GEOTECHNICAL INVESTIGATION REPORT

The King's School, North Paramatta

PSM4935-005R REV2 24 October 2023

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1. Introduction

This report presents the results of the geotechnical investigation undertaken at The King's School located on 87 – 129 Pennant Hills Road, North Parramatta (the **Site**).

This geotechnical report is intended to support a state significant development application (SSDA) as provided by the documents provided to PSM listed in Section 2.1 with the exception of the 'STEAM' building.

PSM note that a specific geotechnical investigation has been undertaken:

- By PSM for the 'PAB' and 'GLU' developments, the results of this investigation are in PSM4935-008R dated 3 August 2023 and are provides specific geotechnical advice for structural design
- By others for the 'STEAM' building for this SSDA.

2. Background

2.1 General

To assist with this geotechnical investigation, PSM were supplied with the following documents:

- Request for proposal document by TSA Management, titled "Tender to STEAM Precinct Project & Masterplan – Geotechnical and Environmental Site Investigation", issue no. 1, dated 2 November 2022
- Planning Secretary's Environmental Assessment Requirements by NSW Department of Planning and Environment
- Scoping report by Urbis, titled "Scoping Report – The Kings School, North Parramatta Campus", dated 12 July 2022
- BVN's masterplan outlining the sketches of proposed prep school upgrade, dated 27 July 2022:
  - "Masterplan Phase 1 – Proposed" (Ref. MAR-AR-DA-A10-XX-02-[09])
  - "Masterplan Phase 2 – Proposed" (Ref. MAR-AR-DA-A10-XX-04-[09]).
- Architectural drawings of the proposed developments by Leaf Architecture, dated 13 January 2023
- TKS – SSDA Submission Development Description provided by TSA Management
- A feature survey provided by the King's School, drawing no. Kings_2022-12-09 REVI, dated 9 December 2022.

Based on the above documents the development is proposed to include:

- Demolition of multiple existing amenities and buildings followed by the construction residential and school facilities including:
  - Several new / upgrades school buildings
  - Staff residences
  - Student residences
  - A sports pavilion.
- Provision of a new entrance and internal roadworks including parking.

We reiterate that this document is not intended to inform for developing the proposed 'STEAM Building'.

Figure 1 presents the extent of the proposed buildings as per the above masterplans.

At this stage we have not sighted the design drawings for the proposed developments.

2.2 Site Background (Aerial Photography)

PSM has reviewed available historical aerial imagery. Generally, the Site has transitioned from being greenfield or used for agricultural purposes into the current state. PSM has not identified any unusual features or risk in the historical aerial photos between 1930 and 2022 for the proposed development.

Select aerial imagery is presented Appendix A.

3. Geotechnical Investigation

3.1 Fieldwork

The fieldwork comprised:

- An initial site walkover on 18 January 2023 to assess accessibility for the geotechnical investigation
- Geotechnical investigations completed between 23 and 25 January 2023 and comprising:
  - Seven (7) boreholes were drilled to refusal at the location of proposed buildings, and a maximum depth of 7.8 m was achieved
  - Four (4) boreholes were drilled to a target depth of 1.0 m along the alignment of the proposed internal road
  - Installation of four (4) standpipe piezometers at two (2) borehole locations. Two (2) standpipes were installed for each location at different depths.

The field work was conducted under the full-time supervision of a PSM engineer who undertook the following tasks:

- Directing the service locating and investigation locations
- Preparing engineering field logs of material encountered
- Collecting soil samples for laboratory testing documented in Section 3.2.

Prior to the investigation, the borehole locations were checked by a certified service locator under the supervision of a PSM geotechnical engineer to detect for the presence of underground services.

Upon completion, each borehole was reinstated by backfilling with cuttings and/or fine gravels and compacted by tamping with hand tools.

Figure 1 presents the borehole locations. Table B1 in Appendix B presents the coordinates of the locations. Table B2 in Appendix B presents the tabulated borehole logs of the material encountered. Appendix C presents the piezometer construction records. Appendix D presents select site photos.

3.2 Laboratory Testing

This section presents the laboratory testing completed; laboratory certificates are provided in Appendix E.

3.2.1 California Bearing Ratio (CBR)

PSM recovered four (4) bulk soil samples for the CBR testing. The following sample preparation was undertaken prior to CBR testing:

- Compact to 98% Standard Maximum Dry Density, at optimum moisture content (OMC)
- Four (4) day-soaked sample; and
- 4.5 kg surcharge.

Table 1 – CBR Test Results

Sample Location or Depth (m)	Inferred Geotechnical Unit	Soaked CBR (%)	Optimum Moisture Content (%)	Standard Maximum Dry Density (t/m^3)	Swell (%)
BH02 (0.1 – 1.0)	FILL	8.0	15.9	1.76	0.5
BH03 (0.3 – 0.8)	FILL	6.0	20.4	1.63	0.0
BH04 (0.5 – 1.0)	RESIDUAL	1.5	22.2	1.54	3.0
BH05 (0.5 – 1.0)	RESIDUAL	6.0	24.0	1.58	0.5

3.2.2 Shrink Swell Testing

PSM recovered three (3) undisturbed samples were recovered for shrink swell testing.

Table 2 – Shrink Swell Results

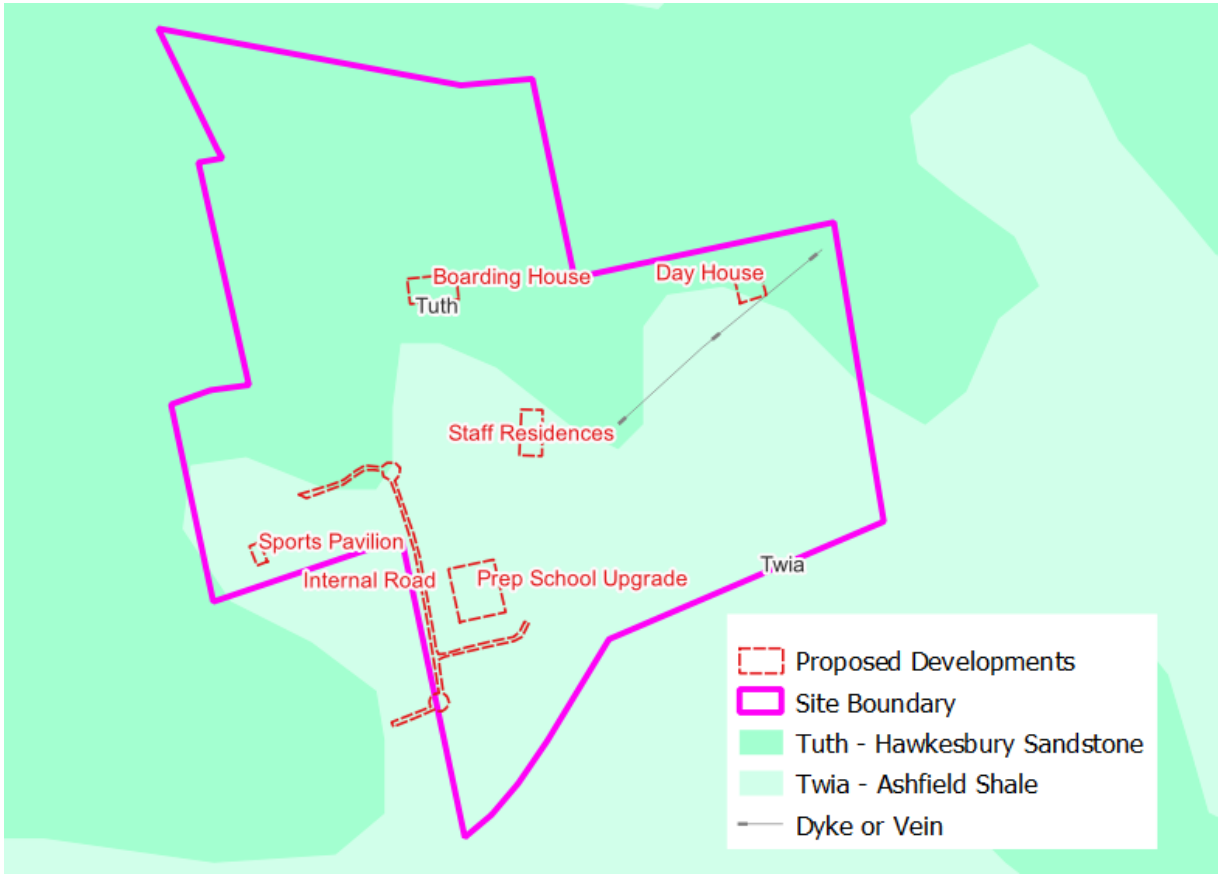
Sample Depth (m)	Inferred Geotechnical Unit	Moisture Content (Before Swell) (%)	Moisture Content (After Swell) (%)	Shrink Swell I_{ss} (%)
BH01 (0.5 – 0.6)	RESIDUAL	19.3	22.4	0.67
BH10 (0.5 – 0.7)	RESIDUAL	15.5	15.3	0.39
BH11 (0.5 – 1.0)	RESIDUAL	20.9	22.8	1.65

4. Site conditions and Results of Investigation

4.1 Geological setting

The NSW Seamless Geology dataset (Department of Regional New South Wales, 2019) shown in **Inset 1:**

- The northern half of the site in underlain by Hawkesbury Sandstone
- The southern half of the site is underlain by Ashfield Shale overlying Hawkesbury Sandstone. Given that we are near the boundary between the two units we would expect the shale to comprise a thin layer (up to several metres) overlying the sandstone
- A vein or dyke is shown to occur in the North-East of the Site.



Inset 1: Site extents underlain by NSW Seamless Geology dataset.

4.2 Surface conditions

The Site is currently an active school with associated buildings, internal roads and facilities. Table 3 summarises the surface conditions on each development shown in Figure 1.

Table 3 – Surface Conditions

Proposed Development	Surface Conditions
Day House	Adjacent to an existing building with a paved driveway, varying vegetation between grass and dense vegetation with mature trees.
Boarding House	Adjacent to two (2) existing buildings with a paved driveway, surface covered in grass with mature trees.
Staff Residence	Currently occupied by a tennis court surrounded by grass and mature trees.
Internal Road	Varies between a gravel road, paved and current buildings.
Prep School	Currently in use, conditions comprise buildings, paved areas and turfed grass.
Sports Pavilion	Grassed surface and lies over an approximately 1.5H:1V batter. This indicates that some earthworks have been completed in this area to form the current level area associated with the sports fields. Some outcrops of medium to high strength SANDSTONE were observed nearby (Appendix D7, Photo 13).

4.3 Subsurface Conditions

The geotechnical units encountered within the boreholes are summarised in Table 4.

Table 5 presents the elevation to the top of inferred geotechnical units encountered in each borehole.

Regarding the sub-surface conditions PSM note the following:

- FILL includes surficial soil encountered likely to be of anthropogenic origin (i.e landscaping works)
- The BEDROCK encountered was consistent with the regional geology discussed in Section 4.1:
  - The SHALE is not present everywhere across the Site and was encountered at locations of relatively higher elevation
  - It is inferred that towards the creeks and lakes on the north and west of the Site that the SHALE is completely weathered / eroded and the SANDSTONE is present beneath the soil profile
  - The SHALE and SANDSTONE have distinctly different strength and weathering characteristics
  - No coring was undertaken and BEDROCK properties have been inferred from outcrops, drilling resistance and drilling cuttings.

Table 4 – Summary of Inferred Geotechnical Units

Inferred Geotechnical Unit	Inferred Depth to Top of Unit (m)	Description
TOPSOIL	0.0	Typically Silty SAND to Sandy SILT; fine-grained, non-plastic, brown, dry to moist, stiff.
FILL	0.0	Typically a CLAY to Sandy CLAY, low to high plasticity, fine grained pale brown to orange to red, moist, firm.
RESIDUAL	0.0 to 2.6	Typically: CLAY to Sandy CLAY; medium to high plasticity, orange - brown to brown, fine grained sand, dry to moist, firm to very stiff. Sand trace Clay to SAND; yellow – brown to orange – brown, fine grained, medium plasticity clay, moist, medium dense.
BEDROCK A	0.75 to 3.5	SHALE was typically: SHALE; grey, orange and grey, pale orange – brown, occasionally iron stained, thinly laminated, dry to moist, very stiff soil strength to low strength, extremely to highly weathered.

Inferred Geotechnical Unit	Inferred Depth to Top of Unit (m)	Description
BEDROCK B	0.6 – 7.6	SANDSTONE was typically: SANDSTONE; fine grained, pale grey, red - orange, iron-stained, typically medium strength but ranges from very low to high strength, highly to moderately weathered.

Table 5 – Elevation to Top of Geotechnical Units Encountered

BH ID	Reduced Level at Top of Inferred Geotechnical Units (m AHD)					
	TOPSOIL	FILL	RESIDUAL	BEDROCK A	BEDROCK B	EOH[1]
BH01	NE[2]	68.85	68.45	NE	68.25	68.05[3]
BH02	NE	69.41	68.11	NE	NE	67.91
BH03	NE	68.61	67.81	NE	NE	67.61
BH04	NE	75.86	75.36	NE	NE	74.86
BH05	NE	75.32	75.12	NE	NE	74.32
BH06	NE	77.04	76.44	75.74	74.04	72.34[3]
BH07	NE	82.39	82.31	81.64	78.89	76.29[3]
BH08	NE	75.91	75.76	73.41	68.31	68.11[3]
BH09	72.14	NE	71.84	NE	69.54	69.34[3]
BH10	NE	73.53	73.33	NE	72.23	72.23[3]
BH11	NE	73.55	73.15	NE	72.15	71.95[3]

(1) EOH: End of Hole
(2) NE: Not Encountered
(3) Indicates termination due to TC-bit refusal.

4.4 Groundwater

Groundwater was encountered at 4 m BGL in BH08 approximately one hour after excavation of the hole during and after installation of the piezometer. No groundwater was encountered in other boreholes or piezometers.

No additional groundwater monitoring has been undertaken by PSM. Further monitored data is included in Section 9.2.1 of the **JBS&G PSI** (Ref. 61452-150732 Rev3, dated 18 October 2023).

5. Discussion and Geotechnical Design Advice

5.1 Minor Earthworks

PSM anticipates that minor earthworks may be required and recommend that once details are finalised an earthwork specification for be prepared specifically for these works. Where the ground is required to support structures, we recommend that as a minimum the earthworks specification shall include the following:

- Requirements for stripping of vegetation, TOPSOIL, and surficial FILL placed as landscaping top soil
- Requirements for proof rolling of the exposed surface. The exposed subgrade surface proof rolled with a minimum 12 tonne smooth drum non-vibratory roller, a geotechnical engineer should witness the proof rolling and advise the number of passes for each section and identify “soft spots”. Any “soft spots” identified should be excavated and replaced with approved material, with a maximum compacted layer thickness of 200 mm
- Requirements for subgrade preparation. The exposed subgrade surface shall be scarified, and moisture conditioned to a depth of 150 mm and bring the layer into the acceptable moisture variation range
- Definition of compaction and moisture variation requirements for new fill to be placed. Typically, we recommend that fill to be placed and compacted to a density ratio of between 98% and 102% (Standard) and moisture variation of between 2% dry and 2% wet

- Requirements with regards to maximum layer thickness for new fill. Typically we recommend a maximum compacted layer thicknesses of 200 mm. If larger earthmoving equipment is employed (e.g. 12t rollers or Cat825) the layer thicknesses could be increased to 300mm
- Testing requirements. We typically recommend that fill be placed in Lots that are defined as a single layer of ENGINEERED FILL consisting of uniform material which has undergone similar treatment and that each Lot be tested on "a none to fail basis", i.e., if any one test undertaken with a Lot fails, the whole of the Lot shall be reworked and retested. The minimum density testing frequency we recommend are as follows:
  - For Lots less than 30 m^3 – 1 test per Lot
  - For Lots between 30 m^3 to 150 m^3 – 2 tests per Lot
  - For Lots greater than 150 m^3 – shall not be less than the greater of:
    - 1 test per 500 m^3 of material placed
    - 3 tests per lot.

Fill placed in accordance with a specification developed in accordance with the above recommendations is referred to herein as ENGINEERED FILL.

5.2 Salinity Risk

The Department of Planning, Industry and Environment's (DPIE) geospatial database on salinity risk indicates the Site to vary between very low and moderate. The locations of proposed developments over the salinity risk map is presented in Inset 2. It is addressed in Section 2.10 of the JBS&G PSI that a Salinity Management Plan is not required for the development. This is consistent with the geotechnical perspective as the developments are detached buildings or internal roads and does not include salinity risk activities (i.e. no major ground disturbance, no significant changes to surface hydrology).

Inset 2: Site developments underlain by DPIE salinity risk map, green indicates very low and yellow indicates moderate.

5.3 Acid Sulphate Soil Risk

DPIE's geospatial database on Acid Sulfate Soil Risk show no known occurrences of acid sulphate soils. It is addressed in Section 2.8 of the JBS&G PSI that an acid sulphate management plan is not required for the development.

5.4 Groundwater Impacts

No proposed developments have significant excavations below observed ground water levels and hence no adverse geotechnical groundwater issues are expected.

5.5 Site classification

Ground movement estimates based on the conditions at the time of investigation and site classification as per AS2870-2011 are as follows:

- Where more than 0.4 m of FILL is present then a 'P' Classification. Provided FILL is assessed / replaced with ENGINEERED FILL, reclassification is permitted as per clause 2.5.3 of AS2870-2011
- A Characteristic Surface movement "y_s" in the order of:
  - Up to 30 mm would be anticipated in locations of shallow BEDROCK (i.e Sports Pavillion, Boarding House, Day House as located in Figure 1), therefore a site classification of 'M' would apply
  - Up to 50 mm would be anticipated in other locations, therefore an approximate site classification of 'H1' would apply.

Ground movement estimates should be confirmed once the details development is known.

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

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

Mounds at perimeters or penetrations of slabs open to the environment can be taken to be as per AS2870-2011. We highlight the ongoing maintenance requirements associated with designs in accordance with AS2870-2011.

5.6 Foundations

5.6.1 Shallow Footings

It is expected that the foundations used as part of the proposed development at the site would typically include strip, pad, or other shallow footings.

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 5. Further advice should be sought if the footings are located adjacent to a batter or wall.

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

Settlements in the RESIDUAL and ENGINEERED FILL can be estimated using the elastic moduli provided in Table 6.

The differential settlement due to the building load shall also be assessed.

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

Where footings are located within the zone of influence of an existing batter or retaining wall, the bearing capacity may need to be reduced and further advice should be sought. The zone of influence is defined as the zone above a 2H:1V line extending from the toe of the batter or the toe of the retaining wall.

Further advice should be sought for piled foundations.

Table 6 – Engineering Parameters for Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m3)	Soil Effective Strength Parameters		Ultimate Bearing Pressure under Vertical Centric Loading (kPa)	Allowable Bearing Pressure (ABP) under Vertical Centric Loading [3] (kPa)	Ultimate Shaft Adhesion (kPa)	Elastic Parameters	
		c' (kPa)	φ' (deg)				Long Term Youngs Modulus (MPa)	Poisson's Ratio
ENGINEERED FILL / RESIDUAL	18	3	27	420	150[1]	N/A	10	0.3
BEDROCK A	22	N/A	N/A	1,500[2]	700	150	100	0.25
BEDROCK B[4]	22	N/A	N/A	8000	3500	800	400	0.25

(1) Pad footings (for ABP of 150 kPa) should have a minimum horizontal dimension of 1 m and a minimum embedment depth of 0.5 m
(2) Ultimate values occur at large settlement (>5% of minimum footing)
(3) ABP is an end bearing pressure to cause settlement of <1% of minimum footing
(4) Designers relying on BEDROCK B properties should include confirmation of properties by inspections during construction by a geotechnical engineer.

5.6.2 Piled Foundations

Piled foundation should be founded within the BEDROCK units. Piles should be designed in accordance with the requirements in AS 2159 (2009), *Piling – Design and Installation.* Selection of the pile system depends on many considerations and should be undertaken by the designer in conjunction with the Principal and contractor / builder. The parameters provided in Table 6 may be adopted in the design of piles founded in the BEDROCK units.

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

- The ABP needs to be confirmed by a geotechnical engineer during a pile inspection
- Under permanent load, the contribution of side adhesion for soils should be ignored
- Pile settlement needs to be checked using the recommended elastic parameters in Table 6.

The bearing capacities provided are contingent on piles or footings being vertically and centrally loaded. Further advice should be sought if the footings are not vertically and centrically loaded. Shoulder higher bearing capacities be required, further advice should be sought from PSM.

With regards to the pile design, we recommend that:

- A geotechnical strength reduction factor, ϕ_g = 0.60 (AS2159-2009 CL 4.3.2) be adopted for a high redundancy for an assessed average risk rating (ARR) of 3.0. This should be reviewed to suit the specific design and construction methods proposed by the structural designers
- It may be possible to increase the pile reduction factors, if the details of the proposed pile installation procedures indicate a high level of quality control with regards to concrete placement, base cleanliness, etc
- A geotechnical strength reduction factor ϕ_g = 0.40 is adopted, then no pile testing will be required (AS2159-2009 CL 8.2.4 (b)).

Where the pile is sized using the allowable bearing capacity in Table 6 (i.e., assuming all serviceability load is carried by the base), the settlement would be expected to be less than 1% of the pile diameter plus elastic shortening of the pile itself.

Further advice should be sought if piles are not founded in BEDROCK units.

5.7 Slabs

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

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

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

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

5.8 Excavation Conditions

Excavation of the TOPSOIL, FILL, RESIDUAL and BEDROCK units is expected to be achievable using conventional earth-moving equipment. The BEDROCK B unit comprises low strength and stronger Sandstone rock breaking using hydraulic impact hammers may be required. Please note that during the PSM geotechnical investigation an 8-tonne rig encountered practical auger refusal with a tungsten carbide bit when drilling in BEDROCK. We have inferred this to comprise medium strength or stronger sandstone.

Prospective contractors should make their own assessment of excavatability based on the logs and their site inspection and experience. It is our experience that excavatability is heavily dependent on both the operator and the plant used. Any earthworks contractor should satisfy itself with regard to excavatability, especially in the BEDROCK unit. We reiterate that the depth to BEDROCK and the condition of the BEDROCK varies significantly across the site. Depending on the location BEDROCK may comprise several metres of BEDROCK A (weathered SHALE) or shallow medium strength or stronger BEDROCK B (SANDSTONE).

5.9 Temporary and Permanent Batters

The batter slope angles shown in Table 7 are recommended for the design of batters up to 3 m height and above the groundwater table, subject to the following recommendations:

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

Table 7 – Design Batter Slope Angles

Unit	Temporary	Permanent
ENGINEERED FILL / RESIDUAL	1.5H:1V	2.0H:1V
BEDROCK A	1H:1V	1:5:1V
BEDROCK B	1H:1V	1H:1V

Steeper batters may be possible subject to future advice, this would be subject to excavation depths, retained material and would involve inspections during construction.

5.10 Design subgrade CBR

A design CBR of 3.0% can be adopted for subgrade formed for RESIDUAL or ENGINEERED FILL.

We recommend that specific CBR testing be undertaken at subgrade level when pavement layouts are finalised.

6. Closing

Based on the geotechnical conditions encountered during the site investigation it is our opinion that there are no significant or unusual geotechnical concerns that would preclude an appropriate design for the proposed development. PSM recommends that designers use the geotechnical advice provided in Section 5 to inform their designs, location specific information should still be considered.

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

Yours Sincerely

STEPHEN DU
GEOTECHNICAL ENGINEER

DAVID PICCOLO
PRINCIPAL

Encl. Figure 1.
Appendix A – Historical Aerial Photos
Appendix B – Tabulated Borehole Locations and Borehole Logs
Appendix C – Standpipe Piezometer Construction Records
Appendix D – Select Site Photographs
Appendix E – Laboratory Certificates

316000 316500 317000 317500

6260000 6259500

Boarding House
BH10
BH11
Day House
BH9
Staff Residences
BH8
BH2
Sports Pavilion
BH1
BH3
BH7
BH4
GLU
PAB
Internal Road
BH6
BH5

316000 316500 317000 317500

Legend

- Site Boundary
- Proposed Developments
  - Boarding House
  - Day House
- GLU
- Internal Road
- PAB
- Sports Pavilion
- Staff Residences
- Borehole location
- Borehole location with piezometers

NOTES:
1. Aerial imagery sourced from Nearmaps.com dated 23 November 2023.

Scale 1:5,000
N 0 50 100 150 m
Horizontal Datum: GDA2020
Grid: MGA Zone 56

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	Date: 22 Aug 2023	Paper: A3

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Geotechnical Site Investigation
The King's School, North Paramatta

SITE LOCALITY PLAN

PSM4935-005R REV2 | Figure 1

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Appendix A
Historical Aerial Photos

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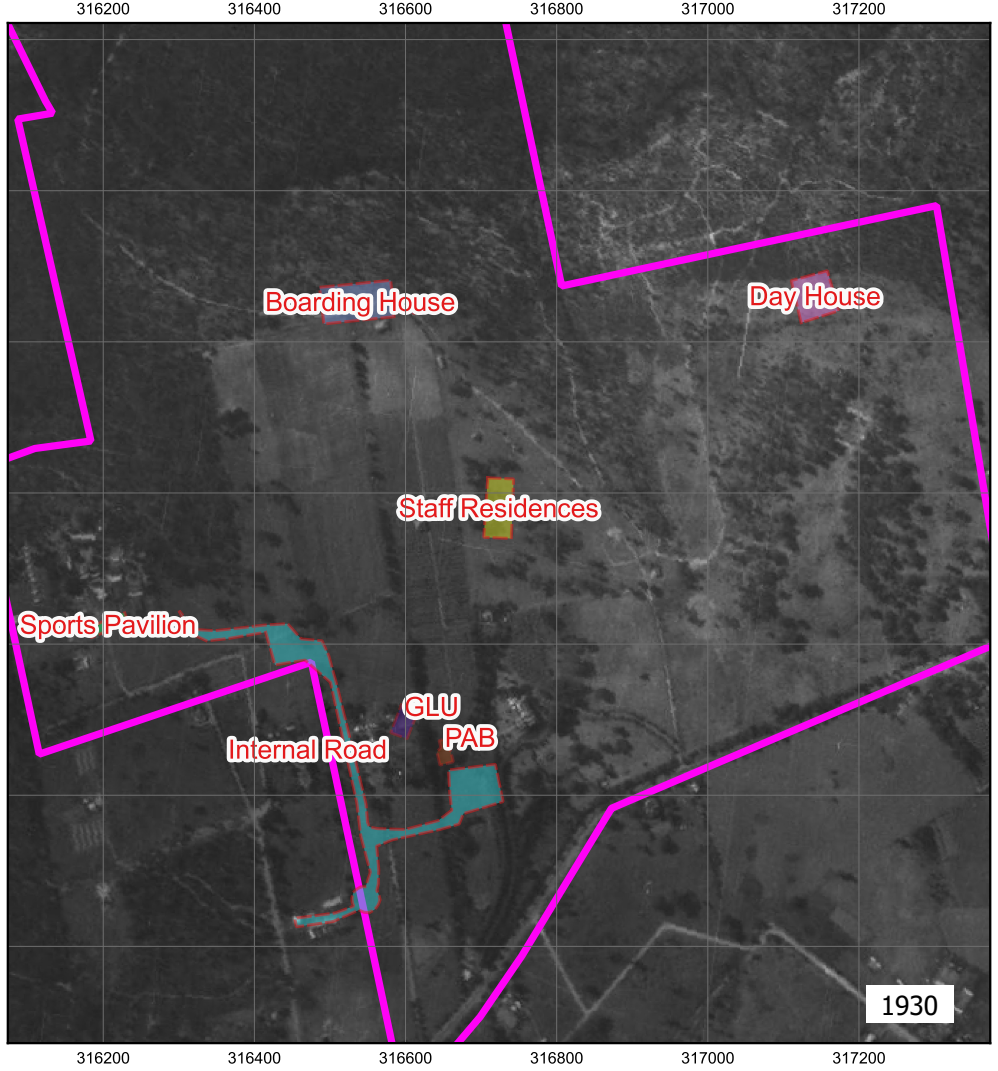

Legend

Proposed Developments
- Boarding House
- Day House
- GLU
- Internal Road
- PAB
- Prep School Upgrade
- Sports Pavilion
- Staff Residences
- Site Boundary

N

Scale 1:10,000

0 200 400 m

Grid: EPSG:7856

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Date: 22 Aug 2023	Paper A4

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HISTORIAL AERIAL PHOTOS
(1 OF 2)

PSM4935-005R REV2 | APPENDIX A1

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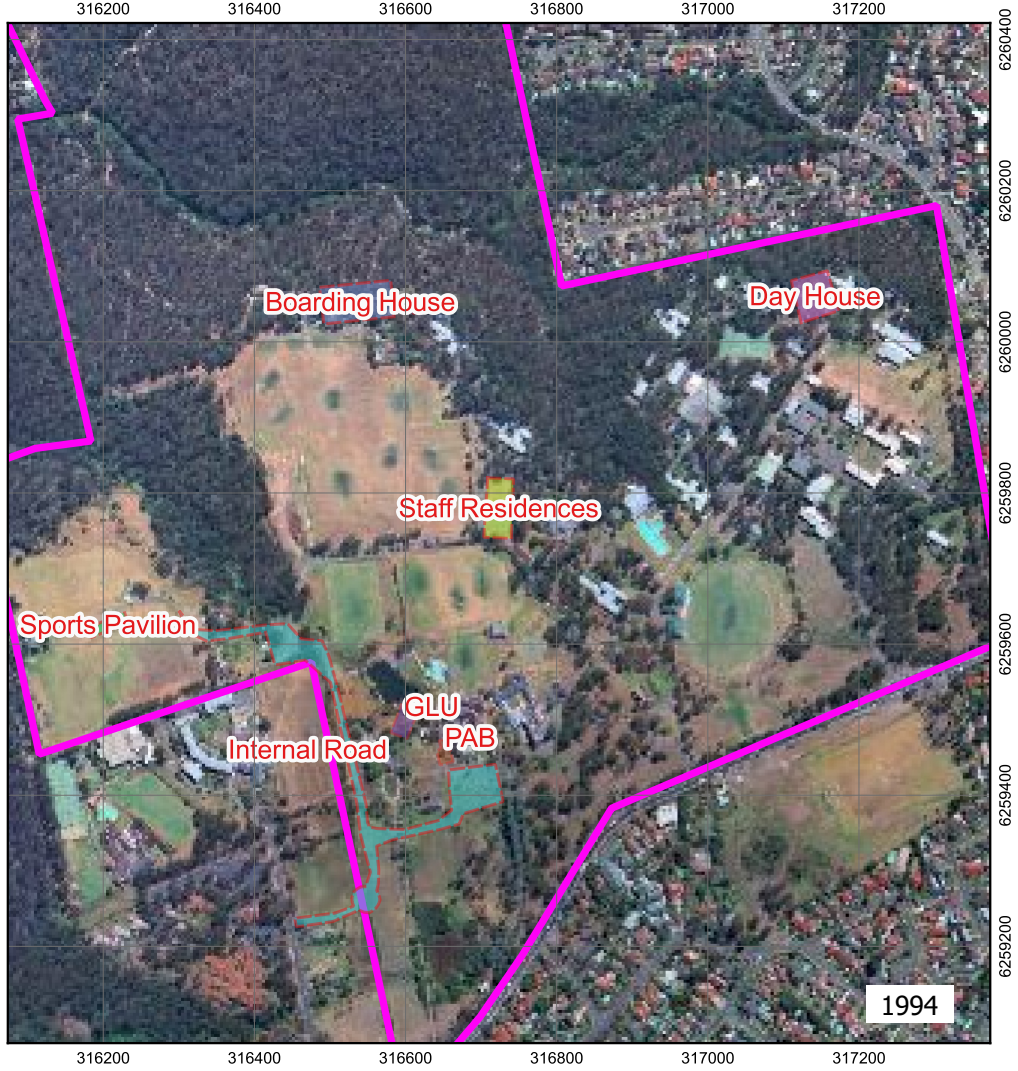

Legend

Proposed Developments
- Boarding House
- Day House
- GLU
- Internal Road
- PAB
- Prep School Upgrade
- Sports Pavilion
- Staff Residences
- Site Boundary

N

Scale 1:10,000

0 200 400 m

Grid: EPSG:7856

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Appendix B
Tabulated Borehole Locations and Borehole Logs

Table A1 – Tabulated Borehole Logs

BHID	Approximate Depth (m)	Material Encountered	Notes
BH 01	0.0 – 0.4	CLAY, medium plasticity, dark brown, moist, firm, roots up to 0.1 m.	Inferred FILL
	0.4 – 0.6	CLAY; high plasticity, brown, moist to dry, stiff.	Inferred RESIDUAL U – tube sample at 0.5 m - 0.6 m
	0.6 – 0.8	SANDSTONE; fine grained, pale grey and red - orange, dry, medium to high strength, moderately weathered.	Inferred BEDROCK B
	0.8	Hole terminated at 0.8 m. Tungsten Carbide bit (TC-Bit) Refusal.	
BH02	0.0 – 1.3	Sandy CLAY, low to medium plasticity, dark brown, fine grained sand, moist, firm, roots up to 0.1 m.	Inferred FILL CBR Test sample taken at 0.1 – 1.0 m
	1.3 – 1.5	CLAY; high plasticity, orange - brown, moist, stiff.	Inferred RESIDUAL
	1.5	Hole terminated at 1.5 m. Target depth was achieved.	
BH03	0.0 – 0.8	CLAY, medium plasticity, dark brown, moist, firm, roots up to 0.1 m.	Inferred FILL CBR Test sample taken at 0.3 – 0.8 m.
	0.8 – 1.0	CLAY; medium to high plasticity, brown, moist firm.	Inferred RESIDUAL
	1.0	Hole terminated at 1.0 m. Target depth was achieved.	
BH04	0.0 – 0.5	Silty CLAY; low plasticity, dark brown, moist, soft to firm, roots up to 0.1 m.	Inferred FILL
	0.5 – 1.0	CLAY; high plasticity, brown, dry, stiff to very stiff.	Inferred RESIDUAL CBR Test sample taken at 0.5 – 1.0 m.
	1.0	Hole terminated at 1.0 m. Target depth was achieved.	
BH05	0.0 – 0.2	CLAY; low plasticity, dark brown, moist, firm, roots up to 0.1 m.	Inferred FILL
	0.2 – 0.5	CLAY; medium plasticity, orange and brown, dry to moist, stiff.	Inferred RESIDUAL
	0.5 – 1.0	Becomes very stiff.	CBR Test sample taken at 0.5 – 1.0 m.

BHID	Approximate Depth (m)	Material Encountered	Notes
	1.0	Hole terminated at 1.0 m. Target depth was achieved.	
BH06	0.0 – 0.1	Silty CLAY trace sand, low plasticity, dark brown, fine grained sand, moist, firm, roots up to 0.1 m. Fragments of bitumen on base of unit.	Inferred FILL
	0.1 – 0.6	CLAY trace gravel, medium to high plasticity, mottled brown and black, fine grained and sub-angular gravel, moist, firm to stiff.	SPT 0.50 - 0.95: 3,5,6 N=11 350 mm recovery.
	0.6 – 0.8	CLAY; medium to high plasticity, mottled orange and brown, red, dry to moist, stiff.	Inferred RESIDUAL
	0.8 – 1.3	Becomes dry and very stiff.	
	1.3 – 3.0	SHALE; grey, occasionally iron stained, dry, very stiff soil strength to very low strength, extremely to highly weathered.	Inferred BEDROCK A SPT 1.50 - 1.95: 10,18,15 N=33 450 mm recovery.
	3.0 – 4.7	SANDSTONE; fine grained, dark grey and brown, thinly laminated, dry, very low strength, highly weathered.	Inferred BEDROCK B
	4.6 – 4.7	Becomes low to medium strength.	
	4.7	Hole terminated at 4.7 m. TC-Bit Refusal.	
BH07	0.0 – 0.08	Silty CLAY with sand; medium plasticity, dark brown, fine grained sand, moist, firm, roots up to 0.08 m.	Inferred FILL
	0.08 – 0.75	CLAY; high plasticity, brown, dry, stiff to very stiff.	Inferred RESIDUAL U – tube at 0.5 m - 0.8 m.
	0.75 – 2.5	SHALE; orange and grey, thinly laminated, dry, very stiff soil strength to very low strength, extremely to highly weathered.	Inferred BEDROCK A

BHID	Approximate Depth (m)	Material Encountered	Notes
	2.5 – 3.5	Becomes grey.	
	3.5 – 6.1	SANDSTONE; fine grained, dark grey and brown, dry to moist, very low to low strength, highly to extremely weathered. Becomes low strength with depth.	Inferred BEDROCK B
	6.1	Hole terminated at 6.1 m. TC-Bit Refusal.	
BH08	0.0 – 0.15	SAND trace Clay and Gravel; medium grained, dark brown, medium grained and sub-rounded to sub-angular gravel, high plasticity clay, firm, moist, roots up to 0.1 m.	Inferred FILL
	0.15 – 1.2	CLAY; high plasticity, orange - brown, moist, firm to stiff.	Inferred RESIDUAL
	1.2 – 1.7	Becomes mottled grey, orange and red, stiff.	SPT 0.50 - 0.95: 5,4,5 N=9 400 mm recovery. SPT 1.50 - 1.95: 4,7,9 N=16 450 mm recovery.
	1.7 – 2.0	Becomes mottled grey and orange	
	2.0 – 2.5	SHALE; pale orange – brown, dry, very stiff soil strength, to very low strength, extremely to highly weathered.	Inferred BEDROCK A
	2.5 – 5.0	SHALE; dark grey and orange, dry, very low strength, highly weathered.	Groundwater encountered at 4m.
	5.0 – 7.6	SHALE; grey, moist, very low strength, highly weathered.	
	7.0 – 7.6	Becomes very low to low strength.	

BHID	Approximate Depth (m)	Material Encountered	Notes
	7.6 – 7.8	SANDSTONE; fine grained, grey - brown, thinly laminated, dry, low to medium strength, highly weathered.	Inferred BEDROCK B
	7.8	Hole terminated at 7.8 m. TC-Bit Refusal.	
BH09	0.0 – 0.1	Silty SAND to Sandy SILT; fine-grained, non-plastic, brown, dry to moist, stiff.	Inferred TOPSOIL
	0.1 – 1.0	CLAY; high plasticity, mottled brown orange - red, moist, stiff.	Inferred RESIDUAL SPT 0.50-0.95: 6,7,8 N=15 450 mm recovery.
	1.0 – 2.0	Clayey SAND to Sandy CLAY; high plasticity clay, fine grained sand, mottled grey, red and orange, moist to dry, stiff / medium dense.	SPT 1.50 - 1.95: 5,7,9 N=16 400 mm recovery.
	2.0 – 2.6	Gravelly CLAY; high plasticity, grey - brown, fine grained and sub-angular gravel, dry, stiff to very stiff.	
	2.6 – 2.8	SANDSTONE; fined grained, grey, dry, low to medium strength, highly weathered.	Inferred BEDROCK B
	2.8	Hole terminated at 2.8 m. TC-Bit Refusal.	
BH10	0.0 – 0.2	Sandy CLAY; medium plasticity, brown, fine grained sand, moist, firm, roots up to 0.1 m.	Inferred FILL
	0.2 – 0.4	SAND trace clay; medium to fine grained, yellow - brown, medium plasticity clay, moist, medium dense.	Inferred RESIDUAL
	0.4 – 1.3	Clayey SAND; fine grained, mottled red and brown, moist, medium dense.	U – tube sample at 0.5 m - 0.7 m.
	0.9 – 1.2	Becomes pale yellow – brown.	
	1.2 – 1.3	Becomes white, dense.	
	1.3	Hole terminated at 1.3 m. TC-Bit Refusal.	Inferred BEDROCK B
BH11	0.0 – 0.4	Sandy CLAY; medium plasticity, brown, fine grained sand, moist, firm, roots up to 0.1 m.	Inferred FILL

BHID	Approximate Depth (m)	Material Encountered	Notes
	0.4 – 0.75	CLAY; high plasticity, brown, moist, stiff.	Inferred RESIDUAL U – tube sample at 0.5 m - 1.0 m.
	0.75 – 1.4	SAND with Clay; fine to medium grained, orange brown, medium plasticity clay, moist to dry, medium dense.	
	1.4 – 1.5	SANDSTONE; fine grained, grey and pale brown, dry, very low to low strength, highly weathered.	Inferred BEDROCK B
	1.5 – 1.6	SANDSTONE; fine to medium grained, red - brown, iron - stained throughout, dry, low to medium strength, highly weathered.	
	1.6	Hole terminated at 1.6 m. TC-Bit Refusal.	

Table A2 - Borehole Coordinates

Borehole ID	Date Completed	Elevation (m)	Easting (m)	Northing (m)
BH01	24/01/23	68.85	316175	6259595
BH02	24/01/23	69.41	316306	6259660
BH03	24/01/23	68.61	316470	6259616
BH04	24/01/23	75.86	316510	6259499
BH05	24/01/23	75.32	316537	6259375
BH06	24/01/23	77.04	316603	6259400
BH07	24/01/23	82.39	316699	6259549
BH08	23/01/23	75.91	316729	6259740
BH09	23/01/23	72.14	316754	6259801
BH10	23/01/23	73.53	316546	6260054
BH11	23/01/23	73.55	317129	6260059

Note: 1. Borehole coordinates surveyed by PSM with a real time kinematic (RTK) workflow and corrections from the AUSCORS network base
2. Coordinates are presented in GDA2020 MGA56 and elevation in AHD.

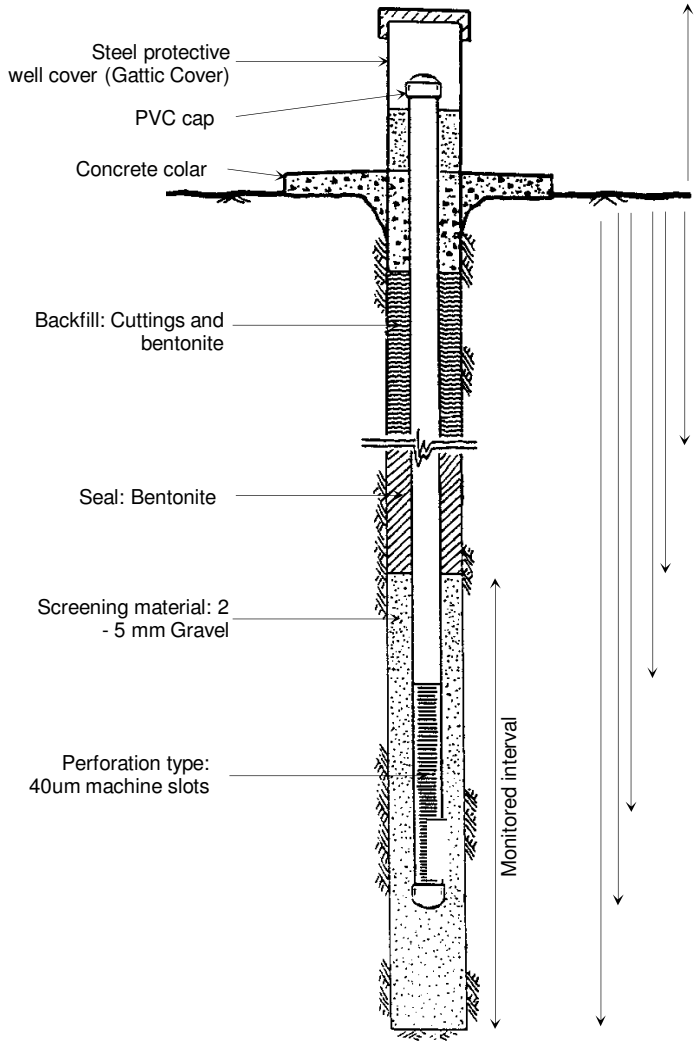
Appendix C
Standpipe Piezometer Construction Records

JOB no.: PSM4935 REV2

PROJECT: Geotechnical Investigation Report
The King's School, North Parramatta

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH06	DRILLING CONTRACTOR:	JK Drilling
PIEZOMETER:	BH06A	RIG:	Hanjin DB8
COLLAR EASTING (m):	316602.337	DEPTH OF HOLE (m):	4.70
COLLAR NORTHING (m):	6259399.538	BOREHOLE INCLINATION:	Vertical
COLLAR RL (m):	77.67	PIEZO INSTALLATION DATE:	24/01/2023
		SUPERVISED BY:	SD



Height of stickup	0.0 m (Flush)
Diameter of PVC	60 mm
Depth to top of seal	3.0 m
Depth to top of gravel pack	4.0 m
Depth to top of screen	4.2 m
Depth to base of screen	4.7 m
Depth to base of piezo	4.7 m
Depth to base of gravel	4.7 m

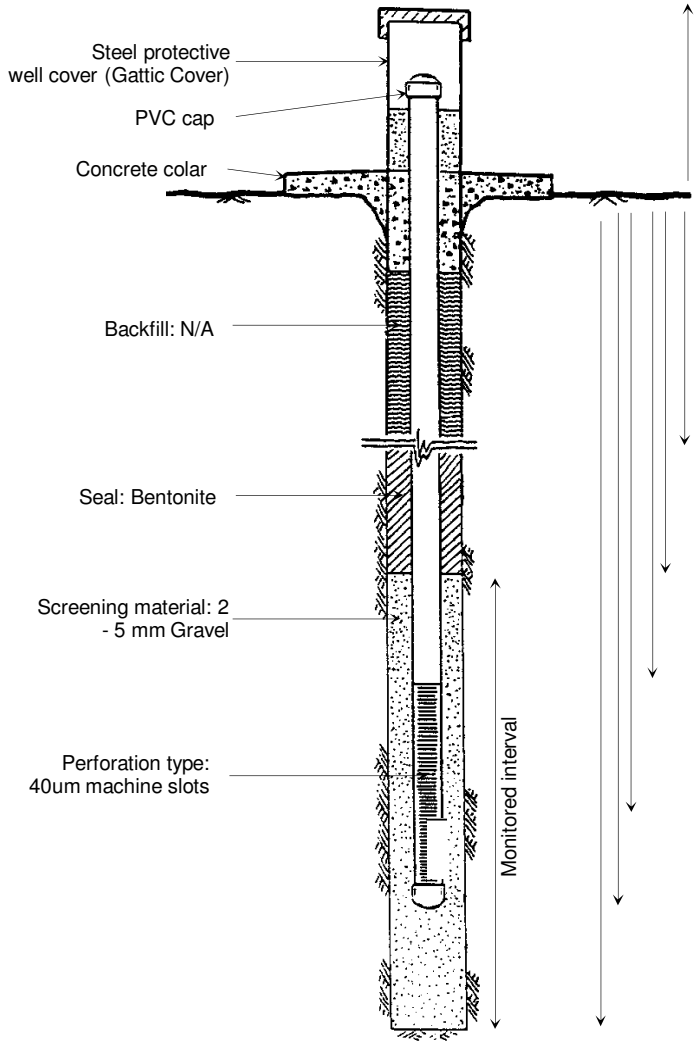
COMMENTS:
1. Borehole coordinates surveyed by PSM with a real time kinematic (RTK) workflow and corrections from the AUSCORS network base
2. Coordinates are presented in GDA2020 MGA56 and elevation in AHD.

JOB no.: PSM4935 REV2

PROJECT: Geotechnical Investigation Report
The King's School, North Parramatta

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH06	DRILLING CONTRACTOR:	JK Drilling
PIEZOMETER:	BH06B	RIG:	Hanjin DB8
COLLAR EASTING (m):	316601.772	DEPTH OF HOLE (m):	1.50
COLLAR NORTHING (m):	6259399.528	BOREHOLE INCLINATION:	Vertical
COLLAR RL (m):	77.13	PIEZO INSTALLATION DATE:	24/01/2023
		SUPERVISED BY:	SD



Height of stickup	0.0 m (Flush)
Diameter of PVC	60 mm
Depth to top of seal	0.0 m
Depth to top of gravel pack	0.7 m
Depth to top of screen	1.0 m
Depth to base of screen	1.5 m
Depth to base of piezo	1.5 m
Depth to base of gravel	1.5 m

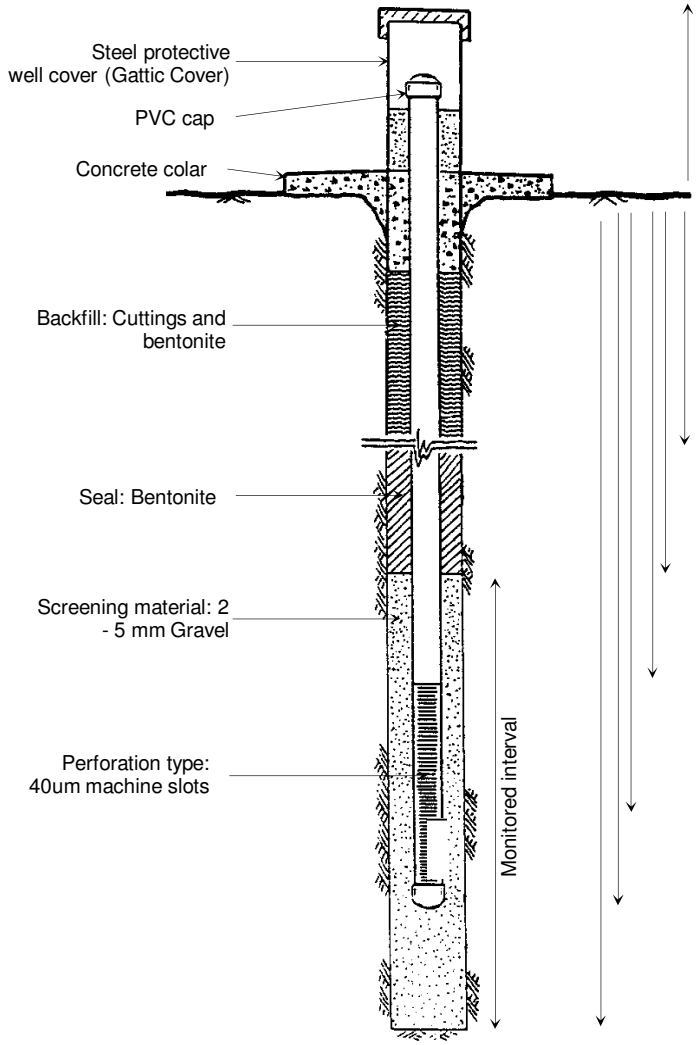
COMMENTS:
1. Borehole coordinates surveyed by PSM with a real time kinematic (RTK) workflow and corrections from the AUSCORS network base
2. Coordinates are presented in GDA2020 MGA56 and elevation in AHD.

JOB no.: PSM4935 REV1

PROJECT: Geotechnical Investigation Report
The King's School, North Parramatta

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH08	DRILLING CONTRACTOR:	JK Drilling
PIEZOMETER:	BH08A	RIG:	Hanjin DB8
COLLAR EASTING (m):	316728.843	DEPTH OF HOLE (m):	7.80
COLLAR NORTHING (m):	6259740.185	BOREHOLE INCLINATION:	Vertical
COLLAR RL (m):	75.911	PIEZO INSTALLATION DATE:	23/01/2023
		SUPERVISED BY:	SD



Height of stickup	0.0 m (Flush)
Diameter of PVC	60 mm
Depth to top of seal	5.5 m
Depth to top of gravel pack	6.5 m
Depth to top of screen	7.0 m
Depth to base of screen	7.8 m
Depth to base of piezo	7.8 m
Depth to base of gravel	7.8 m

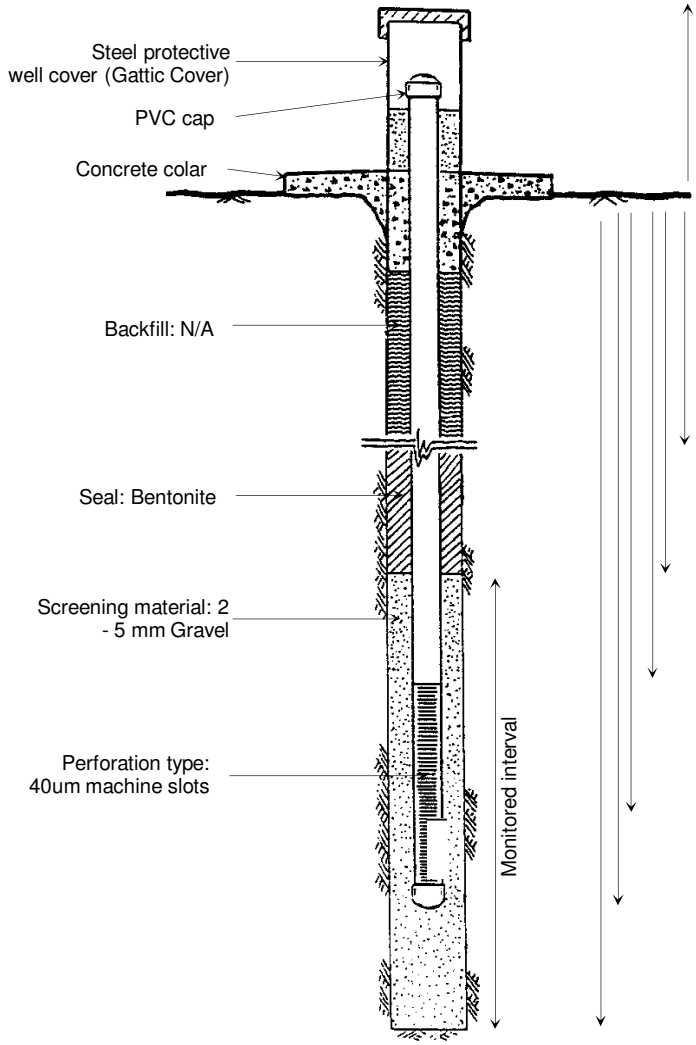
COMMENTS:
1. Borehole coordinates surveyed by PSM with a real time kinematic (RTK) workflow and corrections from the AUSCORS network base
2. Coordinates are presented in GDA2020 MGA56 and elevation in AHD
3. Groundwater water observed at a depth of 4.0 m below ground surface during construction.

JOB no.: PSM4935 REV1

PROJECT: Geotechnical Investigation Report
The King's School, North Parramatta

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH08	DRILLING CONTRACTOR:	JK Drilling
PIEZOMETER:	BH08B	RIG:	Hanjin DB8
COLLAR EASTING (m):	316729.420	DEPTH OF HOLE (m):	2.00
COLLAR NORTHING (m):	6259740.244	BOREHOLE INCLINATION:	Vertical
COLLAR RL (m):	75.862	PIEZO INSTALLATION DATE:	23/01/2023
		SUPERVISED BY:	SD



Height of stickup	0.0 m (Flush)
Diameter of PVC	60 mm
Depth to top of seal	0.0 m
Depth to top of gravel pack	1.0 m
Depth to top of screen	1.0 m
Depth to base of screen	2.0 m
Depth to base of piezo	2.0 m
Depth to base of gravel	2.0 m

COMMENTS:
1. Borehole coordinates surveyed by PSM with a real time kinematic (RTK) workflow and corrections from the AUSCORS network base
2. Coordinates are presented in GDA2020 MGA56 and elevation in AHD.

Appendix D
Select Site Photographs

Photo 1 - Proposed day house location 18 January 2023 (1 of 2)

Photo 2 - Proposed day house location 18 January 2023 (2 of 2)

Photo 3 - Proposed boarding house location 18 January 2023 (1 of 2)

Photo 4 - Proposed boarding house location 18 January 2023 (2 of 2)

Photo 5 - Proposed staff residences location 18 January 2023 (1 of 2)

Photo 6 - Proposed staff residences location 18 January 2023 (2 of 2)

Photo 7 - Proposed internal road 18 January 2023 (1 of 2)

Photo 8 - Proposed internal road location 18 January 2023 (2 of 2)

Photo 9 - Prep school location 18 January 2023 (1 of 2)

Photo 10 - Prep school location 18 January 2023 (2 of 2)

Photo 11 - Proposed sports pavillion location 18 January 2023 (1 of 2)

Photo 12 - Proposed sports pavillion location 18 January 2023 (2 of 2)

Photo 13 - Exposed outcrop on western sports field, 24 January 2023

Photo 14 - Hanjin DB8 drill rig, 24 January 2023

Photo 15 - Typical RESIDUAL recovery (BH04)

Photo 16 - Typical reinstated borehole (BH07)

Appendix E
Laboratory Certificates

115 Wicks Road
Macquarie Park, NSW 2113
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: PSM Admin Pty Ltd
PSM Job No.: PSM4935 - Kings School

Report No.: L4867 - 1
Report Date: 1/02/2023
Page 1 of 1

BOREHOLE NUMBER	BH 02	BH 03	BH 04	BH 05
DEPTH (m)	0.10 - 1.00	0.30 - 0.80	0.50 - 1.00	0.50 - 1.00
Surcharge (kg)	4.5	4.5	4.5	4.5
Maximum Dry Density (t/m^3)	1.79 STD	1.66 STD	1.57 STD	1.61 STD
Optimum Moisture Content (%)	15.9	20.4	22.2	24.0
Moulded Dry Density (t/m^3)	1.76	1.63	1.54	1.58
Sample Density Ratio (%)	98	98	98	98
Sample Moisture Ratio (%)	98	98	100	100
Moisture Contents				
Insitu (%)	17.6	23.1	19.5	20.5
Moulded (%)	15.5	20.0	22.3	23.9
After soaking and				
After Test, Top 30mm(%)	20.4	23.1	33.0	26.7
Remaining Depth (%)	17.8	21.2	25.1	26.2
Material Retained on 19mm Sieve (%)	1*	0	0	0
Swell (%)	0.5	0.0	3.0	0.5
C.B.R. value: @2.5mm penetration		6	1.5	6
@5.0mm penetration	8			

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

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 25/01/2023.
- * Denotes not used in test sample.

NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.
This document shall not be reproduced except
In full without approval of the laboratory. Results relate only to the items tested or sampled.

01/02/2023
Authorised Signature / Date
(D. Treweek)

115 Wicks Road
Macquarie Park, NSW 2113
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SOIL TEST SERVICES
ABN 43 002 145 173

NATA Accredited Laboratory
Number:1327

01/02/2023
Authorised Signature / Date
(D. Treweek)

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North Ryde, Bc 1670
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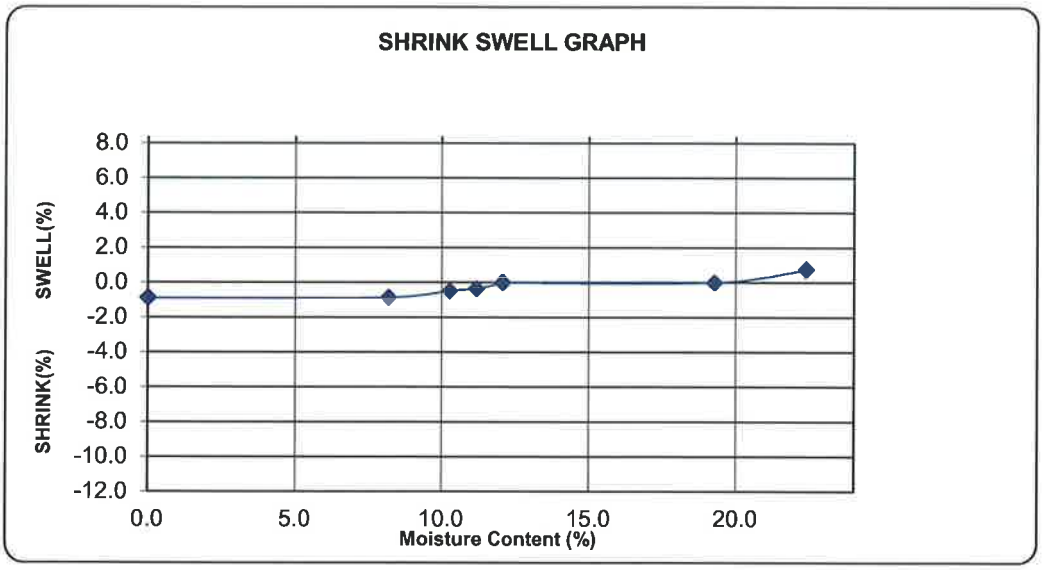
SOIL TEST SERVICES
ABN 43 002 145 173

SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client: PSM Admin Pty Ltd
PSM Job No.: PSM4935 - The King's School

Report No.: L4867 - 2
Report Date: 10/02/2023

Borehole No.: 01		Depth: 0.5 - 0.7m			
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH			
BEFORE TEST	AFTER TEST	BEFORE TEST		AFTER TEST	
19.3%	22.4%	>150	kPa	>350	kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION			SWELL ON SATURATION	SHRINKAGE
25	-0.8%			0.7%	0.9%



SHRINK SWELL INDEX
0.67 %/pF

Notes: Sampled and supplied by client. Sample tested as received.
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Visually estimated inclusions by volume = 0-5%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 03/02/2023.

NATA Accredited Laboratory Number:1327

Authorised Signature / Date (D. Treweek) 10/2/23

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Macquarie Park, NSW 2113
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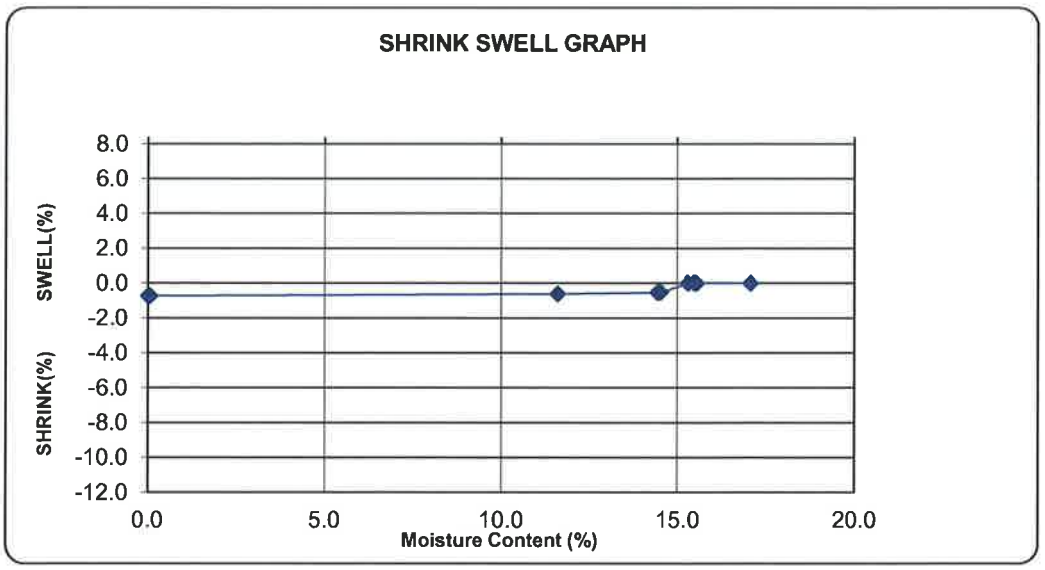
SOIL TEST SERVICES
ABN 43 002 145 173

SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client: PSM Admin Pty Ltd
PSM Job No.: PSM4935 - The King's School

Report No.: L4867 - 2
Report Date: 10/02/2023

Borehole No.: 10		Depth: 0.5 - 0.7m			
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH			
BEFORE TEST	AFTER TEST	BEFORE	TEST	AFTER	TEST
15.5%	15.3%	>80	kPa	>190	kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION			SWELL ON SATURATION	SHRINKAGE
25	-3.8%			0.0%	0.7%



SHRINK SWELL INDEX
0.39 %/pF

Notes: Sampled and supplied by client. Sample tested as received.
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Visually estimated inclusions by volume = 0-5%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 03/02/2023.

NATA
NATA Accredited Laboratory Number:1327

Authorised Signature / Date
(D. Treweek)
10/2/23

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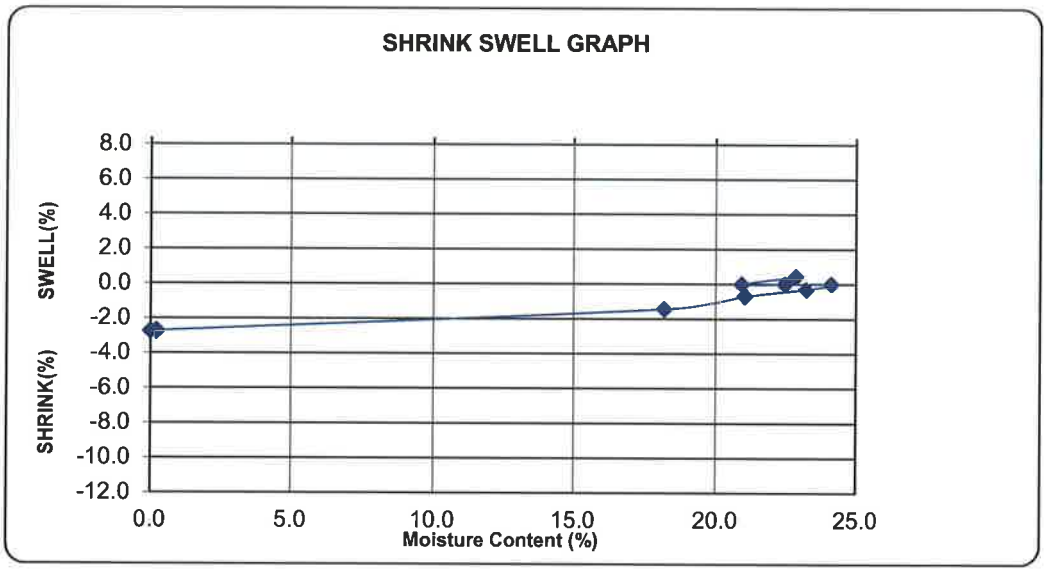
ABN 43 002 145 173

SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client: PSM Admin Pty Ltd
PSM Job No.: PSM4935 - The King's School

Report No.: L4867 - 2
Report Date: 10/02/2023
Page 3 of 3

Borehole No.: 11		Depth: 0.5 - 1.0m			
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH			
BEFORE TEST	AFTER TEST	BEFORE TEST		AFTER TEST	
20.9%	22.8%	>300	kPa	>290	kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION			SWELL ON SATURATION	SHRINKAGE
25	-0.6%			0.4%	2.7%



SHRINK SWELL INDEX
1.65 %/pF

Notes: Sampled and supplied by client. Sample tested as received.
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Visually estimated inclusions by volume = 0-5%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 03/02/2023.

NATA
NATA Accredited Laboratory Number:1327

Authorised Signature / Date (D. Treweek) 10/2/23