2	SE254713.002	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023
BH4	SE254713.003	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023
BH4	SE254713.004	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023
BH5	SE254713.005	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023
BH5	SE254713.006	LB293015	27 Sep 2023	29 Sep 2023	11 Oct 2023	10 Oct 2023	15 Oct 2023	12 Oct 2023

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH2	SE254713.001	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023
BH2	SE254713.002	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023
BH4	SE254713.003	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023
BH4	SE254713.004	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023
BH5	SE254713.005	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023
BH5	SE254713.006	LB293102	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	12 Oct 2023	11 Oct 2023

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH2	SE254713.001	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023
BH2	SE254713.002	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023
BH4	SE254713.003	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023
BH4	SE254713.004	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023
BH5	SE254713.005	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023
BH5	SE254713.006	LB293101	27 Sep 2023	29 Sep 2023	04 Oct 2023	11 Oct 2023†	08 Nov 2023	12 Oct 2023

SURROGATES

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB293102.001	Conductivity (1:2) @25 C*	µS/cm	1	<1

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB293281.001	Conductivity of Extract (1:5 as received)	µS/cm	1	<1
	Salinity (by calculation)*	mg/kg	5	<5

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB293101.001	Chloride	mg/kg	0.25	<0.25
	Sulfate	mg/kg	0.5	<0.5

DUPLICATES

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE254713.004	LB293102.014	Conductivity (1:2) @25 C*	µS/cm	1	1200	1300	30	5
		Resistivity (1:2)*	ohm cm	-	800	760	31	5
SE254714.006	LB293102.023	Conductivity (1:2) @25 C*	µS/cm	1	58	59	33	1
		Resistivity (1:2)*	ohm cm	-	17000	17000	30	1

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE254714.004	LB293281.014	Conductivity of Extract (1:5 as received)	µS/cm	1	18.3	17.58	41	4
		Salinity (by calculation)*	mg/kg	5	6.583565737	63.9638844621	45	4
SE254714.006	LB293281.026	Conductivity of Extract (1:5 as received)	µS/cm	1	33.97	34.7	36	2
		Salinity (by calculation)*	mg/kg	5	32.729250929	35.581542750	37	2

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE254713.004	LB293015.011	% Moisture	%w/w	1	13.1	12.3	38	6
SE254714.006	LB293015.020	% Moisture	%w/w	1	16.8	20.8	35	21

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE254713.004	LB293102.014	pH (1:2)	pH Units	-	4.8	4.8	32	1
SE254714.006	LB293102.023	pH (1:2)	pH Units	-	4.7	4.7	32	0

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE254713.004	LB293101.014	Chloride	mg/kg	0.25	870	860	30	1
		Sulfate	mg/kg	0.5	290	290	31	0
SE254714.006	LB293101.023	Chloride	mg/kg	0.25	21	20	31	4
		Sulfate	mg/kg	0.5	22	22	39	1

LABORATORY CONTROL SAMPLES

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB293102.002	Conductivity (1:2) @25 C*	µS/cm	1	310	303	70 - 130	103

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB293281.002	Conductivity of Extract (1:5 as received)	µS/cm	1	280	303	85 - 115	94

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB293102.003	pH (1:2)	pH Units	-	7.4	7.415	98 - 102	99

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB293101.002	Chloride	mg/kg	0.25	38	40	70 - 130	96
	Sulfate	mg/kg	0.5	38	40	70 - 130	95

MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the

No matrix spike duplicates were required for this job.

FOOTNOTES

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

E-MAILED
9/10 @ 11.48a

SGS EHS Sydney COC
SE254713

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161
email: info@geotech.com.au

Page 1 **of** 1

TO:	**SGS ENVIRONMENTAL SERVICES** **UNIT 16** **33 MADDOX STREET** **ALEXANDRIA NSW 2015**	**Sampling By:**	JH
		Job No:	20429/7
		Project:	Proposed School Upgrade
PH:	**02 8594 0400**	**FAX:**	**02 8594 0499**
Project Manager:	IJ	**Location:**	**Kingswood Public School** Second Avenue, Kingswood
ATTN:	**MS ANGELA MAMALICOS**		

	Sampling details				**Sample type**		**Results required by:**									
	Location	**Depth (m)**	**Date**	**Time**	**Soil**	**Water**	**Salinity**	**Aggressivity Suite**								**KEEP SAMPLE**
1	BH2	0.3 - 0.5	27/09/2023		DS		✓	✓		Aggressivity suit includes pH. SO4, cl and Resistivity)						YES
2	BH2	0.8 - 1.0	27/09/2023		DS		✓	✓								YES
3	BH4	0.8 - 1.0	27/09/2023		DS		✓	✓								YES
4	BH4	3.0 - 3.2	27/09/2023		DS		✓	✓								YES
5	BH5	0.6 - 0.8	27/09/2023		DS		✓	✓								YES
6	BH5	3.3 - 3.5	27/09/2023		DS		✓	✓								YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Ziaudidn Ahmed	Ziaudidn Ahmed	29/09/2023	G.F		29/9/23 2:40pm

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (gla	DSP	Disturbed soil sample (small plastic bag)	* Purge & Trap	@ mole H^+/tonne
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass	✓	Test required	# Geotechnique Screen	

SAMPLE RECEIPT ADVICE

SE254713

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	indra.jworchan@geotech.com.au
Project	**20429/7 Kingswood Public School Second A**
Order Number	**20429/7**
Samples	6

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Fri 29/9/2023
Report Due	Thu 12/10/2023
SGS Reference	**SE254713**

SUBMISSION DETAILS

This is to confirm that 6 samples were received on Friday 29/9/2023. Results are expected to be ready by COB Thursday 12/10/2023. Please quote SGS reference SE254713 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	6 Soil	Type of documentation received	COC
Date documentation received	5/10/2023@11:48AM	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	24.5°C
Sample container provider	Client	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

4 Extra samples not included in COC

SAMPLE RECEIPT ADVICE

SE254713

CLIENT DETAILS

Client Geotechnique

Project 20429/7 Kingswood Public School Second A

SUMMARY OF ANALYSIS

No.	Sample ID	Conductivity (1:2) in soil	Conductivity and TDS by Calculation - Soil	Moisture Content	pH in soil (1:2)	Soluble Anions in Soil from 1:2 DI Extract by Ion
001	BH2 0.3-0.5	2	3	1	1	2
002	BH2 0.8-1.0	2	3	1	1	2
003	BH4 0.8-1.0	2	3	1	1	2
004	BH4 3.0-3.2	2	3	1	1	2
005	BH5 0.6-0.8	2	3	1	1	2
006	BH5 3.3-3.5	2	3	1	1	2

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

TEST RESULTS - ATTERBERG LIMITS

Test Procedure AS1289 3.1.1, 3.2.1, 3.3.1, 3.4.1

NSW DEPARTMENT OF EDUCATION - SCHOOL INFRASTRUCTURE
PO BOX 33
SYDNEY NSW 2000

Laboratory: Penrith
Job No: 20429/7

PROJECT: INTRUSIVE GEOTECHNICAL INVESTIGATION
CONTRACT NO' DDWO 05135/23 - KINGSWOOD PUBLIC SCHOOL

Date Tested: 03/10/2023
Tested By: BG
Checked By: AK

Sample Identification	Borehole 5
Laboratory Number	20429/7-1
Depth (m)	0.3 - 0.6
Test Description	
Liquid Limit (W_L)	55%
Plastic Limit (W_P)	20%
Plastic Index (I_P)	35%
Linear Shrinkage (LS)	12.5%
Mould Length (mm)	127
Sample History	Oven Dried Dry Sieved
Material Description	(CI-CH) Silty CLAY, medium to high plasticity, grey-brown

Form No R004 Version 13 - 07/21 - Issued by ER

Report Date
18/10/2023

A Kench

Accredited for compliance with ISO/IEC 17025 - Testing.

Nata Accreditation Number 2734
Corporate Site Number 2727

Approved Signatory

ATTACHMENT C

Saline Soil Management Plan

Most soils across the site are assessed to be saline. Although some soils are anticipated to be non-saline, large number of sampling and testing will be required to delineate areas with non-saline soils. Therefore, for ease of earthworks, we recommend that the soils across the site are considered to be saline. In addition, soils across the site are assessed to be dispersive and therefore susceptible to excessive erosion. Therefore, earthworks for the proposed upgrade works should be carried out in accordance with a Saline Soil Management Plan (SSMP) aimed at minimising impacts of erosion as well as soil salinity.

The objective of this SSMP is to minimise the impact of saline and dispersive soils on the proposed upgrade works and minimise the impact of the proposed workson the existing salinity and hydrology. More specifically, this SSMP aims to address the following:

- Minimise the disruption to natural surface water drainage
- Minimise the potential for waterlogging or surface water pooling
- Minimise the potential for raising the water table beneath the site
- Minimise the potential for cyclic wetting and drying areas
- Minimise the potential for excessive soil erosion
- Minimise the degradation of building products (masonry, concrete, steel) in the presence of aggressive and/or saline soils

The following principals are recommended for adoption during the earthworks to minimise impacts from saline and dispersive soils.

- Erosion and Sediment Control Plans must be developed and implemented in accordance with the Landcom Guidelines to manage the impacts from the erosive soils (References 12 and 13). All sediment and erosion controls proposed by the Erosion and Sediment Control Plan are to be installed prior to commencement of any excavation or earthworks.
- Map the current primary drainage lines and incorporate these into the surface water drainage system for the site. Do not fill in or block these drainage lines unless appropriate alternative drainage is provided.
- Develop the best use of the existing topography in order to minimise cut and fill operations.
- Where creation of individual building platform requires substantial cut and/or fill consider the use of tiered buildings and/or building with slabs suspended on piers. This will minimise the obstruction of the natural surface water flow.
- Minimise the use of retaining structures; use safely inclined slopes, with grass and plant cover as an alternative. Gabion walls are also a better alternative as they are free draining.
- Reduce groundwater recharge through appropriate land use and land management practices. This can be achieved by minimising deep infiltration and by maximising vegetation cover, planting deep-rooted trees and the use of salt tolerant plants.
- Construct a V-drain behind the crest of all slopes to divert water away from the slope face.

- Ensure that earthworks and construction activities do not affect the natural flow of groundwater. Where groundwater is intercepted during development works/excavation, the flow should be diverted to stormwater drains or creeks by providing appropriate surface and sub-surface drainage.
- On-site water detention in un-lined basins should be prevented, as this provides a localised potential groundwater re-charge. Lined basins, relying solely on evaporation should be used as an alternative.
- The finished ground surface after completion of earthworks should be provided with adequate fall to the street or stormwater manholes to allow run-off of water and prevent water ponding, waterlogging and infiltration of rainwater.
- Construction materials and methods should be appropriate to assess Exposure and Aggressivity Classification presented in this report.