Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan

Proposed Upgrade of
Narrabeen North Public School
Narrabeen Education Precinct
Namona Street, Narrabeen

Prepared for
NSW Department of Education

Project 86973.04
August 2022

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	86973.04	Document No.	R.003.Rev0
Document title	Remediation Action Plan Proposed Upgrade of Narrabeen North Public School		
Site address	Narrabeen Education Precinct, Namona Street, Narrabeen		
Report prepared for	NSW Department of Education		
File name	86973.04.R.003.Rev0		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Henri Dubourdieu / David Holden	Paul Gorman	26 August 2022

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	-	NSW Department of Education c/- Johnstaff Projects Pty Ltd (Priya Mekala)

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

	Signature	Date
Author		26 August 2022
Reviewer		26 August 2022

bsi ISO 9001 Quality Management Systems CERTIFIED
FS 604853

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1. Introduction

Douglas Partners Pty Ltd (DP) was engaged by Johnstaff Projects Pty Ltd on behalf of the NSW Department of Education to complete this Remediation Action Plan (RAP) for the proposed school upgrade works at Narrabeen North Public School (NNPS). The NNPS forms part of the Narrabeen Education Precinct (NEP), the site, located at Namona Street, Narrabeen. The NNPS proposed work area and site layout are shown on Drawings 1 to 3, Appendix A. The RAP was undertaken in general accordance with DP's proposal 86973.04.P.003.Rev1 dated 23 June 2022.

Remediation is required given previous detections of asbestos in soils at NNPS. Therefore, the remediation objectives[1] are to:

- Address potentially unacceptable risks to relevant environmental values from contamination; and
- Render the areas requiring remediation validation sign-off within the NNPS proposed work area, and hence subject to remediation, suitable from a contamination perspective for their continued use as a primary school.

The proposed NNPS project works (within and external to the proposed works area) involve the demolition of various buildings and structures, construction of two-storey buildings, refurbishment of selected buildings and associated landscaping.

It should be noted that this RAP does not form a detailed specification for the proposed site remediation works, but rather represents a planning document which outlines the means by which remediation can be achieved. In this regard, as the areas involving sub-surface disturbance and nature of these works are still to be finalised as part of the final design, this RAP does not seek to highlight the exact areas within the proposed work area where remediation would be applied. Rather it outlines the strategy to be implemented for the different types of works (e.g., slab construction, pavement construction, soft landscaping, etc.). DP would anticipate that as a minimum remediation would be applied to areas of subsurface disturbance within the proposed work area.

Other minimal works may be undertaken as part of the school's general management, within or external to the proposed works area (as shown on Drawings 1 to 3 in Appendix A), such as additional planting in existing landscaped areas and placement of new turf. DP understands that this is to be conducted in accordance with the schools existing asbestos management plan[2] (AMP) rather than this RAP and hence these areas would not be subject to remediation validation sign-off under this RAP.

[1] Devised with reference to CRC Care, '*Remediation Action Plan: Development - Guideline on Establishing Remediation Objective 2019'* (CRC Care, 2019a).
[2] Parsons Brinckerhoff Australia Pty Ltd (PB), *'(draft) Asbestos in Grounds, Asbestos Management Plan, Narrabeen North Public School, Narrabeen North, NSW'*, dated January 2013, PB reference: 3906_ASB_231112_AMP.doc

Moreover, prior to commencing works the area of remediation based on the final proposed works is to be agreed[3] between the NSW Department of Education, Principal Contractor and the Environmental Consultant.

Various management plans associated with the works are anticipated to be required prior to commencement of intrusive works (e.g., Construction Environmental Management Plan (CEMP), AMP, etc.). Development and implementation of these work plans are to take into account the works outlined in this RAP.

The following key guidelines were consulted in the preparation of this report:

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013);
- NSW EPA *Guidelines for Consultants Reporting on Contaminated Land* (NSW EPA, 2020); and
- CRC CARE *Remediation Action Plan: Development - Guideline on Establishing Remediation Objectives* (CRC CARE, 2019a).

This report must be read in conjunction with all appendices including the notes provided in Appendix B.

2. Proposed Development

Details of the proposed works for the NNPS is understood at the time of preparing this report to comprise:

- Demolition of Building H, Building J and the amphitheatre;
- Removal of some trees;
- Removal of some existing demountable classrooms;
- Upgrade works to Building B (double bini-shell) for use as library including heritage conservation and restoration works;
- Refurbishment of Building K and the ground floor of Building V;
- Construction of two new buildings, namely:
  - A two storey building used for general learning spaces; and
  - A two storey building containing administration facilities, multi-purpose hall and out-of-school-hours care facilities on the ground floor with associated covered outdoor leaning area and staff facilities and amenities on the first floor. A covered outdoor leaning area (COLA) will be extending to the east will form part of these works.
- Upgrades to hard and soft landscaping including new pedestrian entry ramps.

Foundation types for the two new two storey buildings are still to be determined as part of the final design documentation. The structural engineer has indicated that whilst pile design is to be determined by a specialist piling contractor, indicative pile depths may be in the order of 5 m below ground level (bgl), with strip footings for these and smaller buildings of around 0.5 m depth.

[3] In the form of an addendum to this RAP.

DP understands that minor landscaping associated with the school's general site management and upgrade of buildings (which do not include intrusive subsurface works, e.g., Building B) may be undertaken within the NNPS proposed works area.

3. Scope of Work

The scope of work to achieve the objectives of the RAP is as follows:

- Summarise the findings of previous investigations used to inform the status of contamination and contamination risk within the proposed work area at NNPS;
- Present a conceptual site model (CSM) to list potential and likely contamination source, pathway and receptor linkages to address potentially unacceptable risks to relevant environmental values from contamination based on results from previous investigations and proposed works;
- Outline a process by which areas subject to remediation under this RAP will be identified and delineated;
- Assess, select and justify a preferred approach to management and / or remediation to render the NNPS proposed development area suitable for its proposed use, and which will minimise potentially unacceptable risk to human health and/or the environment;
- Select an appropriate (preferred) remediation strategy to render the areas subject to remediation within the NNPS proposed work area suitable, from a contamination perspective, for their continued use as a primary school;
- Establish the remediation acceptance criteria (RAC) to be adopted for validation of remediation;
- Identify how successful implementation of the RAP will be validated;
- Outline waste classification, handling and tracking requirements;
- Provide general information on appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner;
- Include contingency plans, an unexpected finds protocol and asbestos finds protocol; and
- Identify the need for, and nature of, any long-term management following the completion of remediation and, if required, provide an outline of an environmental management plan.

4. NNPS Description

Site Address	NEP: Namona Street, Narrabeen. NNPS: 6 Namona Street, Narrabeen.
Area of Proposed Works	The area of proposed works within NNPS subject to this RAP is shown on Drawings 1 to 3, Appendix A.
Legal Description	Lot 3, Deposited Plan 1018621.
Approximate Area	NNPS proposed works area: 8,400 m^2.

Zoning	Zone SP2 Educational Establishment.
Local Council Area	Northern Beaches Council
Current Use	Primary school
Surrounding Uses	North - Grassed open space playing fields for recreational use (Warriewood Valley Sportsground), then Jacksons Road and shopping centre. East - Residential then Oak Street, with Pittwater Road further east. South – Rest of NEP, namely Narrabeen Sports High School (NSHS). West - NBISC, Mullet Creek then low-rise residential and commercial including numerous vehicle workshops.

Location of the NEP and NNPS are shown on Drawing 1, Appendix A.

5. Environmental Setting

Regional Topography	Regional topography slopes gently south-west towards Mullet Creek.
Topography of Proposed Work Area	The proposed work area is relatively flat (approximately reduced level (RL) 3-5 m AHD). It is noted that the northern and western sections of NNPS slope down towards the northern and western boundaries of the school/NEP respectively.
Soil Landscape	Reference to the Sydney 1:100,000 Soil Landscape Series Sheet indicates that the proposed work area is in an area underlain by disturbed terrain.
Geology	Reference to the Sydney 1:100,000 Geological Series indicates that the proposed work area is in an area underlain by Quaternary Period stream alluvial and estuarine sediments. These sediments comprise silty to peaty quartz sand, silt and clay, ferruginous and humic cementation in places, and common shell layers.
Acid Sulphate Soils (ASS)	Reference to the 1:25,000 Acid Sulfate Soils Risk map indicates that the proposed work area is in an area of high probability of occurrence of ASS below 1-3 m depth.
Surface Water	No surface water is present within the NEP. Mullet Creek is located to the west of the NBISC and abuts the southern section of the NEP (section of NSHS). Groundwater from NSHS is likely to discharge into the creek and possibly to some extent be recharged by the creek given its proximity and connection to Narrabeen Lagoon.

Groundwater	Based on proximity to Narrabeen Lagoon and the adjacent Pacific Ocean and the porous nature of the underlying sands, groundwater was expected to be at approximately sea level or slightly higher (i.e., RL 0-2 m AHD). Given the regional topography and proximity to Mullet Creek, groundwater is expected to flow in a south-westerly direction towards Mullet Creek then east towards Narrabeen Lagoon.

It is noted that the above mapping was consistent with the field observations which generally recorded fill overlying natural sands with deeper alluvial clay and sand deposits of variable consistency. These overlayed weathered bedrock at variable and substantial depths. ASS were also confirmed to be present in the natural soils. Further information on previous investigations is summarised in Section 6 with borehole and test pit logs from these investigations included in Appendix C.

6. DP Previous Reports

DP previously conducted a preliminary site (contamination) investigation (PSI)[4] with limited sampling and a geotechnical investigation[5] at the site to assist with initial master planning works for the NEP. In addition, hazardous building materials (HBM) assessments were undertaken on NNPS[6] and NSHS[7] and reported separately. More recently, DP has conducted a detailed site investigation (contamination) (DSI)[8] for selected areas within the site where upgrade works are proposed (i.e., the NNPS proposed work area). A summary of these investigations with respect to NNPS is provided below.

6.1 Preliminary Site (Contamination) Investigation (DP, 2020)

The PSI included a desktop study, a walkover and a preliminary intrusive soil and groundwater investigation to provide data on the potential nature of contamination at the NEP.

Desktop Review

A review of the historical aerial photographs indicated that in 1930 the site appeared to be vacant and surrounded by large lots with multiple parks, ovals, sports grounds and some roads. The site then appeared to undergo development progressively, with additional buildings appearing in aerial photographs from 1955 to present (early photographs did not capture the NNPS or were of insufficient quality to allow comment on development of NNPS prior to the 1955 aerial photograph). Demolition of

[4] DP, *'Report on Preliminary Site (Contamination) Investigation with Limited Sampling, Narrabeen Education Precinct, Namona Street, North Narrabeen',* dated April 2020, DP reference: 86973.01.R.001.Rev0 (DP, 2020).
[5] DP, *'Report on Geotechnical Investigation, Narrabeen Education Precinct, Namona Street, North Narrabeen',* dated March 2020, DP reference: 86973.00.R.002.Rev0 (DP, 2020a).
[6] DP, '*Hazardous Building Materials (HBM) Assessment, Narrabeen North Public School (3906)',* dated March 2020, DP reference: 86973.02.R.002.Rev0 (DP, 2020b).
[7] DP, '*Hazardous Building Materials (HBM) Assessment, Narrabeen Sports High School (8512)',* dated March 2020, DP reference: 86973.02.R.001.Rev0 (DP, 2020c).
[8] DP, '*Report on Detailed Site Investigation (Contamination), School Upgrades – Proposed Works, Narrabeen Education Precinct, Namona Street, Narrabeen',* dated August 2022, DP reference: 86973.04.R.002.Rev0 (DP, 2022).

some buildings was also inferred. Surrounding development appeared to occur progressively over the same period.

A historical title deeds search was undertaken and indicated, along with other desktop information, that land use of the site had generally been residential or vacant prior to 1929 for NNPS, after which the land use transitioned to be used for education purposes, with intermediate ownership by council.

Review of the historical commercial and trade directory data indicated that significant portions of the broader area had been industrialised since the 1950s with a wide range of potentially contaminating activities operating mostly in the surrounding area and associated with motor car related services. The majority of these activities are associated with businesses to the east on the opposite side of Pittwater Road, the south and west on the opposite side of Mullet Creek and to the north on the opposite side of Jackson Road.

Review of the NSW EPA database did not indicate the site, or abutting properties, to be subject to Section 58 Notices or Section 60 Notification under the *Contaminated Land Management Act 1997* or holding licences under Section 308 of the *Protection of the Environment Operations Act 1997*.

Whilst the desktop information indicated potentially contaminating activities and properties in the area, DP (2020) noted that the majority of these properties are located some distance from the investigation areas, hydraulically down or across-gradient from the investigation areas and/or are located on the opposite side of Mullet Creek. Hence it was considered that these factors would reduce the potential of the subject properties to impact the NEP.

Review of the AMP for NNPS[9] indicated that in 2003 the north-eastern area of the site had been subject to clean-up of visible fibrous cement and covered with topsoil / turf / garden beds / hardstands, whilst the western section of the site had been cleaned-up in 2008 with no further remedial works undertaken in this area (these two approximate areas are shown on Drawing 2, Appendix A).

Based on the site history, it was considered that NEP had been used as schools since at least the early 1950s (if not earlier for the NNPS) to the present day. The NEP has had multiple buildings constructed and demolished over time.

The potential sources of historical contamination identified are from surficial soils and fill, past and current site uses, deterioration of previous and existing buildings and adjacent land uses (past and present).

Intrusive Investigation Scope

The scope of the intrusive investigation component for the PSI with respect to NNPS comprised the following:

- Drilling of 15 boreholes across NNPS in areas that were thought most likely to be subject to proposed works for the master plan;
- Conversion of three boreholes to groundwater monitoring wells (BH4, BH6, BH10) as a screen on groundwater quality;

[9] Parsons Brinckerhoff Australia Pty Ltd (PB), *'(draft) Asbestos in Grounds, Asbestos Management Plan, Narrabeen North Public School, Narrabeen North, NSW'*, dated January 2013, PB reference: 3906_ASB_231112_AMP.doc

- Collection of soil samples for contamination testing from all boreholes;
- Development and sampling of the three groundwater wells;
- Dispatch and analysis of selected soil samples and three groundwater samples for analysis of a combination of the following contaminants and parameters at a National Association of Testing Authorities (NATA) accredited laboratory: heavy metals; TRH; BTEX; PAH; OCP; OPP; PCB; total phenols; asbestos; hardness; and toxicity characteristic leaching procedure (TCLP); and
- ASS pH screening and selected chromium reducible sulphur (SCr) analysis to assess the potential presence of ASS.

Subsurface Conditions

The observed subsurface profile comprised pavements or topsoil overlying fill to depths between 0.2 m and 1.3 m bgl, with natural sands were encountered in all boreholes.

With respect to the fill (encountered in all boreholes) this comprised pale brown, brown, dark grey and grey gravelly sand, silty sand, silty clay and gravelly clay with varying proportions on igneous, sandstone and ironstone gravels, silt and rootlets. Ash, charcoal and plastic, were also observed in some of the fill.

The recorded groundwater levels across the site were considered to be relatively consistent and close to sea level, ranging from RL 0.6 m AHD to RL 0.9 m AHD. The depth to groundwater was deeper at NNPS (compared to NSHS) which is generally higher in elevation, with groundwater assessed to likely flow towards Mullet Creek.

Findings

Contamination was considered likely based on the findings of the investigation, with the main concern summarised as follows:

- Asbestos in fill and / or surface soils across the whole site; and
- A copper hotspot in sample BH8/0.05-0.15 (350 mg/kg) which exceeded the environmental site assessment criteria (SAC). It is noted that BH8 whilst within NNPS is outside the current proposed work area (refer to Drawing 3, Appendix A).

It was concluded that, whilst noting the preliminary nature of the assessment, gross widespread chemical contamination of the site did not appear to be prevalent, however, the primary risk driver for soil contamination, and likely future soil management, was considered to be associated with asbestos. There was considered to be a moderate to high risk that asbestos may be present in other parts of the school not sampled.

ASS was identified in the natural soil profiles across both NNPS (predominantly in the deeper natural soil profile).

In regard to groundwater, results were generally low with some detections for metals. DP did not consider there to be broad or significant contamination of the groundwater within the investigation areas. This was generally consistent with the field observations and chemical analysis results of site soils (fill and natural).

Based on the above, the following was recommended:

- Further contamination investigations across NNPS for asbestos, in the building footprints post-demolition and in the fill around BH8;
- Additional ASS investigations to gain a better understanding of the nature and extent of ASS across the investigation areas. DP noted that an ASSMP for the redevelopment works was also anticipated to be required;
- For buildings requiring demolition, the removal and disposal of the identified HBM by an appropriately licensed and qualified contractor to an appropriately licensed disposal facility; and
- Validation / clearance of the demolition works area by a qualified occupational hygienist upon completion of demolition and removal of the buildings, confirming that there are no residual asbestos-containing materials or other HBM remaining on the subject area.

DP considered that NNPS could be made suitable for the proposed development, subject to implementation of the recommendations outlined in the report and any associated remediation and/or management requirements.

6.2 Geotechnical Investigation (DP, 2020a)

The geotechnical model generated as part of the 2020 geotechnical investigation indicated that the site is underlain by variable depths of fill, typically granular, including some surficial topsoil fill and pavement materials. Alluvial and estuarine sands of variable consistency, grading to medium dense and denser with depth, underlie the fill across the site. Alluvial deposits of clay and sand with variable consistency are present beneath the alluvial and estuarine sediments and these underlying deposits are inferred to be of Pleistocene Epoch age. Weathered rock underlies the alluvial deposits, at variable and substantial depths (greater than 30.5 m bgl at BH11/CPT11 on NNPS). Groundwater was measured at depths of 1.3 m to 4.5 m (RL 0.4 m to 1.0 m AHD) during the field work and within the monitoring wells across the NEP, with the groundwater table expected to vary between approximately RL 0 m and 2.0 m AHD.

6.3 Hazardous Building Materials Assessment (DP, 2020b)

The HBM assessment was non-destructive assessments with both schools identifying the presence, or likely presence, based on visual observations of non-friable and friable asbestos, synthetic material fibre (SMF) insulation, lead dust, lead paint, PCB and refrigerants.

The reports noted that a full HBM should be conducted at the site, including prior to any disturbance of the buildings at the site that arises from maintenance, refurbishment, demolition and / or other relevant activities. It also indicated that HBM should be removed prior to undertaking the aforementioned activities.

6.4 Detailed Site Investigation (Contamination) (DP, 2022)

The DSI comprised a review of the PSI (DP, 2020), a walkover and an intrusive soil investigation to provide data on the potential nature of contamination within the investigation areas which focused on areas where proposed intrusive school upgrade works may be undertaken (i.e., for NNPS this reflects the proposed work area).

The scope of the intrusive investigation component as part of DP (2022) with respect to NNPS, included the following:

- Site inspection by an environmental scientist to set out test locations;
- Drilling and excavating a combination of boreholes and test pits at 27 test locations up to 2.6 m below ground level (bgl), 0.4 m into natural soils or prior refusal of borehole/test pit (including borehole / test pit collapse);
- Collection of soil samples for contamination testing from all test locations;
- Opportunistic collection of ASS samples from six of the sample locations (TP1001A, BH1004, TP1005, TP1008, BH1009, TP1018);
- Collection of four surface soil samples on NNPS. Samples SS1 to SS3 were collected from the accessible area of the undercroft of Building J. Sample SS4 was collected from the accessible area of the undercroft of a demountable building in the north-western corner of NNPS;
- Collection of four fragments of potential asbestos containing material (ACM) from the surface as samples (A01 to A04) observed incidentally during investigation works;
- Where sufficient fill sample could be collected, sieve testing of 10L samples for fragments of ACM;
- Submission of selected soil samples to a NATA accredited laboratory for analysis of a combination of the following common contaminants of concern and parameters: heavy metals; TRH; total petroleum hydrocarbons; BTEX; PAH; phenols; OCP; OPP; PCB; pH; CEC; asbestos; TCLP;
- Submission of selected fragments of potential ACM to a NATA accredited laboratory for asbestos ID analysis; and
- ASS pH screening and selected chromium reducible sulphur (SCr) analysis to assess the potential presence of ASS.

Observations and Subsurface Conditions

It was noted that site observations made indicated that the site has remained relatively unchanged since the PSI. Fragments of ACM (samples A01 to A04) were observed on and sampled from the ground surface under and near the demountable buildings at the northern end of the investigation area, in the vicinity of boreholes BH1024 to BH1026. Moreover, additional potential ACM fragments were observed in the same area from which the above samples were taken, and further fragments are likely to be present nearby.

Fill was present at all sample locations and generally comprised a silty clay, sandy clay and silty clay with gravelly sand also present in hardstand areas. It was encountered up to 1.1 m bgl although was typically shallower than 0.8 m. Fragments of ACM were observed within the fill at TP1001A and BH1027. Anthropogenic materials indicative of building demolition materials, such as brick, tile, plastic,

concrete, asphalt, glass and terracotta were observed at some locations, indicating the potential for further asbestos contamination.

Fill was underlain by natural grey sands. This profile was generally consistent with observations made during the PSI (DP, 2020).

Findings

With respect to asbestos, the SAC was exceeded for asbestos in soil samples TP1001A/0.2-0.4, TP1007/0-0.2 and BH1027/0-0.5, and asbestos was also detected in soil sample TP1008/0-0.2 below the SAC. Fragments of ACM were also observed and sampled from locations in the vicinity of boreholes BH1024 to BH1027. Based on these results the asbestos impacted soils within the proposed work area were considered to be present in the central, western and northern sections of the NNPS proposed works area (i.e., west of BH07 and BH09).[10] Refer to Drawing 3, Appendix A for sample locations.

Contamination identified in the soils within the investigation areas requiring consideration was largely related to asbestos, with numerous potential sources identified. ASS was identified in the natural soil profiles across NNPS (predominantly in the deeper natural soil profile).

The following comments and recommendations were provided with respect to NNPS:

- Post demolition investigations should be conducted in the building footprints, where appropriate. Assessment would include asbestos and other contaminants of potential concern (COPC) for comparison against the adopted SAC;
- Development of a RAP to address the asbestos impacted soils within the investigation area (proposed work area), most notably in the central, western and northern sections of the NNPS investigation area (proposed work area);
- Additional ASS assessment may be required for the new NNPS buildings depending on the final depth and nature of works, e.g., if works are limited to 2.5 m or a driven pile approach then further investigations may not be warranted;
- Potential development of an ASS management plan, the need for which will be informed by the final depth and nature of the proposed works. In this regard, soils may require treatment for ASS (e.g., liming);
- For all buildings where proposed disturbance of the building materials is proposed (e.g., maintenance, refurbishment, demolition), a HBM assessment should be undertaken. Subsequently the HBM to be disturbed during the works is to be removed and disposal of by an appropriately licensed and qualified contractor, at an appropriately licensed disposal facility;
- Validation / clearance of the works area post-demolition of buildings should be conducted by a qualified occupational hygienist upon completion of demolition and removal of the buildings. The validation/clearance is to confirm that there are no residual ACM or other HBM remaining on the surface of the building demolition footprints (or associated demolition works area, such as used for stockpiling of demolition waste); and
- Implementation of an unexpected finds and asbestos finds protocol by the contractor, and in agreement with the client, prior to commencing works.

[10] Soils to the east of BH07 and BH09 within the indicated proposed work area (i.e., the investigation area from DP (2022)), have not recorded the presence of asbestos in soil samples tested. Asbestos may still be encountered in these areas and if so is to be managed under the asbestos finds protocol outlined in Section 16.3 and Appendix H.

It was noted that validation of the remedial works will be required during the works by a qualified environmental consultant, and final waste classification assessments of soils will be required prior to soils being disposed off-site.

Consistent with DP (2020), DP considered that NNPS could be made suitable for the proposed development, subject to implementation of the recommendations outlined in the report and any associated remediation and/or management requirements.

For reference, the asbestos results summary table from Appendix H1B of DP (2022) is included in Appendix D.

7. Conceptual Site Model

The data collected during DP (2020 and 2022) generally confirmed that for certain potential contaminant sources outlined in the preliminary CSM in DP (2022), potentially complete pathways to the identified receptors exist, whereas for others, they do not. No other sources of contamination have been identified as a result of the testing results to date. The source (and associated COPC), pathway and receptor linkages are summarised in Table 1.

Potential Sources

S1 – Surficial Soil and Fill - Associated with levelling, demolition of former buildings including imported contaminated fill or residual demolition waste within the investigation areas. HBM, such as asbestos and lead paint, may be a potential issue in surface soils and fill. Similarly, surficial fill may have also been impacted by the historical use of grounds maintenance chemicals and storage of vehicles and fuel associated with the general maintenance of the school grounds.

Primary COPC: Asbestos.

S2 – Deterioration of Existing Buildings (and associated spalling).

Primary COPC: Asbestos.

Potential Receptors

R1 - Current and end users (students, staff and general public);

R2 - Construction and maintenance workers; and

R3 - Adjacent site users.

R4 - Terrestrial ecology.

Potential Pathways

P1 - Ingestion; and

P2 - Inhalation of dust.

In light of the results of DP (2022), a summary of the remaining potentially complete exposure pathways for the proposed land use is shown in the table below.

Table 1: Summary of Potentially Complete Exposure Pathways (Proposed Land Use)

Source and COPC	Transport Pathway	Receptor
S1 - Surficial Soil and Fill Primary COPC: Asbestos S2 - Deterioration of Existing Buildings Primary COPC: Asbestos	P1 - Ingestion P2 - Inhalation of dust.	R1 - Current and end users R2 - Construction and maintenance workers R3 - Adjacent site users R4 - Terrestrial ecology

8. Remediation Extent

As the work areas and nature of these works are still to be finalised as part of the final design, this RAP does not seek to highlight the exact areas where remediation would be applied but rather the strategy to be implemented for different types of works (e.g., slab construction, pavement construction, soft landscaping, etc.). DP would anticipate that as a minimum remediation would be applied to areas of subsurface disturbance within the proposed work area (shown on the Drawings 1 to 3, Appendix A).

Based on the results if the DSI, the asbestos impacted soils within the proposed work are considered for the purpose of this RAP to be present across the central, western and northern sections of the NNPS proposed work area (i.e., west of BH07 and BH09). Refer to Drawing 3, Appendix A for sample locations. Given the more conservative approach preferred by the NSW Department of Education for this project, which requires the remediation or management of all asbestos impacted soils (even where at low concentrations), all surface soils and fill[11] within the NNPS proposed work area and to the west of BH07 and BH09 require remediation or management if disturbed by the works.

Soils to the east of BH07 and BH09 within the indicated proposed work area (i.e., the investigation area from DP (2022)), have not recorded the presence of asbestos in soil samples tested. Hence remediation of soils in this area (subject to disturbance by the works) are not currently proposed to be subject to remediation, however, would require further validation sampling prior to or during disturbance to confirm this. Notwithstanding, there is always the potential for asbestos to be encountered in these areas and if so is to be managed under the asbestos finds protocol outlined in Section 16.3 and Appendix H and subsequently subjected to remediation (as per areas west of BH07 and BH09). In this regard, an alternate approach to undertaking additional validation assessment would be to apply the remediation requirements to this area as well from the commencement of works.

DP understands other minimal works that may be undertaken as part of the school's general management within or external to the proposed works area (as shown on Drawings 1 to 3 in Appendix A), such as additional planting in existing landscaped areas and placement of new turf. It is understood that these works are proposed to be undertaken in accordance with the schools existing

[11] This includes natural soils impacted by fill.

asbestos management plan[12] (AMP) rather than this RAP and hence these areas would not be subject to remediation validation sign-off under this RAP.

Importantly, prior to commencing intrusive works (and preferably as part of the final design works), the area of remediation based on the final proposed works is to be agreed between the NSW Department of Education, Principal Contractor and the Environmental Consultant. This is to be documented in the form of an addendum to this RAP (or similar).

9. Remediation Options Assessment

The objective of the remediation options assessment and evaluation is to establish a preferred remediation strategy. The process involves canvassing various remedial options which may be viable and then ranking each option based on a number of evaluation criteria. The remediation options assessment was undertaken with reference to CRC CARE *Remediation Action Plan: Development - Guideline on Performing Remediation Options Assessment* (CRC CARE, 2019b).

The remediation options assessment is included in Appendix E.

10. Preferred Remediation Strategy

The remediation works must be conducted by experienced and appropriately licensed contractors. An experienced Environmental Consultant is to be engaged to inspect the progress of the works and to provide ongoing advice and recommendations as required. The success of the remediation works will be validated by the Environmental Consultant in consultation with other consultants (e.g., Occupational Hygienist, Arborist, etc.).

10.1 Pre-Remediation Works - Existing Building Inspection and Demolition

Prior to building demolition, an intrusive / destructive pre-demolition HBM assessment is to be conducted. Reference for these works is to be made to previous (non-destructive) HBM survey conducted (DP, 2020b).

Under the direction of suitably qualified and experienced Occupational Hygienist, removal of hazardous building materials (e.g., lead paint, asbestos) from buildings prior to demolition is to be undertaken. The Occupational Hygienist is to inspect the structure to confirm suitability of the HBM removal prior demolition and provide written documentation (including photographs) of this inspection to the NSW Department of Education, the Principal Contractor and Environmental Consultant. Reference for these works is to be made to the intrusive / destructive pre-demolition HBM assessment conducted for the subject building being demolished.

[12] Parsons Brinckerhoff Australia Pty Ltd (PB), *'(draft) Asbestos in Grounds, Asbestos Management Plan, Narrabeen North Public School, Narrabeen North, NSW'*, dated January 2013, PB reference: 3906_ASB_231112_AMP.doc

Works are to be undertaken by an appropriately qualified and licenced contractor, with building materials to be disposed of to a receiving site that is suitably licenced to receive the material.

Following the demolition of buildings, visual inspection and clearance (including clearance certificate) of the ground surface by the Occupational Hygienist is required to confirm no HBM remain on the surface of the demolished building footprints and curtilages within the demolition work area (including and stockpiling areas haulage route(s)). The written documentation is to include photographs and drawing showing area cleared and be provided to NSW Department of Education, the Principal Contractor and Environmental Consultant prior to remedial works commencing in the subject area.

On completion of the demolition works (and prior to remedial works commencing) the building footprints, and demolition works area more generally, are to be inspected by the Environmental Consultant to confirm the absence of ACM at the surface. Concurrently, assessment of the building footprints by the Environmental Consultant for contamination purposes is to be undertaken as part of the inspection. If signs of contamination concern are identified the inspection may be supplemented with a sampling and laboratory analysis regime at the Environmental Consultant's discretion.

10.2 Capping of Asbestos Impacted Soils

The construction approach for concrete slabs, pavements and landscaping can act as a cap to address the direct exposure pathway for asbestos impacted soils. The cap and any future disturbances to it would be managed in accordance with a long term environmental management plan (LTEMP) / update of the school's existing AMP (refer to Section 19).

To minimise the potential for cross contamination and/or impacting the integrity of the cap, capping is only to commence in the area subject to remediation when all sub-surface works required to be undertaken below the marker layer level are completed (e.g., earthworks, service trenches, etc.).

Consultation with other relevant project consultants should be undertaken where necessary when implementing the outlined process (e.g., structural, civil and geotechnical engineers, landscape consultant, arborist, etc.). The minimum capping thickness layers outlined below are from a site remediation perspective. Additional requirements (e.g., thicker building slabs, basecourse layers for pavements, additional topsoil layers, etc.) may be required by the relevant discipline and hence reference is also to made to the relevant drawings.

Note: As indicated in Section 8 and discussed further in Section 10.5, remediation/mitigation (including capping) of soils to the east of BH07 and BH09 within the indicated proposed work area may not be required (subject to validation testing confirming this). An alternate to undertaking additional validation assessment would be to apply the capping approach (or removal approach outlined in Sections 10.3 and 10.4) to areas of subsurface disturbance from the commencement of works.

10.2.1 Building Slabs and Pavements

The following capping process is to be implemented if areas are to be capped by concrete (e.g., the concrete building slab or concrete pavements):

- Inspection of the surface by the Environmental Consultant to confirm the absence of signs of gross contamination of concern and observable asbestos;

- Placement of a marker layer at the surface comprising a non-woven durable geofabric (such as Jaybro mastaTEX, Appendix F) of an easily identifiable colour (e.g., orange). The marker layer is to extend 500 mm past the edge of the capping area with a minimum 200 mm overlap between rolls.

  Note: Where builders plastic is required beneath the building slab (e.g., if required by the structural engineer), this can be used as the marker layer in lieu of geofabric if preferred;

- Survey the location (GPS coordinates to within 100 mm of its true position) and height (AHD to within 50 mm of its true level) of the marker layer area to provide base levels for the cap. As a minimum, a survey point in the order of every 25 m^2 and every 5-10 m along the capping boundary (i.e., between different types of capped areas and where capping ceases) would generally be considered suitable. Additional survey points would be required for smaller areas. Survey locations and results are to be recorded on a site survey drawing;

- Construction of a hardstand capping layer over the marker layer comprising:
  - Building concrete slabs which are a minimum 100 mm thick; or
  - Pavements comprising a total 230 mm capping layer incorporating a minimum 80 mm thick pavement at the surface. Underlying the pavement and overlying the marker layer is to be a layer of clean natural soils and / or basecourse forming the remaining portion of the minimum 230 mm thick capping layer (e.g., This layer would be a minimum 150 mm thick where the surface pavement is 80 mm thick).

    DP understands that the surface pavements are currently proposed to comprise concrete, asphalt or permeable 80 mm Ecotrihex pavers. DP would consider these products appropriate for the above capping approach. Other pavement materials may be used subject to approval by the Environmental Consultant.

- Re-survey of the top of the finished cap at the same locations as the pre-cap survey to confirm the required cap thickness has been achieved for the respective area. If survey results indicate the required cap thickness has not been achieved, the cap non-conformance is to be rectified and re-surveyed. Survey locations and results are to be recorded on a site survey drawing and overlayed on a recent aerial photograph. The survey is also to indicate the nature of the cap for the relevant area (i.e., building slab, concrete, asphalt, pavers).

The general configuration of the hardstand cap over the asbestos impacted soils (or soils presumed to be impacted with asbestos) is shown on Drawings 4 and 5, Appendix A.

10.2.2 Soft Landscaping

The following general capping process is to be implemented for areas are to be capped by soft landscaping (approach to be confirmed based on the actual area requiring caping):

- Inspection of the surface by the Environmental Consultant to confirm the absence of signs of gross contamination of concern and observable asbestos;

- Placement of a marker layer at the surface comprising a non-woven durable geofabric of an easily identifiable colour (e.g., orange). The marker layer is to extend 500 mm past the edge of the capping area with a minimum 200 mm overlap between rolls. To assist with long term durability and site management placement of a double marker layer of the Jaybro mastaTEX (or a higher grade geofabric) in soft landscaping areas;

- Survey the location (GPS coordinates to within 100 mm of its true position) and height (AHD to within 50 mm of its true level) of the marker layer area to provide base levels for the cap. As a minimum, a survey point in the order of every 25 m^2 and every 5-10 m along the capping boundary (I.e., between different types of capped areas and where capping ceases) would generally be considered suitable. Additional survey points would be required for smaller areas. Survey locations and results are to be recorded on a site survey drawing. Survey locations and results are to be recorded on a site survey drawing;
- Construction of minimum 375 mm thick capping layer over the marker layer comprising:
  - A minimum 300 mm thick capping layer comprising topsoil over the marker layer; and
  - A 75 mm thick layer of mulch.

  Note: Alternate materials such as clean natural soils may be used from a contamination perspective. The mulch thickness can be commensurably reduced to the increased topsoil layer thickness (if undertaken); and
- Re-survey of the top of the finished capped at the same locations as the pre-cap survey to confirm the 375 mm thick cap has been achieved. If survey results indicate the 375 mm cap thickness has not been achieved, the cap non-conformance is to be rectified and re-surveyed. Survey locations and results are to be recorded on a site survey drawing and overlayed on a recent aerial photograph.

Tree Protection Zones

The following general capping process is to be implemented for areas that are to be capped by soft landscaping within tree protection zones (TPZs):

- Excavation limited to 100-150 mm depth using hand tools and not within 1 m of the trunk;
- Inspection of the surface by the Environmental Consultant to confirm the absence of signs of gross contamination of concern and observable asbestos;
- Placement of a marker layer at the surface comprising a non-woven durable geofabric of an easily identifiable colour (e.g., orange). The marker layer is to extend 500 mm past the edge of the TPZ, with a minimum 200 mm overlap between rolls. To assist with long term durability and site management placement of a double marker layer of the Jaybro mastaTEX (or a higher grade geofabric) in TPZ area;
- Survey the location (GPS co-ordinates to within 100 mm of its true position) and height (AHD to within 50 mm of its true level) of the marker layer area and boundary of the to provide base levels for the capping material in the TPZ. As a minimum, a survey point in the order of every 5-10 m^2 and every 2-5 m along the capping / TPZ edge would generally be considered suitable. Additional survey points would be required for smaller areas. Survey locations and results are to be recorded on a site survey drawing;
- Place a minimum 200 mm thick capping layer comprising natural soils over the marker layer;
- To minimise potential ponding of water at the base of the tree, fill (natural / topsoil) is not to be placed within 300 mm of the truck and graded up to final level at a grade of 3(H):1(V);
- Soil used in the TPZ is to be free draining;

- Where the minimum 200 mm natural soil layer is placed, 100 mm of a mulch mixture (comprising of woodchip and leaf mulch) is also to be placed above to make an overall capping thickness of 300 mm;
- Leaf mulch / woodchip (or similar) to be placed in the 300 mm area around base of trunk, but not mounded against the tree trunk, to cover the marker layer; and
- At the interface between mulch / woodchip areas and adjacent areas an identifiable marker (such as a plastic edging, for example a 90 mm x 40 mm Integrated Recycling CON920 plastic edge with a rectangular profile) is to be installed to delineate the two areas and assist with retention of mulch within the designated area.

The general configuration of the soft landscaping cap over the asbestos impacted soils (or soils presumed to be impacted with asbestos) is shown on Drawings 6 and 7, Appendix A.

10.3 Consolidation of Asbestos Impacted Soils

To potentially assist with management of soils during construction consideration may be given to consolidating the asbestos impacted soils, or part thereof, into one or several areas and placing this material under a cap. This may be particularly useful where natural soils (and in particular ASS) would be mixed with asbestos impacted soils as part of the construction process, such as during piling. The capping approach outlined in Section 10.2 would then be applied.

The process with respect to removal of the asbestos impacted soils from the areas of subsurface disturbance would entail the following general approach:

- Segregation of the asbestos impacted soils from the underlying natural soils and stockpiling;
- Inspection of the excavation area by the Environmental Consultant to confirm that all asbestos impacted soils (e.g., fill, natural soils mixed with the fill, etc.) has been removed and observable asbestos is not present on the surface;
- Collection of 500 mL surface samples and 10 L bulk samples for asbestos analysis at a minimum rate of three samples per sub-area and with reference to NSW EPA *Sampling Design* (Part 1- Application and Part 2- Interpretation) *Contaminated Land* Guidelines 2022 (NSW EPA, 2022), Western Australia Department of Health (2009), *'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia'*, 2009 (WA, 2009)and Western Australia Department of Health, *'Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*, 2021 (WA, 2021). Number of validation samples for the area to be confirmed by the Environmental Consultant following inspection;
- Laboratory analysis of 500 mL validation samples for asbestos fines/friable asbestos (AF/FA);
- Field sieve tests of the 10 L bulk sample for fragments of ACM and any other asbestos that may be observable to the naked eye;
- Confirmation that the site observations, field and laboratory tests have not recorded the presence of asbestos above laboratory reporting limits (LRL). If asbestos is identified, then additional soil is to be removed and the area re-validated as per the above process and at the direction of the Environmental Consultant; and

- Survey of the area subject to complete removal of asbestos impacted soils (and validation). A survey point in the order of every 25 m^2 and every 5-10 m along the remediated boundary would generally be considered suitable. Additional survey points would be required for smaller areas. Surveys are to be included on a site survey drawing and overlayed on a recent aerial photograph. The survey is to show the level of the area post remediation and boundary of the remediated area and where existing fill has been retained.

10.4 Off-Site Disposal

Whilst undertaking works through the cap, post cap installation, should be avoided where possible, there is always the potential need for minor works post completion of the main remediation capping works (e.g., service trench due to design change). In these circumstances, or where works are undertaken in small isolated areas, off-site disposal may be the more appropriate and preferred option. In this regard, the remediation approach of off-site disposal (and associated works) should not be considered the primary remediation approach.

On removal of the asbestos impacted soils the area is the be inspected, validated, and surveyed as per the process outlined above in Section 10.3.

The fill material is to be stockpiled on geofabric, subject to final waste classification by the Environmental Consultant and then disposed of to an appropriately licensed waste facility. The stockpile should be placed in areas still to be remediated, and where possible not placed in areas where remediation has commenced (e.g., placement of the marker layer) or is complete (e.g., capping layer installed).

Following disposal of the stockpile the footprint of the stockpile is to be inspected by the Environmental Consultant and surface sampling undertaken if deemed to be required. The need for sampling is anticipated to be informed by a number of factors *inter alia* location the stockpile was placed, ground the stockpile was placed (e.g., on soil, concrete, asphalt, etc.), the integrity of the geofabric layer post stockpile removal, etc.

Prior to disposing materials off-site approval is to be sought from and provided by the NSW Department of Education.

10.5 Validation of Areas East of BH07 and BH09

Asbestos has not been detected in previous sample locations within the prosed work area to the east of BH07 and BH09. Given the current results, subsurface disturbance works in this area are not currently required to be subject to remediation, however, validation sampling of said work area(s) would be required to confirm this approach.

The validation process for this area subject to subsurface disturbance would comprise the following general approach:

- Inspection of the subject area by the Environmental Consultant to confirm that all observable asbestos is not present on the surface;

- Collection of 500 mL surface samples and 10 L bulk samples for asbestos analysis at a minimum rate of three samples per sub-area and with reference to NSW EPA (2022), WA (2009) and WA (2021). Number of validation samples for the area to be confirmed by the Environmental Consultant following inspection;
- Laboratory analysis of 500 mL validation samples for AF/FA;
- Field sieve tests of the 10 L bulk sample for fragments of ACM and any other asbestos that may be observable to the naked eye; and
- Confirmation that the site observations, field and laboratory tests have not recorded the presence of asbestos above LRL.

If asbestos is identified, then the remediation/mitigation approach(es) outlined in the preceding sections are to be applied.

As indicated previously, an alternate to the above validation process would be to apply remediation/mitigation approach(es) outlined in the preceding sections to areas of subsurface disturbance from the commencement of works.

11. Remediation Acceptance Criteria

The remediation criteria for asbestos impacted soils, based on consultation with NSW Department of Education, is as follows.

Table 2: Remediation Acceptance Criteria

Remediation Strategy	Remediation Acceptance Criteria
Cap and contain asbestos impacted soils.	The RAC is for the cap to meet the nominated design thickness (refer to Section 10) over the easily identifiable (e.g., orange) geofabric marker layer (or suitable alternative where appropriate, e.g., builder plastic under slabs). Materials used in the cap (excluding concrete and pavement materials) to meet the RAC for common contaminants as outlined in Table G1, Appendix G.
Excavation of asbestos impacted soils for consolidation on site.	The RAC for the base of the excavation is to reach natural soils and be free of asbestos, and for the sides of the excavation to be free of asbestos or subject to capping. Asbestos impacted soils to be placed under cap and the RAC outlined in the aforementioned cap approach then applied to this material.
Excavation of asbestos impacted soils for off-site disposal.	The RAC for the base of the excavation to reach natural soils and be free of asbestos, and for the sides of the excavation to be free of asbestos or subject to capping.

Note: Free of asbestos refers to no observable asbestos at the surface or detections of asbestos within field tests (e.g., 10 L sieve validation tests) or laboratory analysis (e.g., AF/FA validation samples).

In the absence of derivation of Tier 2 site specific target levels, the RAC for contaminants in soil are the same as the Tier 1 SAC adopted for DP (2022), protective of human health and ecology. The RAC for common contaminants is summarised in Table G1, Appendix G. Reference should be made to DP (2022) for further information on how the RAC (based on the SAC) was generated. If other COPC not listed in Table G1 are identified during works, the Environmental Consultant is to generate screening criteria for the subject contaminant with reference to relevant guidance.

The RAC also applies to works under the contingency plan, unexpected find protocol and asbestos finds protocol (Appendix H) and for assessing suitability of imported materials from a contamination perspective.

Moreover, Appendix G (and as summarised in Table G1) also provides a screening criteria for assessing virgin excavated natural material (VENM).

12. Validation Plan

12.1 Data Quality Objectives

The data quality objectives (DQO) for the validation plan are included in Appendix H.

12.2 Validation Assessment Requirements

The following site validation work will be required:

- Field assessment by the Environmental Consultant comprising:
  - Visual inspection, including taking photographs for record purposes;
  - Collecting validation samples from excavations resulting from the removal of contaminated soils;
  - Collecting validation / characterisation samples for materials to be re-used on site;
  - Assessment of the suitability of imported materials proposed for use as part of the cap; and
  - Suitability of the capping being constructed.
- Surveying by the Surveyor comprising:
  - Survey of the extent and levels of the base of the excavations;
  - Survey of the extent and levels of the top of the marker layer; and
  - Survey of the extent and levels of the top of the capping layer (including identifying the different types of capping, e.g., building slabs, pavements, landscaping, TPZ, etc.).
- Laboratory analysis of validation samples at a NATA accredited laboratory for:
  - The COPC relevant to the remediation area; and
  - Quality control (QC) samples in accordance with Section 15.
- Comparison by the Environmental Consultant of the laboratory results with the RAC as appropriate (refer to Section 11); and

- Preparation by the Environmental Consultant of a validation report detailing the methods and results of the remediation works and validation assessment.

12.3 Visual Inspections

All areas to be assessed and validated are to be first subject to a visual inspection by the Environmental Consultant. The Environmental Consultant is to conduct periodic site inspections during each phase of the remediation works (and when any issue of concern is identified). It is foreseen these periodic inspections would be undertaken at the following times:

- Following clearance of the demolition area(s) by the Occupational Hygienist;
- During installation of the marker layer over the asbestos impacted soils;
- During import and placement of soils (or building slab construction, as appropriate) for the capping layer;
- During excavation of asbestos impacted soils (if undertaken);
- When an unexpected find or asbestos find (in areas not anticipated) occurs; and
- Post completion of the works.

A record of the inspections and observations is to be provided as part of the validation assessment report. This is to include a photographic record.

When visually inspecting areas for the presence of asbestos (e.g., prior to marker layer placement), this is to be undertaken on a 3 m x 3 m cross grid pattern to confirm the absence of any visible asbestos at the surface.

12.4 Validation Sampling

The sampling frequency will depend on the volume or area to be assessed and the previous results. The following approximate sampling frequencies are to be adopted but may be modified by the Environmental Consultant to take into account previous results, where applicable.

Small to medium excavations (base <500 m^2):

- Base of excavation: One sample per 25 m^2 to 100 m^2, with a minimum of three samples collected; and
- Sides of excavation: One sample per 10 m to 20 m length or part thereof with a minimum of one sample per wall. Additional samples to be collected at depths of concern where there is more than one depth of concern, with a minimum of one sample per 1.5 m depth.

Large excavations (base ≥500 m^2):

- Base of excavation: Sampling on a grid at a density in accordance with NSW EPA (2022) and a minimum of five samples. In sub-areas with any specific signs of concern, a higher sampling density may be required; and

- Sides of excavation: One sample per 20 m length or part thereof with a minimum of one sample per wall. Additional samples to be collected at depths of concern where there is more than one depth of concern, with a minimum of one sample per 1.5 m depth.

Where contaminated soils are stored or treated on bare soils (not proposed for areas still subject to remediation), the footprint of the stockpile will require validation following removal of the contaminated soils.

Validation samples are to be analysed by a NATA accredited laboratory for the relevant COPC relevant to the remediation area.

Validation sample test results to be compared to the RAC, as per the DQO (Appendix I). Where the RAC is considered to have not been met, the remediation excavation(s) is to be expanded to 'chase-out' impacted material, or an alternate remediation approach adopted for the subject area (e.g., capping) as instructed by the Environmental Consultant. Validation sampling is to continue into the extended excavation or capping validation requirements are to apply. This process is to continue until the impacted material has been appropriately remediated/mitigated.

13. Waste Disposal

Any waste disposed off-site must be initially classified by the Environmental Consultant in accordance with:

- NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA, 2014a);
- NSW EPA *Waste Classification Guidelines, Part 2: Immobilisation of Waste* (NSW EPA, 2014b);
- NSW EPA *Waste Classification Guidelines, Part 4: Acid Sulfate Soils* (NSW EPA, 2014c); and
- NSW EPA *Addendum to the Waste Classification Guidelines (2014) - Part 1: Classifying Waste* (NSW EPA, 2016) [addendum for per- and poly-fluoroalkyl substances (PFAS)].

Disposal of waste must be to an appropriately licensed waste facility, as per *Protection of the Environment Operations Act 1997* NSW (POEO Act) and the *Protection of the Environment (Waste) Regulation 2014* NSW.

Samples are to be collected from stockpiles and / or *in situ* soils at various depths to characterise the full depth of the material. The frequency is to be determined by the Environmental Consultant based on the risk of contamination and heterogeneity of the material.

The suggested sampling frequency for the initial assessment of stockpiles comprising similar materials shall be:

- One sample per 25 m^3 for stockpiles up to 250 m^3, with a minimum of three per stockpile; and
- One sample per 50 m^3 to 100 m^3 for stockpiles greater than 250 m^3, by applying statistical analysis with reference to NSW EPA (2022).

All waste must be tracked by the Remediation Contractor from 'cradle to grave'. Copies of all consignment notes / disposal dockets (or similar) and Environment Protection Licences for receipt and disposal of the materials must be maintained by the Remediation Contractor as part of the site log and must be provided to the Principal Contractor and Environmental Consultant for inclusion in the validation report.

14. Imported Material

Any imported material (including soil, aggregate, etc.) for the remediation works must have contaminant concentrations that meet the relevant criteria outlined in Table G1, Appendix G and have no aesthetic issues of concern. Imported materials is only to be accepted for use if:

- It can legally be accepted onto the site (e.g., classified as VENM), accompanied by a report / certificate prepared by a qualified environmental consultant);
- Visual inspection of the imported soil confirms that the soil has no signs of concern and is consistent with those described in the supporting classification documentation; and
- The materials are validated (by inspection / sampling) by the Environmental Consultant as being suitable for use at the site.

The classification report / certificate for all material proposed for import must be reviewed and approved in writing by the Environmental Consultant prior to import. Materials to be imported may need to meet geotechnical requirements which are to be assessed by others, as required.

If permitted by the development consent and approved by the Principal's Representative, Principal Contractor, Remediation Contractor and Environmental Consultant, material classified under a NSW EPA Resource Recovery Order (RRO) may also be accepted, provided the material can be used on site in accordance with the corresponding Resource Recovery Exemption (RRE).

Any soils (including topsoil and aggregate) imported are to be classified as VENM, be quarried natural material, or must be compliant with an appropriate RRO. All imported material classifications are to be supported by the relevant chemical and physical testing results and at a minimum include analysis for heavy metals, TRH, BTEX, PAH, PCB[13] and asbestos. In this regard, materials imported under an RRO are, in addition to the preceding, also to be compliant with the relevant resource recovery testing requirements and criteria (RRC). Furthermore, results are to be compared against the RAC where applicable. Note, where there is a difference between the RAC and the RRC, the more conservative criteria is to be adopted.

VENM is to be sampled for each source site at a minimum rate of three samples for the first 1,000 m^3 and then one sample per 1,000 m^3 thereafter.

VENM (and excavated natural material (ENM)) reports should include information on the source site's location, history and the potential for contamination (e.g., review of aerial photographs, previous contamination reports and EPA online database), a list of COPC, reasoning for the sampling and analysis approach undertaken, description and photographs of the material assessed (and associated drawing where required) and a determination of the soil's classification.

[13] Minimum PCB analysis requirement not applicable to VENM or quarried materials.

Table G1, Appendix G (and with reference to Section 11) also provides screening criteria for VENM that is to be adopted for imported VENM.

The material must be inspected during importation by the Remediation Contractor, and any materials not meeting the description given in the provided documentation or displaying signs of contamination are to be rejected. The Environmental Consultant is to conduct periodic inspection(s) during and / or following importation to check the same. Additional testing of the imported material may be required, as recommended by the Environmental Consultant, commensurate with the documentation and the material type / classification.

DP notes that generally materials imported under a RRO present a higher contamination risk, hence, extra caution should be used if proposing to use a recycled product.

15. Quality Assurance and Quality Control

Field quality assurance and quality control (QA/QC) testing is to include the following:

- Replicate samples analysed at a rate of 10% of primary samples subject to chemical analysis. This comprising:
  - 5% sample intra-laboratory analysis for the primary COPC that the primary sample has been analysed for; and
  - 5% sample inter-laboratory analysis for the primary COPC that the primary sample has been analysed for.

  Note: Replicate samples for primary samples subject to only asbestos analysis to be at the discretion of the Environmental Consultant;
- Rinsate sample per phase of sampling where re-useable sampling equipment is used. Sample to be analysed for metals, BTEX and TRH; and
- Trip spike and trip blank samples per phase of sampling and where volatile or semi-volatile contaminants are being analysed. Samples to be analysed for BTEX.

All laboratory analysis is to be undertaken by the laboratory in accordance with its NATA accreditation, including in-house QA / QC procedures. It is noted that AF/FA and 10 L bulk sample asbestos analysis as per NEPC (2013) are not NATA accredited tests and hence are exempt from this NATA requirement.

The QC analytical results will be assessed using the following criteria:

- Sampling location rationale met the sampling objective;
- Standard operating procedures are followed;
- Appropriate QA / QC samples are collected / prepared and analysed;
- Samples are stored under secure, temperature-controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory;
- Conformance with specified holding times;

- Accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);
- Field and laboratory replicate samples will have a precision average of +/- 30% relative percentage difference (RPD); and
- Rinsate samples showing that the sampling equipment (if used) is free of introduced contaminants, i.e., the analytes show that the rinsate sample is within the normal range for deionised water.

16. Management and Responsibilities

16.1 Site Management Plan

A general site management plan for the operational phase of site remediation is included in Appendix J. The management plan includes general comments soil, noise, dust, work health safety, remediation schedule, hours of operation and incident response. The Remediation Contractor is to implement the general site management plan for the duration of remedial works by incorporating the plan into their over-arching CEMP.

16.2 Site Responsibilities

The site management plan (Appendix H) provides a summary of the general program management and associated responsibilities. Contact details for key utilities are also included in the event of needing to respond to any incidents.

16.3 Contingency Plan, Unexpected Finds Protocol and Asbestos Finds Protocol

Plans for contingency situations (e.g., encountering asbestos in soils where not previously identified), along with an unexpected finds protocol for dealing with unexpected finds during remediation work / earthworks, are included in Appendix H.

17. Validation Reporting

17.1 Documentation

The following documents are to be collated and reviewed by the Environmental Consultant as part of the validation assessment (including those items that are prepared by the Environmental Consultant):

- Any licences and approvals required for the remediation works;
- Waste classification report(s);

- Transportation Record: comprising a record of all truck-loads of soil (including aggregate) entering the site, including truck identification (e.g., registration number), date, time, source site, load characteristics (e.g., type of material, i.e., quarried aggregate, etc.), approximate volume, use (e.g., general site raising, service trenches, etc.);
- Disposal dockets: for any soil disposed off-site. The Remediation Contractor is to supply records of: transportation records, spoil source, spoil disposal location, receipt provided by the receiving waste facility / site. Note: A record of the building materials disposed off-site is also be kept and provided to the Principal, on request;
- Imported materials records: records for any soil imported onto the site, including source site, classification reports, volume / weight of each load, inspection records of soil upon receipt at site and transportation records;
- Product data sheets and delivery records (e.g., geofabric);
- Letters / memos as required to provide instruction or information to the relevant contractor;
- Records relating to any unexpected finds and contingency plans implemented;
- Laboratory certificates and chain-of-custody documentation;
- Inspections records from the Environmental Consultant (and Occupation Hygienist, where appropriate);
- Photographic records by all contractors and consultants of the works undertaken within their purview of responsibilities;
- Surveys pre- and post-installation of geotextile marker layer and cap and overlay of surveys on a recent aerial photograph;
- Airborne asbestos monitoring records; and
- Interim / final visual and sampling clearances for any asbestos related works.

Note: For all interim and final asbestos clearance reports, these are to also include a drawing(s) and photographs of the areas inspected / cleared.

17.2 Reporting

A validation assessment report is to be prepared by the Environmental Consultant with reference to NSW EPA (2020).

The validation report shall describe the remediation approach adopted, methodology, results and conclusion of the assessment and make a statement regarding the suitability of the areas subject to remediation for their proposed continued use as a primary school. It is also to provide details of any ongoing environmental management (i.e., an LTEMP or updated of the school's existing AMP) which is required in order to maintain the remediation mitigation measures.

It is noted that the report is to address the areas that require remediation validation sign-off, it is not intended to cover the whole school. In this regard, and as noted in Section 8, it will be important prior to commencing works the areas subject to remediation validation sign-off are agreed between the NSW Department of Education, Principal Contractor and the Environmental Consultant.

18. Conclusions

It is considered that the areas subject to remediation as part of the NNPS upgrade works can be rendered suitable for their continued use as a primary school subject to appropriate remediation, management, and validation in accordance with this RAP.

The success of the remediation is to be validated and reported as outlined herein.

If there are any proposed changes to the remediation approach outlined herein due to the results of the building footprint investigation or other reasons (e.g., changes in development, construction process, site observations, etc.), this RAP must be updated in consultation with the relevant parties. Moreover, prior to commencing works the area of remediation based on the final proposed works is to be agreed[14] between the NSW Department of Education, Principal Contractor and the Environmental Consultant.

19. Future Requirements - Environmental Management Plan

On completion of the works development of a LTEMP or update to the school's existing AMP is to be undertaken. This is to outline the management practices to be implemented to prevent damage or degradation of the capping layer and hence protect its integrity. It is also to outline processes to repair and make good the capping layer in the event of planned or inadvertent breaches such that related risks are mitigated and that any potential exposure of the contaminated soils to site users is minimised.

Requirement of LTEMP's are referenced in the NSW EPA Practice Note *Preparing Environmental Management Plans for Contamination Land* (EPA, 2022). As the LTEMP / updated AMP will be superseding the schools existing AMP, its implementation, enforcement and public notification are proposed to be through existing mechanisms, *viz.* managed, implemented and publicly notified by the NSW Department of Education.

20. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Narrabeen Education Precinct, Namona Street, Narrabeen in accordance with DP's proposal dated 23 June 2022 and acceptance received from Johnstaff Projects Pty Ltd on behalf of NSW Department of Education. The work was carried out as a variation to the Standard Form Agreement SINSW02795/21 dated 7 April 2022 agreed between DP and NSW Department of Education. This report is provided for the exclusive use of NSW Department of Education for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents. DP's interpretations and conclusions are based on the information provided being accurate. DP cannot be held liable for these interpretations and conclusions where the information provided is not accurate.

[14] In the form of an addendum to this RAP.

This RAP has been prepared based on the results of previous investigations at the site and the proposed works. Should site conditions encountered during works differ from those currently understood and as outlined in this report, the proposed works be altered and/or the remedial approach amended without DP's knowledge and agreement, this RAP would no longer be valid for remediation of the site.

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

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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

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

Douglas Partners Pty Ltd

Appendix A

Drawings

LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Boundaries shown are approximate only

Legend
- Site Boundaries
- NNPS Proposed Work Area
- NSHS Proposed Work Area

0 50 100 150 200 m

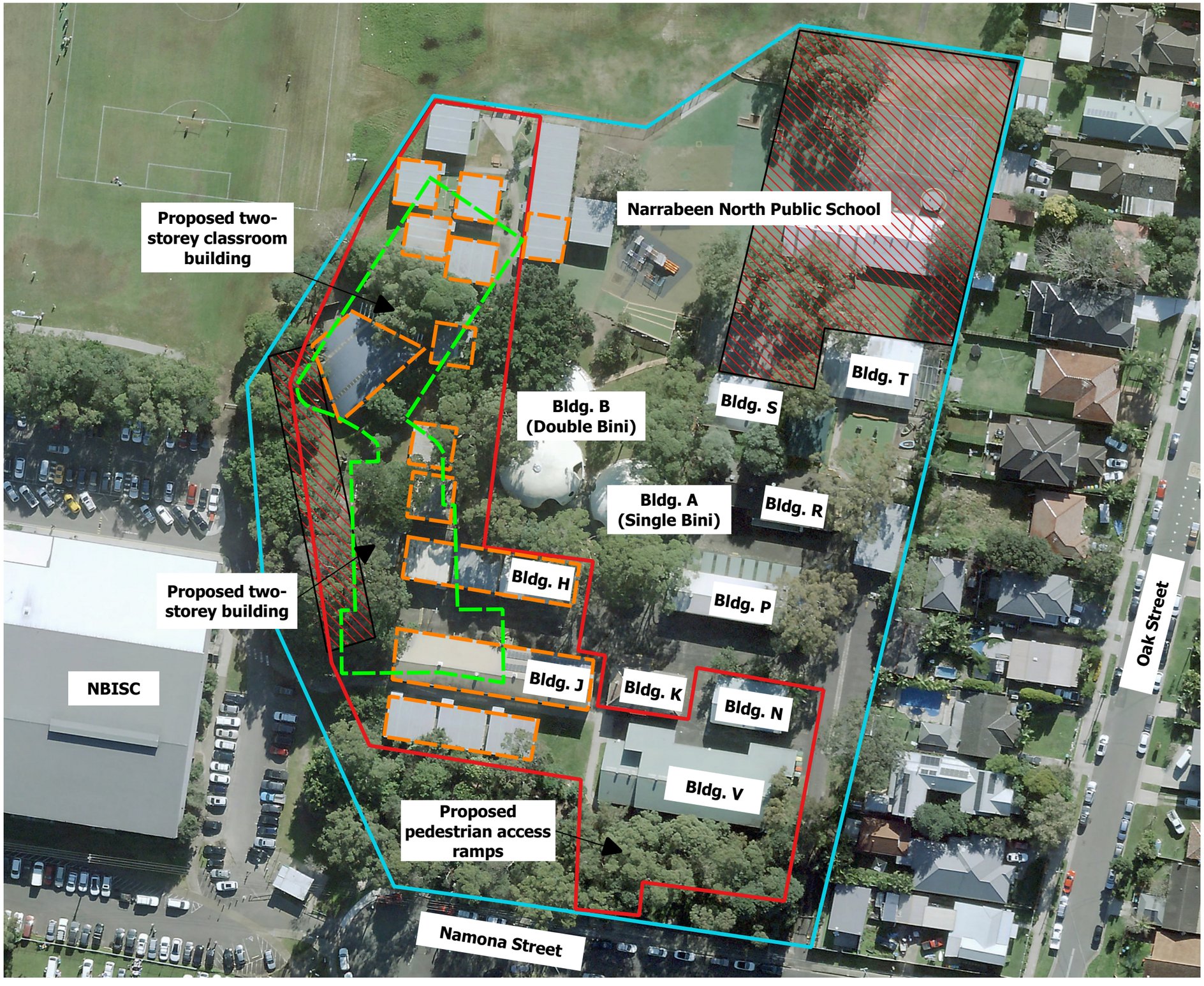
Douglas Partners
Geotechnics / Environment / Groundwater

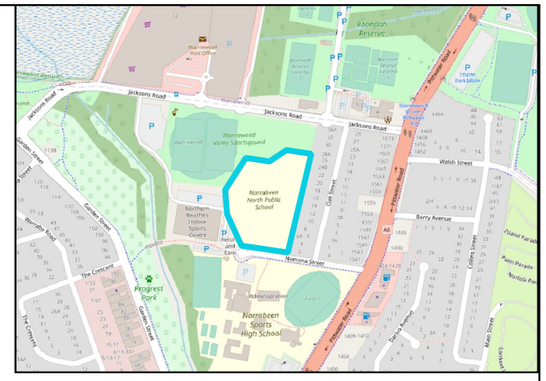
CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:3000 @ A3	DATE:	10.08.2022

TITLE: **Site Overview**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	1
REVISION:	0





LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Boundaries shown are approximate only
4. NNPS AMP Asbestos Zones were sourced from Figure 1 of the AMP and are approximate only

Legend
- Narrabeen North Public School
- Proposed Work Area
- NNPS AMP Asbestos Zones
- Buildings Proposed for Demolition
- Proposed Buildings

0 20 40 60 m

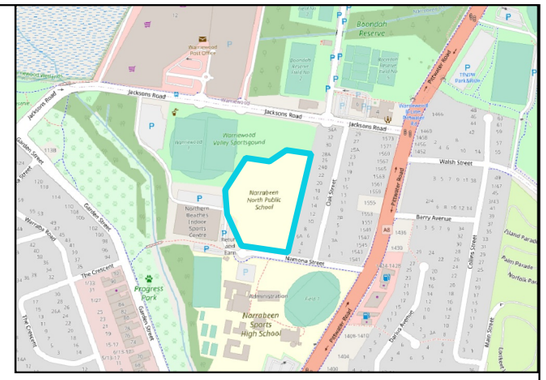
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:850 @ A3	DATE:	11.08.2022

TITLE: **Site Location Plan - Narrabeen North Public School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	2
REVISION:	0



LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Test locations and boundaries shown are approximate only
4. NNPS AMP Asbestos Zones were sourced from Figure 1 of the AMP and are approximate only
5. CPTs were also undertaken at some borehole locations

Legend

- Narrabeen North Public School
- Proposed Work Area
- NNPS AMP Asbestos Zones
- Buildings Proposed for Demolition
- Proposed Buildings

Test Locations (DP, 2022)

- Borehole
- Test Pit
- Surface Sample
- Fragment of Potential Asbestos Containing Material (PACM)

Previous Test Locations (DP, 2020)

- Groundwater Monitoring Well
- Borehole
- CPT Only

0 20 40 60 m

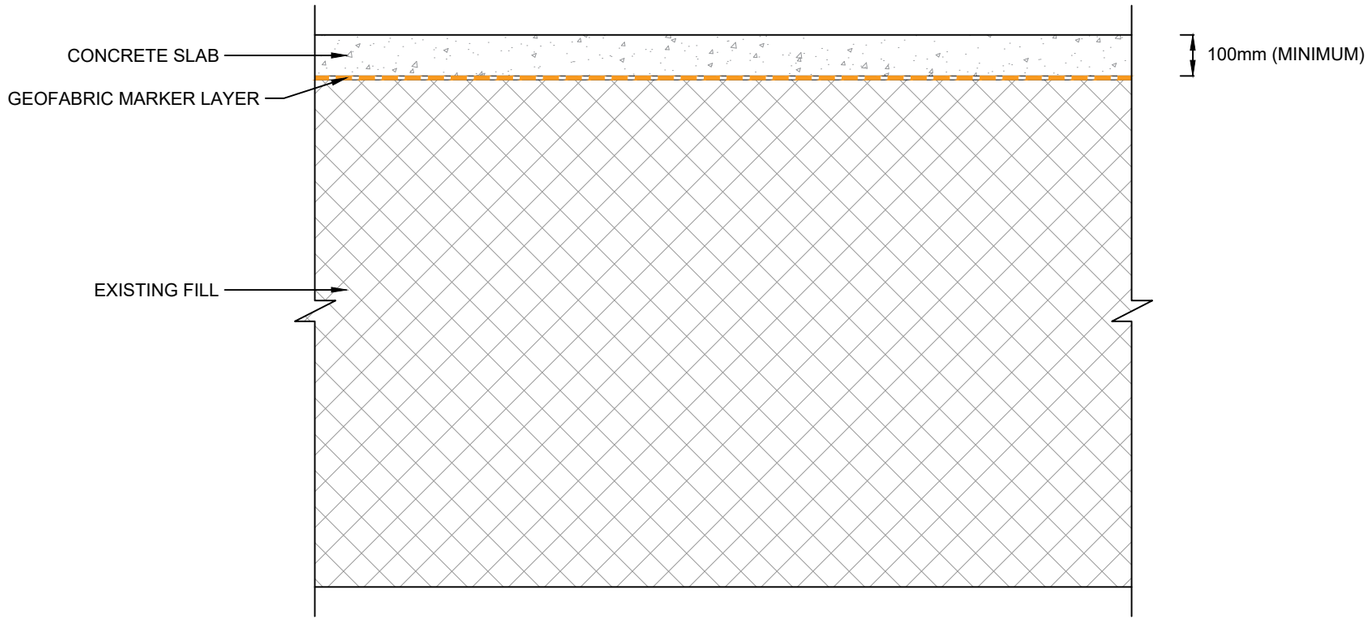
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:850 @ A3	DATE:	10.08.2022

TITLE: **Test Locations - Narrabeen North Public School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

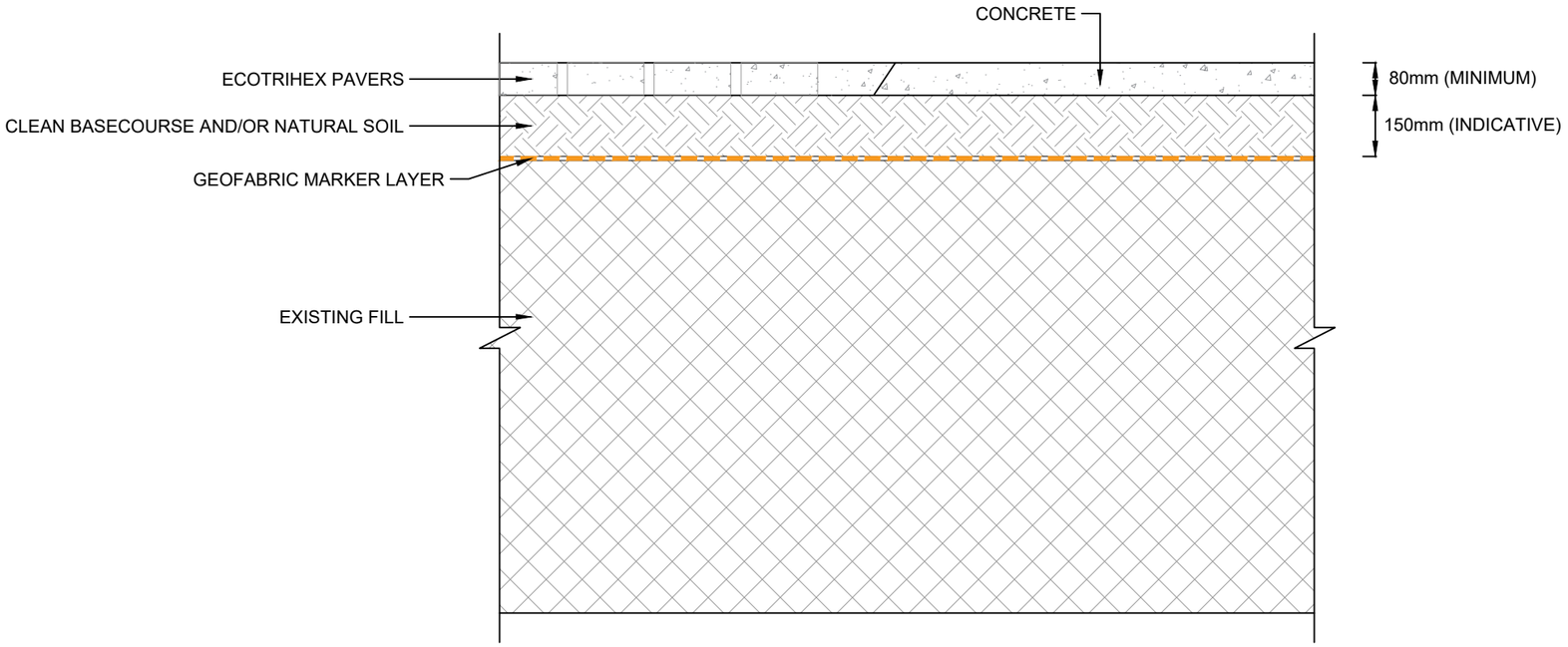
PROJECT No:	86973.04
DRAWING No:	3
REVISION:	0



CAPPING STRATEGY - BUILDING SLABS

NOTES:
1. Drawings are not for construction purposes.
2. Designs are indicative only and may be updated and amended based on the final design works.
3. Alternate products may be used to those examples indicated in the final design if confirmed to be suitable by the Environmental Consultant.
4. Maximising the thickness of the capping layer should be considered where possible to allow flexibility in design and during works.
5. Specific requirements from other disciplines (e.g. structural, civil, geotechnical, services, landscape, arborist, etc.) should be considered when developing final design.
6. Requirements of the building slab to be confirmed by structural engineer.
7. Building plastic may be used as an alternate marker layer to the geofabric.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: NSW Department of Education	TITLE: **Capping Strategy - Building Slabs** **Narrabeen North Public School, Narrabeen Education Precinct** **Namona Street, Narrabeen**	PROJECT No: 86973.04
	OFFICE: Sydney / DRAWN BY: MG		DRAWING No: 4
	SCALE: NTS / DATE: 25.08.2022		REVISION: 1

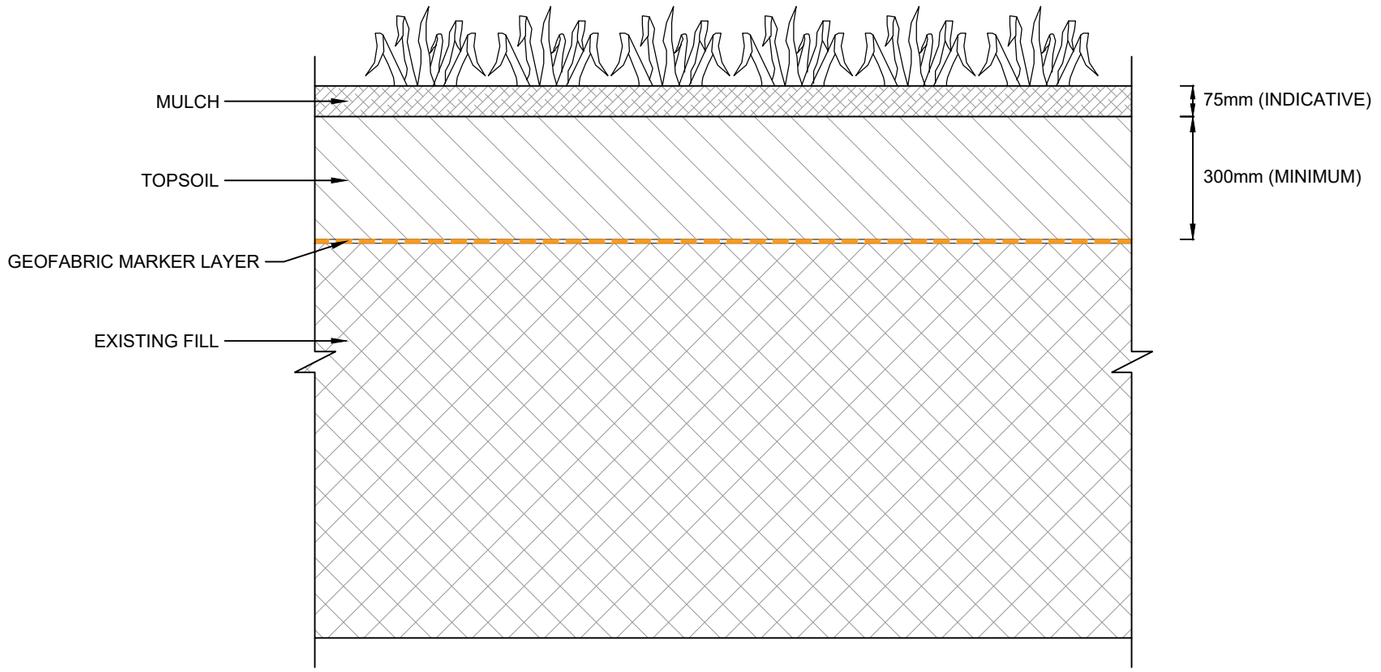


CAPPING STRATEGY - PAVEMENTS

NOTES:

1. Drawings are not for construction purposes.
2. Designs are indicative only and may be updated and amended based on the final design works.
3. Alternate products may be used to those examples indicated in the final design if confirmed to be suitable by the Environmental Consultant.
4. Maximising the thickness of the capping layer should be considered where possible to allow flexibility in design and during works.
5. Specific requirements from other disciplines (e.g. structural, civil, geotechnical, services, landscape, arborist, etc.) should be considered when developing final design.
6. Requirements of the pavement design to be confirmed by the civil engineer and landscape consultant.
7. Total capping thickness to be a minimum 230 mm, with pavement forming a minimum 80 mm. An increase in the pavement thickness may allow for a commensurate reduction in the thickness of the underlying clean basecourse/natural soil layer.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: NSW Department of Education	TITLE: **Capping Strategy - Pavements** **Narrabeen North Public School, Narrabeen Education Precinct** **Namona Street, Narrabeen**	PROJECT No: 86973.04
	OFFICE: Sydney / DRAWN BY: MG		DRAWING No: 5
	SCALE: NTS / DATE: 25.08.2022		REVISION: 1

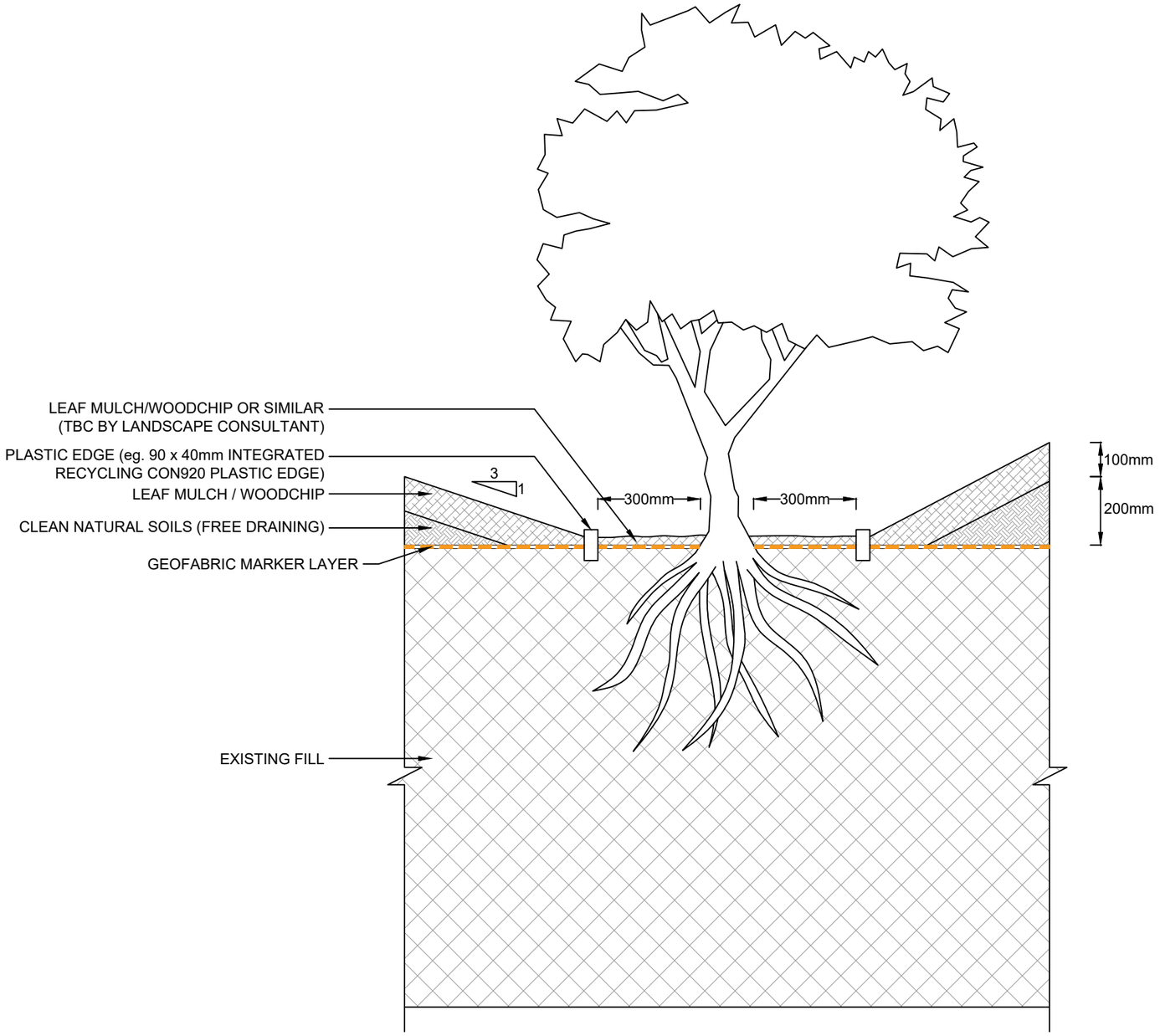


CAPPING STRATEGY - SOFT LANDSCAPING

NOTES:

1. Drawings are not for construction purposes.
2. Designs are indicative only and may be updated and amended based on the final design works.
3. Alternate products may be used to those examples indicated in the final design if confirmed to be suitable by the Environmental Consultant.
4. Maximising the thickness of the capping layer should be considered where possible to allow flexibility in design and during works.
5. Specific requirements from other disciplines (e.g. structural, civil, geotechnical, services, landscape, arborist, etc.) should be considered when developing final design.
6. Requirements of the landscape design to be confirmed by the landscape consultant and arborist (where required).
7. Total capping thickness to be a minimum 375 mm, including a minimum 300 mm thick layer of topsoil. Clean natural soils may be used in lieu of topsoil from a contaminated land remediation perspective.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: NSW Department of Education	TITLE: **Capping Strategy - Soft Landscaping** **Narrabeen North Public School, Narrabeen Education Precinct** **Namona Street, Narrabeen**	PROJECT No: 86973.04
	OFFICE: Sydney / DRAWN BY: MG		DRAWING No: 6
	SCALE: NTS / DATE: 25.08.2022		REVISION: 1



NOTES:

1. Drawings are not for construction purposes.
2. Designs are indicative only and may be updated and amended based on the final design works.
3. Alternate products may be used to those examples indicated in the final design if confirmed to be suitable by the Environmental Consultant.
4. Maximising the thickness of the capping layer should be considered where possible to allow flexibility in design and during works.
5. Specific requirements from other disciplines (e.g. structural, civil, geotechnical, services, landscape, arborist, etc.) should be considered when developing final design.
6. Requirements of the landscape design to be confirmed by the landscape consultant and arborist.
7. If required, existing fill greater than 1 m from trunk may be removed using hand tools to 100-150 mm deep. This is to be undertaken in consultation with the arborist.
8. Works within the TPZ may need to be supervised by the arborist. To be confirmed by the arborist.

CAPPING STRATEGY - TREE PROTECTION ZONES

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: NSW Department of Education		TITLE: **Capping Strategy - Tree Protection Zones**	PROJECT No: 86973.04
OFFICE: Sydney	DRAWN BY: MG	**Narrabeen North Public School, Narrabeen Education Precinct**	DRAWING No: 7
SCALE: NTS	DATE: 25.08.2022	**Namona Street, Narrabeen**	REVISION: 1

Appendix B

About this Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Appendix C

Borehole and Test Pit Logs

Appendix C1

DP (2022)

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342193.1
NORTHING: 6269969.1

PIT No: TP1001
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
4	0.0	FILL/Silty SAND: fine to medium, grey-brown, trace charcoal and asphalt fragments, moist		E	0.0		PID < 1 ppm		
	0.2				0.2				
	0.3	Pit discontinued at 0.3m Possible service encountered							
3	1								1
2	2								2
1	3								3
0	4								4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.1 AHD
EASTING: 342188.6
NORTHING: 6269974

PIT No: TP1001A
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
					0.0		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, moist		E*					
	0.2				0.2		PID < 1 ppm		
		FILL/SAND: fine to medium, grey-brown, trace clay, brick, tile, plastic, concrete and asbestos containing material, moist		E	0.3				
					0.8		PID < 1 ppm		
	0.9			E	0.9				
		SAND SP: fine to medium, pale grey, with nodules of indurated brown sand, silt and clay (coffee rock), moist, alluvial and estuarine							
		Below 1.1 m: brown, with silt, trace clay			1.3		PID < 1 ppm		
				E	1.4				
					1.8		PID < 1 ppm		
				E	1.9				
		Below 2.1 m: wet						▼	
					2.2				
	2.3			E	2.3				
		Pit discontinued at 2.3m Test pit collapse							

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 2.1 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD10/20220419 taken from 0-0.2 m.

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342206.6
NORTHING: 6269964.3
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4.6	0.01	MULCH							
		FILL/Silty SAND: fine to medium, dark grey-brown, trace rootlets and charcoal, moist		E	0.1 0.2		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.5 0.6		PID < 1 ppm		
		Below 0.7 m: pale grey							
	1			E	1.0 1.1		PID < 1 ppm		1
		Below 1.3 m: brown, with silt, trace clay							
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342186.9
NORTHING: 6269942.3

PIT No: TP1003
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILL/Silty SAND: fine to medium, grey-brown, trace charcoal, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/Silty SAND: fine to medium, grey-brown, moist			0.2				
				E	0.3		PID < 1 ppm		
					0.4				
	0.5	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine							
				E	0.7		PID < 1 ppm		
					0.8				
		Below 0.9 m: with nodules of indurated brown sand, silt and clay (coffee rock)							
				E*	1.1		PID < 1 ppm		
					1.2				
	1.4	Pit discontinued at 1.4m Target depth reached							

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD1/20220413 taken from 1.1-1.2 m.

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342207.9
NORTHING: 6269937.9
DIP/AZIMUTH: 90°/--

BORE No: BH1004
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, brown, angular to subangular igneous gravel, with silt, moist		E	0.2		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, brown, trace rootlets, moist			0.3				
4	0.7	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine		E	0.8		PID < 1 ppm		
	1	Below 1.0 m: pale yellow-grey			0.9				1
		Below 1.2 m: with nodules of indurated brown sand, silt and clay (coffee rock)		E	1.3		PID < 1 ppm		
3					1.4				
	2			E	1.8				2
					1.9				
				E	2.3				
	2.5	Bore discontinued at 2.5m			2.4				
2		Target depth reached							
	3								3
1									
	4								4
0									

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 2.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342175.1
NORTHING: 6269928

PIT No: TP1005
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, grey-brown, trace rootlets, moist		E	0.0		PID < 1 ppm		
	0.2	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine			0.2				
				E	0.5		PID < 1 ppm		
					0.6				
	1.0			E	1.0		PID < 1 ppm		
					1.1				
				E	1.5				
					1.6				
	2.0			E	2.0				
	2.1	Pit discontinued at 2.1m Test pit collapse			2.1				

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.8 AHD
EASTING: 342196.8
NORTHING: 6269922.8
DIP/AZIMUTH: 90°/--

BORE No: BH1006
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	MULCH							
		FILL/Silty SAND: fine to medium, dark grey-brown, moist		E	0.1 0.2		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
				E*	1.1 1.2		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD2/20220413 taken from 1.1-1.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342176.3
NORTHING: 6269912.9

PIT No: TP1007
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
4		FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace plastic fragments and asbestos containing material, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
		Below 0.5 m: pale grey, reducing silt		E	0.5		PID < 1 ppm		
					0.6				
3	1			E	1.0		PID < 1 ppm		1
					1.1				
	1.5	Pit discontinued at 1.5m Target depth reached							
2	2								2
1	3								3
0	4								4

5 10 15 20

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

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

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.0 AHD
EASTING: 342178
NORTHING: 6269895.4

PIT No: TP1008
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace asbestos containing material, moist		E	0.0		PID < 1 ppm		
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.2				
				E	0.5		PID < 1 ppm		
					0.6				
	1	Below 0.9 m: with nodules of indurated brown sand, silt and clay (coffee rock)		E	1.0		PID < 1 ppm		1
					1.1			▼	
		Below 1.4 m: wet		E	1.5				
					1.6				
	2			E	2.0				2
					2.1				
				E	2.5				
	2.6	Pit discontinued at 2.6m Test pit collapse			2.6				
	3								3
	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.4 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342203.6
NORTHING: 6269898.5
DIP/AZIMUTH: 90°/--

BORE No: BH1009
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.025	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt, angular to subangular igneous gravel, moist		E*	0.2 0.3		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, dark grey, trace fine igneous gravel, moist							
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.7 0.8		PID < 1 ppm		
	1	Below 1.0 m: reducing silt		E	1.2 1.3		PID < 1 ppm		
				E	1.8 1.9				
	2	2.0 Bore discontinued at 2.0m Target depth reached							
	3								
	4								

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 2.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD3/20220414 taken from 0.2-0.3 m.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342217.2
NORTHING: 6269905.9
DIP/AZIMUTH: 90°/--

BORE No: BH1010
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt, angular to subangular igneous gravel, moist		E	0.2 0.3		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, dark grey, trace fine igneous gravel, moist							
	0.6	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E*	0.7 0.8		PID < 1 ppm		
	1	Below 1.0 m: reducing silt							1
				E	1.2 1.3		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD4/20220414 taken from 0.7-0.8 m.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.5 AHD
EASTING: 342192.8
NORTHING: 6269875.6
DIP/AZIMUTH: 90°/--

BORE No: BH1011
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, moist, trace silt, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
	1.0	Bore discontinued at 1.0m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342210.4
NORTHING: 6269871.3
DIP/AZIMUTH: 90°/--

BORE No: BH1012
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID < 1 ppm		
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
	1.0	Bore discontinued at 1.0m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.1 AHD
EASTING: 342250.9
NORTHING: 6269886.1
DIP/AZIMUTH: 90°/--

BORE No: BH1013
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.2	FILL/Gravelly SAND: fine to coarse, grey-brown, fine to medium angular to subangular igneous gravel, with silt and asphalt, trace brick, moist		E	0.1 0.2		PID < 1 ppm		
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.3 0.4		PID < 1 ppm		
		Below 0.4 m: reducing silt							
	1.0	Bore discontinued at 1.0m Target depth reached		E	0.9 1.0		PID < 1 ppm		

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342264.8
NORTHING: 6269877.8
DIP/AZIMUTH: 90°/--

BORE No: BH1014
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID < 1 ppm		
	0.15	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt and asphalt, angular to subangular igneous gravel, moist			0.15				
		SAND SP: fine to medium, grey, with silt, moist, alluvial and estuarine		E	0.4		PID < 1 ppm		
		Below 0.5 m: trace silt			0.5				
				E*	0.9		PID < 1 ppm		
3	1.0	Bore discontinued at 1.0m Target depth reached			1.0				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD5/20220414 taken from 0.9-1.0 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342235
NORTHING: 6269851.8
DIP/AZIMUTH: 90°/--

BORE No: BH1015
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace roots, rootlets and terracotta fragments, moist		E*	0.0		PID < 1 ppm		
					0.2				
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E	0.6		PID < 1 ppm		
					0.7				
	1								1
				E	1.1		PID < 1 ppm		
					1.2				
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD6/20220414 taken from 0-0.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342237.1
NORTHING: 6269842.4
DIP/AZIMUTH: 90°/--

BORE No: BH1016
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace mulch, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E*	0.5		PID < 1 ppm		
					0.6				
	1			E	1.0		PID < 1 ppm		1
					1.1				
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD7/20220414 taken from 0.5-0.6 m.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342245.1
NORTHING: 6269856.7

PIT No: TP1017
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0				0.0				
		FILL/Silty SAND: fine to medium, brown, trace clay, rootlets and terracotta fragment, moist		E			PID < 1 ppm		
	0.2				0.2				
		FILL/Silty SAND: fine to medium, dark grey-brown, trace rootlets, moist			0.4		PID < 1 ppm		
				E	0.5				
	0.6								
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.9		PID < 1 ppm		
				E	1.0				
					1.4		PID < 1 ppm		
				E*					
	1.5				1.5				
		Pit discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD8/20220414 taken from 1.4-1.5 m.

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

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342256.8
NORTHING: 6269842.9

PIT No: TP1018
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E*	0.0		PID < 1 ppm		
					0.2				
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E	0.5		PID < 1 ppm		
					0.6				
		Below 0.8 m: pale grey							
3	1			E	1.0		PID < 1 ppm		1
					1.1				
		Below 1.2 m: trace nodules of indurated brown sand, silt and clay (coffee rock)							
				E	1.5				
					1.6				
2	2			E	2.0				2
	2.1	Pit discontinued at 2.1m			2.1				
		Test pit collapse							
1	3								3
0	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD9/20220414 taken from 0-0.2 m.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342172.1
NORTHING: 6269921.1

PIT No: TP1019
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
4									5 10 15 20
		FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, glass, brick, terracotta, concrete and plastic fragments, moist		E	0.0		PID < 1 ppm		
	0.2				0.2				
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.3		PID < 1 ppm		
					0.4				
		Below 0.6 m: pale grey							
				E	0.9		PID < 1 ppm		
3	1 1.0	Pit discontinued at 1.0m Target depth reached			1.0				1
	2								2
2									
	3								3
1									
	4								4
0									

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Approximate levels inferred from provided survey.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342180.1
NORTHING: 6269905.5

PIT No: TP1020
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, with silt, grey-brown, trace gravel, rootlets and slag, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
	0.7	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E	0.9		PID < 1 ppm		
	1				1.0				1
				E*	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Target depth reached			1.5				
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Approximate levels inferred from provided survey. *Blind replicate BD11/20220419 taken from 1.4-1.5 m.

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

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342237.3
NORTHING: 6269938.1
DIP/AZIMUTH: 90°/--

BORE No: BH1021
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist		E	0.1 0.2		PID < 1 ppm		
	0.25	Bore discontinued at 0.25m Refusal on gravel and geofabric							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 0.25 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 5.1 AHD
EASTING: 342242.5
NORTHING: 6269937
DIP/AZIMUTH: 90°/--

BORE No: BH1022
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
5		FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist			0.1				
		Below 0.1 m: trace rootlets		E	0.2		PID < 1 ppm		
					0.6				
				E			PID < 1 ppm		
	0.7	Bore discontinued at 0.7m			0.7				
4	1	Refusal on gravel and geofabric							1
	2								2
3	3								3
2	4								4
1									

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 0.7 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342240.5
NORTHING: 6269914.9
DIP/AZIMUTH: 90°/--

BORE No: BH1023
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	MULCH							
		FILL/Silty SAND: fine to medium, brown, trace rootlets and fine gravel, moist		E	0.1 0.2		PID < 1 ppm		
		Below 0.3 m: dark brown		E	0.4 0.5		PID < 1 ppm		
	0.7	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.9 1.0		PID < 1 ppm		
				E	1.4		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.4 AHD
EASTING: 342188.4
NORTHING: 6269990.3
DIP/AZIMUTH: 90°/--

BORE No: BH1024
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILL/Silty CLAY: medium to high plasticity, brown mottled red, trace ironstone, rootlets and fine igneous gravel, w~PL		E	0.0		PID = 2 ppm		
	0.2				0.2				
	0.3	Silty SAND SM: fine to medium, dark grey-brown, moist, alluvial and estuarine			0.3				
	0.4			E*	0.4		PID = 2 ppm		
	0.6				0.6				
	0.9	Below 0.9 m: wet		E	0.9		PID = 1 ppm	▼	
	1.1	Bore discontinued at 1.1m Target depth reached			1.1				

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.1 m.

WATER OBSERVATIONS: Groundwater observed at 0.9 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD22/20220714 taken from 0.4-0.6 m.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.0 AHD
EASTING: 342198.4
NORTHING: 6269993
DIP/AZIMUTH: 90°/--

BORE No: BH1025
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
3	0.0	FILL/SAND: fine to medium, grey, trace clay, fine to coarse gravel, brick and concrete fragments, moist, reworked natural		E	0.0		PID = 2 ppm		
					0.2				
				E	0.5		PID = 1 ppm		
					0.7				
	0.8	FILL/Sandy CLAY: medium to high plasticity, yellow mottled red, trace silt and ironstone, w~PL			0.9				
2	1			E			PID = 1 ppm		1
	1.1	Silty SAND SM: fine to medium, dark grey-brown, trace rootlets, wet, alluvial and estuarine			1.1			▼	
					1.2				
				E			PID = 1 ppm		
					1.4				
	1.7	Bore discontinued at 1.7m Target depth reached							
1	2								2
0	3								3
-1	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.7 m.

WATER OBSERVATIONS: Groundwater observed at 1.1 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.5 AHD
EASTING: 342210.9
NORTHING: 6269985.5
DIP/AZIMUTH: 90°/--

BORE No: BH1026
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILL/SAND: fine to medium, grey, trace clay, silt, brick, tile and plastic fragments, moist, possibly reworked natural		E*	0.0 - 0.2		PID = 1 ppm		
	0.9	Below 0.9 m: brown, with silt and clay, trace clay nodules		E	0.9 - 1.1		PID = 2 ppm		
	1.1	SAND SP: fine to medium, dark grey-brown, moist, alluvial and estuarine		E	1.2 - 1.4		PID = 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Approximate coordinates obtained via DGPS. Approximate levels inferred by comparison with nearby boreholes. *Blind replicate BD23/20220714 taken from 0-0.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342199.8
NORTHING: 6270003.5
DIP/AZIMUTH: 90°/--

BORE No: BH1027
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4		FILL/Silty SAND: fine to medium, brown, trace fine igneous gravel, rootlets and asbestos containing material, moist		E	0.0 0.2		PID = 2 ppm		
	0.6	SAND SP: fine to medium, grey, moist, alluvial and estuarine		E	0.6 0.8		PID = 3 ppm		
3	1	Below 1.2 m: indurated brown sand, silt and clay (coffee rock)		E	1.2 1.4		PID = 3 ppm		1
	1.6	Bore discontinued at 1.6m Target depth reached							
2	2								2
1	3								3
0	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.6 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Appendix C2

DP (2020)

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342285.8
NORTHING: 6269998.5
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.15	FILL/Gravelly SAND SP: fine to coarse, brown, igneous, trace silt, moist		E*	0.4 0.5		PID<1ppm		
	0.6	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist							
	1	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
	1.5	Silty SAND SM: fine to coarse, dark brown, indurated, moist, alluvial and estuarine		E	1.4 1.5		PID<1ppm		
	2 2.0	Bore discontinued at 2.0m - Target Depth Reached		E	1.9 2.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200123 taken at 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.5 AHD
EASTING: 342229.9
NORTHING: 6269957.2
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		E	0.0		PID<1ppm		
				E	0.1		PID<1ppm		
	0.35	FILL/Silty SAND SM: fine to coarse, brown and orange-brown, moist		E	0.2		PID<1ppm		
	0.5				0.3				
					0.35				
	0.8	FILL/Silty SAND SM: fine to medium, dark grey, trace ash and charcoal, moist			0.45				
				E	0.9		PID<1ppm		
		FILL/SAND SP: fine to medium, grey, trace ash, moist (possible natural)			1.0				
		SAND SP: fine to medium, grey, moist, alluvial and estuarine		E	1.4		PID<1ppm		
		- From 1.0m: pale grey			1.5				
				E	1.9		PID<1ppm		
					2.0				
	2.65	SAND SP: fine to medium, dark brown, trace rootlets, indurated, moist, alluvial and estuarine							
	3.0	Bore discontinued at 3.0m - Target Depth Reached, refusal on coffee rock							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.9 AHD
EASTING: 342213.9
NORTHING: 6270007.2
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 86973.01
DATE: 21/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/TOPSOIL (Silty SAND) SM: fine to coarse, dark brown, trace rootlets, moist		E	0.0		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
				E*	0.1		PID<1ppm		
	0.3	FILL/Gravelly CLAY CH: medium to high plasticity, orange-brown, ironstone, sandstone, igneous, trace silt, w~PL			0.3				
				E	0.4		PID<1ppm		Bentonite 0.15-0.9m
					0.5				Plain PVC 0-1.5m
		SAND SP: fine to medium, grey, moist, alluvial and estuarine		E	0.9		PID<1ppm		
		- From 0.4m: fine, pale grey			1.0				
				E	1.5		PID<1ppm		
					1.6				
	2.1	- From 2.0m: wet							
		SAND SP: fine to medium, brown and dark brown, indurated, wet, alluvial and estuarine		E**	2.4		PID<1ppm		
					2.5				Gravel 0.9-4.5m
									Machine Slotted PVC Screen 1.5-4.5m
					3.5				
	3.6	Sandy CLAY CL: low plasticity, brown and dark brown, fine to medium sand, trace sub-rounded gravel, wet, alluvial and estuarine		E			PID<1ppm		
					4.0				
					4.5				End Cap
				E			PID<1ppm		
					5.0				
	5.2	SAND SP: fine to medium, yellow-brown, trace sub-rounded gravel, saturated, alluvial and estuarine			5.5				
				E			PID<1ppm		
					6.0				
					6.5				
				E			PID<1ppm		
					7.0				
					7.5				
				E			PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached			8.0				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.0m, Solid flight augers (TC-bit) to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 2.0m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200121 taken from 0.1-0.3m, **Blind replicate sample BD5/20200121 taken from 2.4-2.5m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342193.8
NORTHING: 6269948.2
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/TOPSOIL (Silty SAND) SM: fine to coarse, brown, trace rootlets, gravel, moist		E	0.0 0.1		PID<1ppm		
		FILL/Silty SAND SM: fine to coarse, grey, trace ash and charcoal, moist		E	0.4 0.5		PID<1ppm		
	0.8	Silty SAND SM: fine to medium, grey and pale grey, moist, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
	1.5	Silty SAND SM: fine to medium, brown, trace rootlets, moist, alluvial and estuarine		E	1.9 2.0		PID<1ppm		
		- From 2.4m: red-brown							
	3.0	Bore discontinued at 3.0m - Target Depth Reached		E*	2.9 3.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD8/20200122 taken from 2.9-3.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342195.8
NORTHING: 6269907.2
DIP/AZIMUTH: 90°/--

BORE No: BH06
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05 0.15		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
	0.2	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4 0.5		PID<1ppm		
		SAND SP: fine to medium, grey, moist From 0.7m: pale grey		E	0.9 1.0		PID<1ppm		Backfill 0.15-1.3m
				E*	1.4 1.5		PID<1ppm		Plain PVC 0-2.8m
				E	1.9 2.0		PID<1ppm		Bentonite 1.3-2.3m
	2.3	SAND SP: fine to medium, brown and red-brown, indurated, moist, alluvial and estuarine		A	2.4 2.5		PID<1ppm		
	3.2	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine						▼	Gravel 2.3-5.8m Machine slotted PVC Screen 2.8-5.8m
	6.0	Bore discontinued at 6.0m - Target Depth Reached							End Cap

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 4.0m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200122 taken from 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342224.6
NORTHING: 6269898.6
DIP/AZIMUTH: 90°/--

BORE No: BH07
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.05	ROADBASE: gravel, igneous <20mm			0.15				
		FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4		PID<1ppm		
	0.7				0.5				
		SAND SP: fine to medium, pale grey, moist, alluvial and estuarine		E	0.9		PID<1ppm		
					1.0				
				E*	1.4		PID<1ppm		
					1.5				
				E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached			2.5				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD5/20200122 taken from 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342263.8
NORTHING: 6269899.7
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.05				0.15				
	0.15	ROADBASE: gravel, igneous <20mm		E	0.4		PID<1ppm		
		FILL/Silty SAND SM: fine to coarse, dark grey, trace ash and chemical , moist			0.5				
	0.9	FILL/Silty SAND SM: fine to medium, grey, trace ash, moist		E	0.9		PID<1ppm		
					1.0				
		Silty SAND SM: fine to medium, grey, moist, alluvial and estuarine		E	1.4		PID<1ppm		
					1.5				
	1.7	Silty SAND SM: fine to medium, brown and red-brown, indurated, moist, alluvial and estuarine		E*	1.9		PID<1ppm		
					2.0				
				E			PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached			2.5				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD6/20200122 taken from 1.9-2.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342223.1
NORTHING: 6269873
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND SM: fine to coarse, dark grey, trace plastic, ash, moist		E	0.0		PID<1ppm		
					0.1				
				E	0.2		PID<1ppm		
				E*	0.4		PID<1ppm		
					0.5				
	0.7	SAND SP: fine, pale grey, moist, alluvial and estuarine							
				E**	0.9		PID<1ppm		
					1.0				
				E	1.4		PID<1ppm		
					1.5				
				E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
					2.5				
				E	2.9		PID<1ppm		
	3.0				3.0				
		SAND SP: fine to coarse, dark brown, wet, alluvial and estuarine		E	3.1		PID<1ppm	▼	
		- From 3.3m: saturated			3.2				
				E	3.4		PID<1ppm		
	3.5				3.5				
		Silty SAND SM: fine to coarse, brown and yellow-brown, trace shells, saturated, alluvial and estuarine		E			PID<1ppm		
					4.0				
				E	4.5		PID<1ppm Slight Sulfidic Odour		
					5.0				
				E	5.5		PID<1ppm Slight Sulfidic Odour and Stain		
					6.0				
				E	6.5		PID<1ppm		
					7.0				
				E	7.5		PID<1ppm		
	8.0				8.0				
		Bore discontinued at 8.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.3m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200121 taken from 0.4-0.5m, **Blind replicate sample BD3/20200121 taken from 0.9-1.0, Bulk sample for CBR taken from 0.2-0.8m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 3.8 AHD
EASTING: 342270.9
NORTHING: 6269850.6
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, with clay, trace rootlets, moist		E	0.0		PID<1ppm		Well Plug and Flush Gatic Cover
				E	0.1		PID<1ppm		Concrete 0-0.15m
	0.35	FILL/Silty CLAY CL-CH: low to medium plasticity, orange and brown, with sand and ironstone gravel, trace rootlets, moist		E	0.2		PID<1ppm		Backfill 0.15-0.5m
					0.3				
					0.4				
					0.5				
	1	Silty SAND SM: fine to medium, grey, dry, alluvial and estuarine		E*	0.9		PID<1ppm		Plain PVC 0-2.0m
		- From 0.8m: pale grey			1.0				Bentonite 0.5-1.5m
				E	1.4		PID<1ppm		
					1.5				
	1.8	Silty SAND SM: fine to medium, dark brown, indurated, moist, alluvial and estuarine		E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
					2.5				
				E	2.9		PID<1ppm		
					3.0				
		- From 3.1m: wet							
	3.3	SAND SM-SC: fine to medium, brown and yellow-brown, trace silt and clay, wet, alluvial and estuarine							Gravel 1.5-6.0m
					4.0				Machine Slotted PVC Screen 2.0-6.0m
				A			PID<1ppm		
					4.5				
		- From 5.1m: silty							
	6.0	Bore discontinued at 6.0m							End cap
		- Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater obserbed whilst augering at 3.1m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200121 taken from 0.9-1.0m,

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342289.3
NORTHING: 6269918.2
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
	0.25	ROADBASE: gravel, igneous <20mm		E	0.3 0.4		PID<1ppm		
		FILL/Silty SAND SM: fine to medium, grey, trace roots, moist		E*	0.9 1.0		PID<1ppm		
	1.3	Silty SAND SM: fine to medium, pale brown and pale grey, trace roots, moist, alluvial and estuarine - From 1.5m: pale brown		E	1.5 1.7		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
	2.3	Silty SAND SM: fine to medium, dark grey, moist, alluvial and estuarine		E	2.4 2.5		PID<1ppm		
				E	2.9 3.0		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD7/20200122 taken from 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342259.1
NORTHING: 6269921.8
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05 0.15		PID<1ppm		
	0.2	FILL/Silty SAND SM: fine to medium, dark grey, trace ash and charcoal, moist		E	0.4 0.5		PID<1ppm		
		SAND SP: fine to medium, pale grey, trace ash, dry, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
	1.5	Bore discontinued at 1.5m - Target Depth Reached		E	1.4 1.5		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342230.9
NORTHING: 6269984.8
DIP/AZIMUTH: 90°/--

BORE No: BH13
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/Silty SAND SM: fine to coarse, brown and dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
		FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4 0.5		PID<1ppm		
	0.8	SAND SP: fine to medium, pale grey, moist		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342269.2
NORTHING: 6269752.5
DIP/AZIMUTH: 90°/--

BORE No: BH102
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
2	0.3	FILL/Silty SAND SM: fine to coarse, dark brown, trace clay and rootlets, moist		E B	0.0 0.03		PID<1ppm		
		FILL/SAND SW: fine to coarse, pale brown, trace gravel, concrete and glass, moist		E B	0.1 0.4 0.5		PID<1ppm PID<1ppm		
1	1.0	Silty SAND SM: fine to medium, dark grey, moist, alluvial and estuarine - From 1.3m: pale grey, wet		E* E	1.0 1.1 1.4 1.5		PID<1ppm PID<1ppm	▼	
0	2.0	Bore discontinued at 2.0m - Target Depth Reached							
-1	3								
-2	4								
-3	5								
-4	6								
-5	7								
-6	8								
-7	9								

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 2.0m

WATER OBSERVATIONS: Free groundwater observedwhilst push tubing at 1.3m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200123 taken at 1.0-1.1m, Bulk sample for CBR taken from 0.5-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342186.3
NORTHING: 6269783
DIP/AZIMUTH: 90°/--

BORE No: BH103
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASHPALTIC CONCRETE							
	0.12	CONCRETE: grey with aggregate <20mm		A	0.15 0.25		PID=5ppm		
	0.4	FILL/SAND SW: fine to coarse, brown, with sandstone gravels and cobbles, trace shells, moist		A	0.4 0.5		PID<1ppm		
		SAND SP: fine to medium, pale grey, moist, alluvial and estuarine		E	1.0				
	1.5	Bore discontinued at 1.5m - Target Depth Reached		E*	1.4 1.5		PID<1ppm	▼	

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push Tube to 1.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200120 taken at 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.3 AHD
EASTING: 342153.3
NORTHING: 6269733.5
DIP/AZIMUTH: 90°/--

BORE No: BH104
PROJECT No: 86973.01
DATE: 21/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		A*	0.0 0.1		PID<1ppm		Well Plug and Flush Gatic Cover
		FILL/SAND SW: fine to coarse, pale brown, with shell fragments, moist		A	0.4 0.5		PID<1ppm		Concrete 0-0.15m Bentonite 0.15-1.1m Plain PVC 0-1.1m
	0.9			A	0.9		PID<1ppm		
	0.95	FILL/Silty CLAY CL-CH: low to medium plasticity, dark brown, trace rootlets and organic matter, moist (possible original topsoil)		E	0.95 1.0		PID<1ppm		
	1.38	FILL/SAND SW: fine to coarse, pale yellow-brown, with shell fragments, moist		E	1.4 1.5		PID<1ppm	▼	
		Silty SAND SM: fine to medium, grey, trace shells, moist, alluvial and estuarine - From 1.6m: dark grey, wet		E	1.9 2.0		PID<1ppm		
		- From 2.3m: with organic matter		E	2.4 2.5		PID<1ppm		
	2.7	SAND SP: fine to medium, dark grey, trace shells, wet, alluvial and estuarine							
		- From 3.5m: saturated		E	3.5		PID<1ppm		Gravel 1.1-6.0m Machine Slotted PVC Screen 1.1-6.0m
					4.0				
				E	4.5		PID<1ppm		
					5.0				
				E	5.5		PID<1ppm		
					6.0				End Cap
		- From 6.5m: brown and grey		E	6.5		PID<1ppm		
	7.0	Silty SAND SM: fine to medium, brown, trace shell fragments, saturated, alluvial and estuarine			7.0				
				E	7.5		PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached			8.0				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** HW Cased to 6.0m

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 6.0m, Wash bore to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.6m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200120 taken from 0-0.1m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342146.9
NORTHING: 6269682.5
DIP/AZIMUTH: 90°/--

BORE No: BH105
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		A	0.0 0.1		PID<1ppm		
		FILL/SAND SW: fine to coarse, brown, trace shells and gravel, moist		A	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID=1ppm		
	1.4	- From 1.3m : dark brown		E	1.3		PID<1ppm		
		Silty SAND SM: fine to medium, grey, moist, alluvial and estuarine		E	1.4 1.5		PID<1ppm	▼	
		- From 1.62m: wet		E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached		E	2.4 2.5		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 2.5m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.62m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342210.2
NORTHING: 6269674.3
DIP/AZIMUTH: 90°/--

BORE No: BH106
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		Well Plug and Flush Gatic Cover
	0.5	FILL/SAND SP: fine to medium, brown, trace glass, moist		E E*	0.3 0.4 0.5		PID<1ppm PID<1ppm		Concrete 0-0.15m Bentonite 0.15-0.4m Plain PVC 0-1.0m
		FILL/Sandy CLAY CH: medium to high plasticity, mottled red, yellow-brown, pale-brown and pale grey, with igneous, sandstone and ironstone gravel, trace clinker, moist		E	0.9 1.0		PID<1ppm		
	1.48	Silty SAND SM: fine to medium, grey, wet, alluvial and estuarine		E	1.4 1.5		PID<1ppm	▼	
				E	1.9 2.0		PID<1ppm		Gravek 0.4-4.0m
	2.5	SAND SP: fine to medium, grey, saturated, alluvial and estuarine		E	2.9 3.0		PID<1ppm		Machine Slotted PVC Screen 1.0-4.0m
	4.0	Bore discontinued at 4.0m - Target Depth Reached							End Cap

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) 4.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200122 taken from 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.0 AHD
EASTING: 342209
NORTHING: 6269638.7
DIP/AZIMUTH: 90°/--

BORE No: BH107
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.28	FILL/Silty SAND SM: fine to coarse, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
	0.72	FILL/SAND SW: fine to coarse, pale yellow-brown, trace shells, dry to moist		E*	0.4 0.5		PID<1ppm		
	1	FILL/SAND SW: fine to coarse, pale brown, with shell fragments, moist to wet		E	0.9 1.0		PID<1ppm		
	1.5			E	1.4 1.5		PID<1ppm	▼	
	1.7	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, wet							
	2	SAND SP: fine to medium, grey, wet, alluvial and estuarine		E	1.9 2.0		PID<1ppm		
		- From 2.5m: dark grey		E	2.4 2.5		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached		E	2.9 3.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200122 taken at 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342248.5
NORTHING: 6269728.1
DIP/AZIMUTH: 90°/--

BORE No: BH108
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILL/TOPSOIL (Silty SAND) SM : fine to coarse, dark brown, with gravel, trace rootlets and ash, moist		E*	0.0 0.1		PID<1ppm		
	0.7	FILL/Silty SAND SM: fine to medium, brown, trace gravel, rootlets and ash, moist		E	0.4 0.5		PID<1ppm		
	1.2	FILL/SAND SW: fine to coarse, pale brown, trace shell, moist		E	0.9 1.0		PID<1ppm		
		SAND SP: fine to medium, pale grey, moist, alluvial and estuarine - From 1.5m: wet		E	1.4 1.5		PID<1ppm	▼	
		- From 2.1m: saturated		E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube 2.5m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200123 taken at 0.0-0.1m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342192
NORTHING: 6269605.7
DIP/AZIMUTH: 90°/--

BORE No: BH109
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
	0.5	FILL/SAND SW: fine to coarse, pale brown, trace brick, moist		E	0.3 0.5		PID<1ppm		
		FILL/SAND SW: fine to coarse, pale brown, trace shells, moist		E*	0.9 1.0		PID<1ppm		
	1.45			E	1.4 1.45		PID<1ppm	▼	
	1.55	FILL/Silty SAND SM: dark grey, fine to coarse grained, trace rootlets, wet			1.55				
		SAND SP: grey, fine to medium grained, wet, alluvial and estuarine		E E	1.9 2.0		PID<1ppm PID<1ppm		
		- 2.4m: dark grey, sulphidic odour, mottled brown colour		E	2.4 2.5		PID<1ppm Slight Sulfidic Odour		
		= 2.7m: wuth shells to 2.9m, slight to no odour		E	2.9 3.0		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.45m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200122 taken from 0.9-1.0

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342180.6
NORTHING: 6269708.6
DIP/AZIMUTH: 90°/--

BORE No: BH110
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
2.15	0.05	FILL/Silty SAND SM: fine to medium, dark brown, trace roots, moist		A	0.1		PID<1ppm		
				A	0.2		PID<1ppm		
1.85	0.35	FILL/Silty SAND SM: fine to medium, dark brown, moist		A	0.3		PID<1ppm		
					0.4				
1.6	0.6	SAND SC: fine to medium, pale brown with gravel, trace clay, moist, alluvial and estuarine			0.5				
				A	0.9		PID<1ppm		
1.1	1.1	SAND SW: fine to coarse, pale brown, trace shells, moist, alluvial and estuarine							
				A	1.2		PID<1ppm		
					1.3				
0.7	1.5	SAND SW: fine to coarse, dark grey, moist, alluvial and estuarine - From 1.5m: fine to medium, pale grey		A	1.4		PID<1ppm		
					1.5				
		Bore discontinued at 1.5m - Target Depth Reached							

RIG: Hand Tools **DRILLER:** LT/TB **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342166.6
NORTHING: 6269590.6
DIP/AZIMUTH: 90°/--

BORE No: BH111
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND SM: fine to medium, dark brown, trace shells, gravel, organics and plastic, moist		A	0.0–0.1		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
				A	0.4–0.5		PID<1ppm		Bentonite 0.15-0.7m
	0.7	FILL/SAND SW: fine to coarse, pale brown, trace shells, moist							Plain PVC 0-1.0m
				E*	0.9–1.0		PID<1ppm		
	1.4	FILL/SAND SM: fine to coarse, dark grey, trace organic matter, ash and clay, moist		E	1.4–1.5		PID<1ppm	▼	
	1.7	SAND SP: fine to medium, grey and pale grey, trace roots and shell fragments, wet, alluvial and estuarine		E	1.9–2.0		PID<1ppm		
				E	2.4–2.5		PID<1ppm		
				E	3.0–3.5		PID<1ppm		Gravel 0.7-6.0
									Machine Slotted PVC Screen 1.0-6.0m
				E	4.0–4.5		PID<1ppm		
				E	5.0–5.5		PID<1ppm		
				E	6.0–6.5		PID<1ppm		End Cap
				E	7.0–7.5		PID<1ppm		
				E	7.5–8.0		PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** HW Cased to 6.0m

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 5.5m, Wash bore to to 8.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200120 taken at 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342159.5
NORTHING: 6269622.3
DIP/AZIMUTH: 90°/--

BORE No: BH112
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets and clay, moist		A	0.0 0.1		PID<1ppm		
	0.3	FILL/Silty SAND SM: fine to coarse, brown with sandstone and igneous gravels and cobbles, trace concrete, buildling rubble and fibre cement sheet (asbestos containing material), moist		A	0.4		PID<1ppm		
	0.6	Bore discontinued at 0.6m - Refusal at depth 0.6m on possible gravel		A1	0.5 0.6		Fibre cement sheet sample 'A1'		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.6m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.3 AHD
EASTING: 342209.6
NORTHING: 6269719.7
DIP/AZIMUTH: 90°/--

BORE No: BH113
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.13	CONCRETE: grey with aggregate <20mm							
	0.16	FILL/GRAVEL GP: fine to coarse, grey brown, igneous and sandstone, with sand, moist		E	0.2		PID<1ppm		
	0.3			E	0.3		PID<1ppm		
					0.4				
		FILL/SAND SW: fine to coarse, brown and pale brown, with shells, moist		E	0.7		PID<1ppm		
	0.85				0.8				
	1	FILL/Clayey SAND SC: fine to coarse, brown, trace gravel, roots and ash, moist		E*	0.9		PID<1ppm		1
					1.0				
		SAND SW: fine to coarse, dark grey and grey, moist, alluvial and estuarine		E	1.4		PID<1ppm		
					1.5			▼	
		- From 1.8m: wet		E	1.9		PID=2ppm		
	2				2.0				2
		- From 2.1m: Saturated							
	2.5	Bore discontinued at 2.5m							
		- Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.8m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200123 taken at 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 3.4 AHD
EASTING: 342245.1
NORTHING: 6269787.8
DIP/AZIMUTH: 90°/--

BORE No: BH114
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
		FILL/SAND SM: fine to coarse, brown, with shells and organic matter, trace silt moist		E	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID<1ppm		
		- From 1.8m: with irontstone and concrete gravel							
	2.6	Bore discontinued at 2.6m - Refusal at 2.6m on possible gravel							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 2.6m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 5.0 AHD
EASTING: 342260.1
NORTHING: 6269797.7
DIP/AZIMUTH: 90°/--

BORE No: BH116
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/Silty SAND SM: fine to medium, trace clay, roots							
		FILL/SAND SW: fine to coarse, pale brown, with shells, moist		E	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
				E	2.4 2.5		PID<1ppm		
				E	2.9 3.0		PID<1ppm		
	3.1			E	3.1 3.2		PID=2ppm		
	3.2	FILL.Silty SAND SM: fine to coarse, brown, trace clay, moist		E	3.4		PID<1ppm		
	3.5	FILL/SAND SP: fine to medium, red-brown, moist		E	3.5 3.6		PID<1ppm		
	3.7	Silty SAND SM: fine to medium, dark brown, trace organic matter, moist			3.7				
		SAND SP: fine to medium, pale brown, moist, alluvial and estuarine		E	4.1 4.2		PID<1ppm		
	4.5	- From 4.4m: wet		E	4.4 4.5		PID<1ppm	▼	
		Bore discontinued at 4.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 4.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 4.5m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.5 AHD
EASTING: 342258.2
NORTHING: 6269781.2
DIP/AZIMUTH: 90°/--

BORE No: BH117
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/SAND SM: fine to medium, dark brown, trace silt and roots, moist		E	0.1 0.2		PID<1ppm		
	0.6	FILL/SAND SM: fine to coarse, pale brown, with shells, trace ash and asphaltic concrete, dry		E	0.4 0.5		PID<1ppm		
		FILL/ Silty SAND SM: fine to coarse, brown, with shells, trace gravel, moist		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E*	1.9 2.0		PID<1ppm		
				E	2.4 2.5		PID<1ppm		
	2.7	SAND SW: fine to coarse, orange-brown, trace shell grafments, moist		E	2.9 3.0		PID=2ppm		
	3.0	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine - From 3.5m: wet		E	3.4 3.5		PID<1ppm	▼	
	4.0	Bore discontinued at 4.0m - Target Depth Reached		E	3.9 4.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 4.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.5m

REMARKS: Location coordinates are in MGA94 Zone 56. * Blind replicate sample BD5/20200123 taken at 1.9-2.0m

SAMPLING & IN SITU TESTING LEGEND

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

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Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Rock Strength

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

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

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Rock Descriptions

Degree of Fracturing

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

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

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

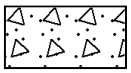
Symbols & Abbreviations

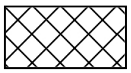
Graphic Symbols for Soil and Rock

General

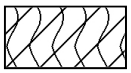

Asphalt

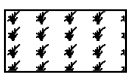

Road base

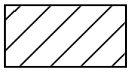

Concrete

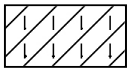

Filling

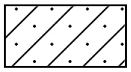
Soils


Topsoil

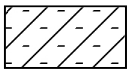

Peat

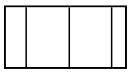

Clay

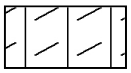

Silty clay

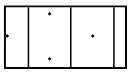

Sandy clay

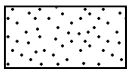

Gravelly clay

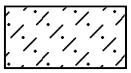

Shaly clay

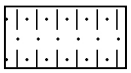

Silt


Clayey silt


Sandy silt

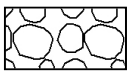

Sand

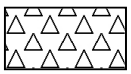

Clayey sand


Silty sand


Gravel

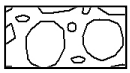

Sandy gravel


Cobbles, boulders

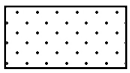

Talus

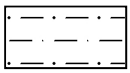
Sedimentary Rocks

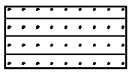

Boulder conglomerate

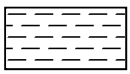

Conglomerate


Conglomeratic sandstone

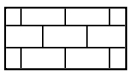

Sandstone


Siltstone

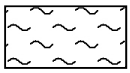

Laminite

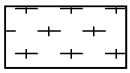

Mudstone, claystone, shale

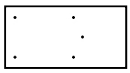

Coal


Limestone

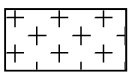
Metamorphic Rocks

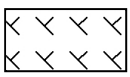

Slate, phyllite, schist

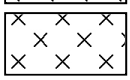

Gneiss

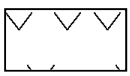

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix D

Asbestos Summary Results Table Extracted from DP (2022)

Table H1B: Summary of Results - Asbestos - NNPS			Field Screening							Laboratory Analysis				
			Approximate Sample Volume	Weight of Sample	Number of Fragments	Condition of Fragments (good/poor)	Size Range of Fragments (mm)	Weight of Retained ACM	Bonded ACM in Soil	Trace Analysis	ACM >7mm Estimation	Asbestos- AF/FA Estimation	Asbestos- AF/FA Estimation	Asbestos ID
		Units	L	g	-	-	mm	g	% w/w	-	g	g	% w/w	-
		PQL	-	0.1	-	-	1	1	-	-	0.1	-	0.001	-
Sample ID	**Depth**	**Sample Date**												
TP1001	0 - 0.3 m	13/04/2022	10	10390	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1001A	0 - 0.2 m	19/04/2022	10	4125	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1001A	0.2 - 0.4 m	19/04/2022	10	11528	**1**	**Good**	**50 x 70**	**29**	**0.038**	NAD	-	-	<0.001	NAD
TP1001A	0.7 - 0.9 m	19/04/2022	10	13823	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1002	0.1 - 0.4 m	13/04/2022	10	8740	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1003	0 - 0.5 m	13/04/2022	10	13382	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1004	0.1 - 0.5 m	13/04/2022	5	4643	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1005	0 - 0.2 m	13/04/2022	10	11752	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1006	0.1 - 0.4 m	13/04/2022	5	4642	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1007	0 - 0.2 m	13/04/2022	10	9540	0	-	-	-	-	NAD	-	**0.0336**	**0.0069**	**Detected**
TP1008	0 - 0.2 m	13/04/2022	10	6142	0	-	-	-	-	NAD	-	**0.0001**	<0.001	**Detected**
BH1009	0.025 - 0.1 m	14/04/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
BH1009	0.1 - 0.5 m	14/04/2022	10	11836	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1010	0.1 - 0.5 m	14/04/2022	10	9843	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1011	0 - 0.4 m	19/04/2022	10	10810	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1012	0 - 0.5 m	19/04/2022	10	9965	0	-	-	-	-	NAD	-	-	-	NAD
BH1013	0.03 - 0.2 m	14/04/2022	10	13699	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1014	0.05 - 0.15 m	14/04/2022	10	11571	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1015	0 - 0.4 m	14/04/2022	10	14650	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1016	0 - 0.5 m	14/04/2022	10	13387	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1017	0 - 0.2 m	14/04/2022	10	12332	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1017	0.2 - 0.6 m	14/04/2022	10	13824	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1018	0 - 0.3 m	14/04/2022	10	10702	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1019	0 - 0.2 m	19/04/2022	10	6728	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1020	0 - 0.2 m	19/04/2022	10	5120	0	-	-	-	-	NAD	-	-	<0.001	NAD
TP1020	0.2 - 0.7 m	19/04/2022	10	9989	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1021	0 - 0.25 m	19/04/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
BH1022	0 - 0.7 m	19/04/2022	10	13589	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1023	0.1 - 0.3 m	13/04/2022	10	8142	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1024	0 - 0.3 m	14/07/2022	10	8173	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1025	0 - 0.8 m	14/07/2022	10	10231	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1025	0.8 - 1.1 m	14/07/2022	10	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
BH1026	0 - 0.6 m	14/07/2022	10	9870	0	-	-	-	-	NAD	-	-	<0.001	NAD
BH1027	0 - 0.5 m	14/07/2022	10	10089	0	-	-	-	-	NAD	-	**4.0153**	**0.7663**	**Detected**
SS1	0 - 0.1 m	14/04/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
SS2	0 - 0.1 m	14/04/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
SS3	0 - 0.1 m	14/04/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
SS4	0 - 0.1 m	14/07/2022	-	-	-	-	-	-	-	NAD	-	-	<0.001	NAD
A01	Surface Fragment	14/07/2022	-	-	-	-	-	-	-	-	-	-	-	-
A02	Surface Fragment	14/07/2022	-	-	-	-	-	-	-	-	-	-	-	**Detected**
A03	Surface Fragment	14/07/2022	-	-	-	-	-	-	-	-	-	-	-	-
A04	Surface Fragment	14/07/2022	-	-	-	-	-	-	-	-	-	-	-	**Detected**

Notes:

1. Asbestos results from DP (2020) tabulated in Appendix H3 - no asbestos previously detected within investigation area at DP (2020) sample locations

Appendix E

Remediation Options Assessment and Evaluation

Appendix E
Remediation Options Assessment and Evaluation
Proposed Upgrade of Narrabeen North Public School
Narrabeen Education Precinct, Namona Street, Narrabeen

E1.0 Introduction

The following key guidelines and technical reports were consulted in the preparation of this remediation options assessment:

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* [NEPM]) (NEPC, 2013); and
- CRC CARE *Remediation Action Plan: Development - Guideline on Performing Remediation Options Assessment* (CRC CARE, 2019a).

The first stage of developing a remediation strategy is to establish clear and measurable remediation objectives and remediation criteria (clean-up levels). These will form the requirements against which remediation options are assessed.

The next stage of the remediation options assessment is to select technology and management options, or combinations of options, that have the potential to reduce contaminant concentrations and/or apply management controls as necessary so that the remediation objectives are achieved and unacceptable risk posed by the contamination in the context of the current and proposed site use is addressed. Where several viable options have been identified, an assessment of each of the options will be required to determine which option will most adequately and sustainably meet the remediation objectives (CRC CARE, 2019a).

The remediation objectives are to:

- Address potentially unacceptable risks to relevant environmental values from contamination (refer to the CSM in Section 7); and
- Render the areas requiring remediation validation sign-off within the NNPS proposed work area, and hence subject to remediation, suitable from a contamination perspective for their continued use as a primary school.
- (Refer to Section E2).

E2.0 Hierarchy of Remediation Options

NEPC (2013) stipulates the preferred hierarchy of options for site clean-up (remediation) and / or management which is outlined as follows:

- On-site treatment of the contamination so that it is destroyed, or the associated risk is reduced to an acceptable level; and

- Off-site treatment of excavated soil, so that the contamination is destroyed, or the associated risk is reduced to an acceptable level, after which soil is returned to the site.

or, if these two options are not practicable;

- Consolidation and isolation of the soil on site by containment with a properly designed barrier; and
- Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material.

or,

- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

When deciding which option to choose, the sustainability (namely environmental and economic) of each option should be considered, in terms of achieving an appropriate balance between the benefits and effects of undertaking the option. In cases where no readily available or economically feasible method is available for remediation, it may be possible to adopt appropriate regulatory controls or develop other forms of remediation (NEPC, 2013).

E3.0 Remediation Options Assessment

E3.1 Introduction

The contaminated soil requiring remediation is asbestos impacted fill. As the work areas and nature of these works are still to be finalised as part of the final design, this RAP does not seek to highlight the exact areas where remediation would be applied but rather the strategy to be implemented for different types of works (e.g., slab construction, pavement construction, soft landscaping, etc.). DP would anticipate that as a minimum remediation would be applied to areas of subsurface disturbance.

In general, from a contaminated land perspective, soils with contaminant concentrations below the adopted site assessment criteria (SAC) may not require remediation. Notwithstanding, DP has been advised for this project that a more conservative approach to asbestos contamination is preferred by the NSW Department of Education and hence all asbestos impacted soils require remediation or management (i.e., even if below the SAC as outlined in DP (2022)).

E3.2 Remediation Options

Given the straightforward nature of the contamination issues at the site and the necessary earthworks (final landform) as part of the proposed development, only two options for the soil contamination have been considered, as follows:

- Excavation and offsite disposal; and
- On-site management (cap and contain).

The following key guidelines have therefore been consulted:

- CRC CARE *Technology Guide: Soil - Excavation* (CRC CARE, 2019b);

- CRC CARE *Technology Guide: Soil - Containment* (CRC CARE, 2019c);
- WA DoH *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (WA DoH, 2009);
- WA DoH *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia* (WA DoH, 2021); and
- WorkCover NSW Managing Asbestos in or on Soil (WorkCover NSW, 2014).

E4.0 Summary of Preferred Remediation Strategy

Due to the size of both the site and the proposed work area, and also that proposed buildings are to be constructed approximately at existing levels, it is considered unlikely that excavation and offsite disposal would be preferred from an economic perspective. As such, the primary preferred remediation option suggested is on-site management (cap and contain), and capping would comprise a combination of concrete building slabs, pavements and landscaping.

Where fill is removed from one area and consolidated with other fill in another area, the area where fill has been removed would not require capping (subject to appropriate validation being undertaken that confirms the asbestos impacted soils had been removed). This would also apply to validated areas east of BH07 and BH09 (refer to Drawing 3, Appendix A for sample locations).

It is noted that given the potential need for minor works post completion of the main remediation capping works (e.g., service trench), excavation and offsite disposal has been included in this RAP which may be preferable for smaller quantities of generated spoil and / or remediation areas.

Douglas Partners Pty Ltd

Appendix F

Example Geofabric

MASTATEX™ Orange

Warning Layer Geotextile

Techincal Specifications

Jaybro

GEOMASTA™

DESCRIPTION

mastaTEX™ GFO is a high quality staple fiber geotextile, designed for separating contaminated and non-contaminated soils. Due to its bright Orange coloring, mastaTEX™ GFO is most commonly used as a warning layer in areas liable to future excavations. mastaTEX™ GFO provides the same performance as other geotextiles in the mastaTEX™ range.

APPLICATIONS

- Segregation of contaminated soil
- Filtration
- Warning Layer

SPECIFICATIONS

	TEST METHOD	UNIT	VALUES
INDEX PROPERTIES			
Material			Polyester (PET)
Grab Tensile Strength	AS 3706.2B	N	500
Wide Strip Tensile Strength	AS3706.2A	kN/m	8.1
Mass	AS 3760.1	gsm	140
TYPICAL HYDRAULIC PROPERTIES MEAN			
Pore Size	AS 3706.7	µm (Microns)	120
Nominal Flow Rate	AS 3706.9	l/m² /s	240
DIMENSIONS			
Width		m	6
Length		m	150
Roll Diameter		m	400

UNDERSTANDING AUSTRALIAN GEOTEXTILE STANDARDS

NSW

ROADS & MARITIME SERVICES (RMS)
QA SPECIFICATION R63 GEOTEXTILES (SEPARATION AND FILTRATION)
May 2013 Edition 4 / Revision 0

RMS R63 is the NSW Main Roads specification documentation to which all Geotextile products are to be tested and approved before use on road and bridgeworks.

Clause 2 Material Requirements specifies the minimum requirements for the raw material quality, manufacturing processes, product testing & certification.

Clause 3 Storage, Packaging, Identification and Delivery specifies the method in which the product must be packaged, stored, marked and delivered.

Clause 4 Construction Requirements covers general site preparation, installation and site requirements.

Jaybro Geosynthetics recommend the client read and understand Clause 4 and all subsequent annexures prior to installation.

QLD

TRANSPORT AND MAIN ROADS (TMR) MRTS27 GEOTEXTILES SEPARATION AND FILTRATION
June 2009

Clause 6 Material Requirements specifies the minimum requirements for the raw material quality, manufacturing processes, product testing & certification.

Clause 7 Storage, Packaging and Identification specifies the method in which the product must be packaged, stored and marked.

Clause 8 Delivery and Product Compliance covers requirements for ordering and delivery of geotextiles.

Clause 9 Construction Requirements covers general site preparation, installation and site requirements.

Clause 10 Acceptance criteria details the requirements by the contractor for onsite testing and sampling.

Jaybro Geosynthetics recommend the client read and understand MRTS27 prior to installation.

VIC

VICROADS 210 – GEOTEXTILES IN EARTHWORKS
December 2014

This section covers the requirements for the supply, handling and placing of geotextiles as listed below or used as a separation layer, or as a separation and filtration layer,in earthworks at locations shown on the drawings or specified.

210.03 Properties of Geotextiles. General; specifies material properties and manufacturing process.

Robustness; outlines how the geotextiles are to be classified according to the G Rating

Equivalent Opening Size; specifies pore size for use as a filtration material

UV Radiation Stabilisation; The geotextile shall be stabilised against deterioration due to ultra-violet radiation such that when tested in accordance with AS 3706.11 Standard

Testing; All testing shall be performed by laboratories with third party accreditation to ISO/IEC 17025 by a signatory to the International Laboratories Accreditation Cooperation (ILAC) scheme, e.g. by NATA (National Association of Testing Authorities, Australia)

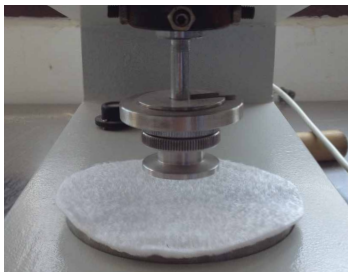
Jaybro Geosynthetics recommend the client read and understand VR210.04 and all subsequent annexuresprior to installation

NATA
WORLD RECOGNISED ACCREDITATION

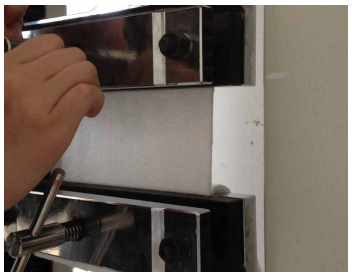
WHAT IS NATA?

National Association of Testing Authorities is the authority responsible for the accreditation of laboratories, inspection bodies, calibration services, producers of certified reference materials and proficiency testing scheme providers throughout Australia. It is also Australia's compliance monitoring authority for the OECD Principles of GLP. All State Standards specify geotextile testing must be completed by a NATA accredited laboratory.

TEST METHODS



AS 3706.1
MASS & THICKNESS



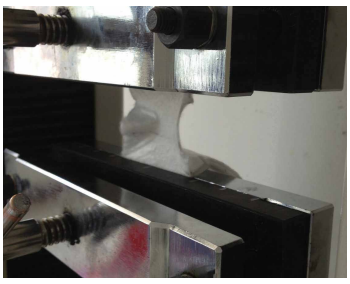
AS 3706.2A
WIDE STRIP TENSILE STRENGTH

AS 3706.2B
GRAB TENSILE STRENGTH

AS 3706.4
CBR BURST STRENGTH

AS 3706.9
PERMITTIVITY

AS 3706.7
PORE SIZE



AS 3706.3
TRAPEZOIDAL TEAR STRENGTH

Jaybro
GEOMASTA™

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29 Penelope Crescent
Arndell Park NSW 2148

MELBOURNE EAST
Factory 3, 1364 Heatherton Road
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CANBERRA
3 Daly Street,
Queanbeyan West NSW 2620

COFFS HARBOUR
Unit 5, 22 Isles Drive
Coffs Harbour NSW 2450

PERTH
Unit 1/94 Beringarra Avenue,
Malaga WA 6090

MELBOURNE
27 Tullamarine Park Road
Tullamarine VIC 3043

BRISBANE
71 Lavarack Avenue
Eagle Farm QLD 4009

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Appendix G

Remediation Acceptance Criteria

Appendix G
Remediation Acceptance Criteria
Proposed Upgrade of Narrabeen North Public School
Narrabeen North Public School, Narrabeen Education Precinct

G1.0 Remediation Acceptance Criteria

For any materials being imported onto site or areas requiring further validation (e.g., unexpected finds), laboratory results are to be compared to NEPC (2013)[1] health and ecological screening / investigation levels. Table G1 provides a summary of the levels derived in DP (2022). Reference to DP (2022) and NEPC (2013) should be undertaken for greater information on how these levels have been generated.

Table G1: Health and Environmental Screening Levels (mg/kg)

Contaminants		HIL-A & HSL-A Direct Contact	HSL-A Vapour Intrusion	EIL/ESL	VENM - ANZECC 1992/LRL (mg/kg)
Metals	Arsenic	100	-	100	0.2-30
	Cadmium	20	-	-	0.04-2
	Chromium (VI)	100	-	200	0.5-110
	Copper	6000	-	220	1-190
	Lead	300	-	1100	2-200
	Mercury (inorganic)	40	-	-	0.001-0.1
	Nickel	400	-	190	2-400
	Zinc	7400	-	570	2-180
PAH	Benzo(a)pyrene TEQ[1]	3	-	33	-
	Naphthalene	1400 (HSL)	3	170	-
	Total PAH	300	-	-	0.95-5
TRH	C6 – C10 (less BTEX) [F1]	700[#]	45	180	<25 (LRL)
	>C10-C16 (less Naphthalene) [F2]	1000[#]	110	120	<50 (LRL)
	>C16-C34 [F3]	2500[#]	-	300	<100 (LRL)
	>C34-C40 [F4]	6300 (HSL)	-	2800	<100 (LRL)

[1] NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* (NEPC, 2013).

Contaminants		HIL-A & HSL-A Direct Contact	HSL-A Vapour Intrusion	EIL/ESL	VENM - ANZECC 1992/LRL (mg/kg)
BTEX	Benzene	100 (HSL)	0.5	50	0.05-1
	Toluene	14000 (HSL)	160	85	0.1-1
	Ethylbenzene	4500 (HSL)	55	70	<1 (LRL)
	Xylenes	12000 (HSL)	40	105	<1 (LRL)
Phenol	Pentachlorophenol (used as an initial screen)	100	-	-	0.03-0.5/LRL
OCP	Aldrin + Dieldrin	6	-	-	<0.2 (LRL)
	Chlordane	50	-	-	<0.1 (LRL)
	DDT+DDE+DDD	240	-	180 (DDT)	<0.1 (LRL)
	Endosulfan	270	-	-	<0.1 (LRL)
	Endrin	10	-	-	<0.1 (LRL)
	Heptachlor	6	-	-	<0.1 (LRL)
	HCB	10	-	-	<0.1 (LRL)
	Methoxychlor	300	-	-	<0.1 (LRL)
PCB [2]		1	-	-	<5 (LRL)

Notes to Table: # Management limits - Table 1 B(7), Schedule B1 of NEPC (2013) LRL – Laboratory reporting limit
1. Sum of carcinogenic PAH 2. Non dioxin-like PCBs only 3. NL – not limiting

With respect to asbestos concentrations, as per NEPC (2013) *Table 7: Health Screening Levels for Asbestos Contamination in Soil* no asbestos is to be visible at the surface whilst concentrations for bonded ACM are to be less than 0.01% w/w and concentrations for asbestos fines / fibrous asbestos (AF/FA) are to be less than 0.001% w/w. However, based on consultation with NSW Department of Education, a conservative approach of no (or 'free of') asbestos is to be applied as the RAC for this project. Free of asbestos refers to no observable asbestos at the surface or detections of asbestos within field tests (e.g., 10 L sieve validation tests) or laboratory analysis (e.g., AF/FA validation samples).

It is noted that the benzo(a)pyrene (B(a)P) ecological screening level in NEPC (2103) is a low reliability value. Higher reliability screening levels have been published in CRC CARE *Risk-based Management and Remediation Guidance for Benzo(a)pyrene* (CRC CARE, 2017). As such, the high reliability value of 33 mg/kg for fresh B(a)P has been adopted for the RAC.

For the purpose of providing screening criteria to compare laboratory results against for assessing virgin excavated natural material (VENM), the published background concentrations in ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Environmental Soil Quality Guidelines* Background A [ANZECC A] have been adopted. In the case of organics, where no reference values exist the LRL has been adopted as the screening level.

Appendix H

Contingency Plan and Unexpected Finds Protocol

Appendix H
Contingency Plan, Unexpected Finds Protocol and Asbestos Finds Protocol
Proposed Upgrade of Narrabeen North Public School
Narrabeen Education Precinct, Namona Street, Narrabeen

H1.0 General

Where conditions are found to be different than that anticipated during the remediation works, the proposed remediation approach may not be appropriate for the contamination encountered. In such cases the Environmental Consultant is to re-assess the contamination and remediation approach. Where necessary the Environmental Consultant is to prepare an addendum to, or revision of, this RAP.

H2.0 Contingency Plan

This contingency plan has been developed to provide guidance on processes to follow if contamination (or indicators of contamination), other than that included in the remediation strategy (Section 10), is encountered during the remediation works. Any such finds shall be surveyed and the location documented.

Although the NNPS proposed work area has been subject to previous investigations, there remains a potential for soil contamination to be present between sampled locations and outside areas previously investigated (as indicated by the proposed work area outline on the Drawings 1 to 3, Appendix A). In the event that signs of soil contamination, other than that included in the remediation strategy, are encountered during remediation e.g., evidence of asbestos in areas not previously encountered, petroleum, or other chemical odours which weren't previously identified the following protocols are to apply:

- The Principal Contractor's Site Manager is to be notified and the affected area closed off by the use of barrier tape and warning signs (or similar);
- The Environmental Consultant is to be notified to inspect the area and assess the significance of the potential contamination and determine extent of remediation works (if deemed necessary) to be undertaken. An assessment report and management plan detailing this information is to be compiled by the Environmental Consultant and provided to the Principal's Representative where considered appropriate (e.g., where additional or alternate remediation is required);
- A suitable remediation / mitigation strategy is to be prepared by the Environmental Consultant in consultation with the Principal's Representative and the Principal Contractor;
- The Principal Contractor or Principal's Representative is to notify to the Consent Authority or Private Certifier (as appropriate) of the works if required by the development consent;
- The agreed remedial / mitigation strategy, based on the RAP and relevant guidelines, shall be implemented; and
- All details of the assessment and remedial/mitigation works are to be included in the final validation report.

H3.0 Unexpected Finds Protocol and Asbestos Finds protocol

This unexpected finds protocol (UFP) and asbestos finds protocol (AFP) has been developed to provide guidance on processes to follow if any unexpected find (including asbestos in areas where it has not previously identified / encountered) is encountered during the remediation or future civil and construction works. Any unexpected finds or asbestos finds (in areas where asbestos in areas where it has not previously identified/encountered) should be surveyed and the location documented.

All personnel are to be inducted into their responsibilities under this (UFP and AFP), which should be included or referenced in the Principal Contractors construction environmental management plan.

All personnel are required to report unexpected signs of environmental concern to the Principal Contractor's Site Manager if observed during the course of their works e.g., presence of potential unexploded ordinance, unnatural staining, potential contamination sources (such as buried drums or tanks), chemical spills, asbestos where not anticipated to be present, etc.

Should signs of concern be observed, the Principal Contractor's Site Manager, as soon as practical, is to:

- Stop work in the affected area and ensure the area is barricaded to prevent unauthorised access;
- Notify authorities to obtain emergency response for any health or environmental concerns (e.g., fire brigade), if required;
- Notify the Principal's Representative of the occurrence;
- Notify any of the authorities that the Principal Contractor is legally / contractually required to notify (e.g., NSW EPA, Council); and
- Notify the Environmental Consultant (or Occupational Hygienist, as appropriate).

The Principal's Representative is to notify any of the authorities which the Principal is legally / contractually required to notify (e.g., EPA, Council). Where appropriate the Principal's Representative is to also implement appropriate stakeholder consultation

The Environmental Consultant is to assess the extent and significance of the find and develop an investigation, remediation / mitigation approach using (where possible and suitable) the principles and procedures already outlined in the RAP.

Douglas Partners Pty Ltd

Appendix I

Data Quality Objectives

Appendix I
Data Quality Objectives
Proposed Upgrade of Narrabeen North Public School
Narrabeen Education Precinct, Namona Street, Narrabeen

I1.0 Introduction

The objective of the validation plan is to assess whether the remediation as outlined in Section 10 and which primarily comprises construction of a capping layer has been successfully completed. Successful completion will also be with respect to the remediation action plan (RAP) more generally and assess the resultant suitability of the remediated areas for their intended continued use as a primary school. Moreover, the validation assessment will provide information on environmental impacts which may have resulted from the works.

The validation assessment is to be conducted with reference to the seven step data quality objectives (DQOs) as outlined in NEPC (2013)[1] and described below. The DQO in NEPC (2013) is in turn, based on the DQO process outlined in USEPA (2006)[2], and associated guidelines.

I2.0 Data Quality Objectives

Table 1: Data Quality Objectives

Step	Summary
1: State the problem	The proposed work area in NNPS which involves works comprising subsurface disturbance requires remediation and validation of the remediation in order to render the subject area suitable for its continued land use as a primary school. The objective of the validation plan is to confirm the successful implementation of this RAP. A conceptual site model (CSM) for the areas to be remediated has been prepared (Section 7).
2: Identify the decisions / goal of the study	The decision is to determine if the area subject to remediation is suitable for its continued land use (primary school) following remediation. The CSM identifies contamination within the proposed work area (refer to Drawings 1 to 3, Appendix A) which poses potentially unacceptable risks to human health. The remediation strategy required the placement of a marker layer above the asbestos contaminated soils and construction of a capping layer. Areas where a cap is not placed the asbestos contaminated soils are to be relocated under an area with a cap (i.e., consolidation of the asbestos impacted soils) or disposed off-site and the subject area validated.

[1] NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* (NEPC, 2013).
[2] USEPA. (2006). *Guidance on systematic planning using the data quality objectives process, EPA QA/G-4.* Washington DC.: United States Environmental Protection Agency, Office of Environmental Information.

Step	Summary
	The decision is to establish whether the capping layer has been placed in general accordance with the RAP and / or the asbestos impacted soil appropriately removed and the area validated and hence whether the remediated area has been remediated in general accordance with the RAP.
3: Identify the information inputs	Relevant inputs to the decision include: • Results from previous investigations (including mapping and other desktop information); • The CSM identifying contaminants of potential concern (COPC) and affected media; • Results analysed for the relevant COPC using NATA accredited laboratories and methods, where possible; • Field results (e.g., 10 L asbestos sieve results); • Field and laboratory QA / QC data to assess the suitability of the environmental data for the validation assessment; • Results compared with the remediation action criteria (RAC); • Inspections of the maker layer prior to capping works; • Assessments of aggregates, soil, etc. imported as part of the capping; • Inspections of the capping; • Review of the survey(s) of the installed capping; • Inspections where asbestos impacted soils have been removed (including stockpile footprints); • Review of the survey(s) for areas where asbestos impacted soils have been removed and the area validated; • An enforceable long term environmental management plan or update of the school's existing asbestos management plan has been prepared for implementation during use of the land as a primary school (post development); and • Details of the proposed development.
4: Define the study boundaries	The lateral boundaries of the proposed work area are indicated on Drawings 1 to 3, Appendix A. Remediation of the asbestos impacted soils within the proposed works area which are considered to be present in the central, western and northern sections of the NNPS (i.e., west of BH07 and BH09). Works within the proposed work area east of BH07 and BH09 is to be subject to validation (and if required remediation if validation samples fail the RAC). The vertical boundaries are to the extent of contamination impact as determined from the site history assessment, site observations and previous investigations used to inform the RAP.

Step	Summary
	As the work areas and nature of these works are still to be finalised as part of the final design, this RAP does not currently highlight the exact areas within the proposed work area where remediation would be applied. DP would anticipate that as a minimum remediation would be applied to areas of subsurface disturbance. Prior to commencing works the area of remediation based on the final proposed works is to be agreed between the NSW Department of Education, Principal Contractor and Environmental Consultant (and documented in the form of an addendum to this RAP (or similar)).
5: Develop the analytical approach (or decision rule)	The decision rule is the construction of the capping to at least the minimum thicknesses outlined in Section 10.2 and within the indicated survey tolerance. Conversely where asbestos impacted soils are removed and/or the area validated (refer to Sections 10.3, 10.4 and 10.5) validation samples are to meet the RAC. Quality control results are to be assessed according to their relative percent difference (RPD) values. For field and laboratory replicate results, RPDs should generally be below 30%; for field blanks, results should be at or less than the limits of reporting (NEPC, 2013). The field and laboratory quality assurance assessment is included in Section 15.
6: Specify the performance or acceptance criteria	Baseline condition: The capping has not been constructed in accordance with this RAP and/or the asbestos impacted soils have not been appropriately removed (where appropriate) - null hypothesis. Alternative condition: The capping has been constructed in accordance with this RAP and the asbestos impacted soils removed and the subject area validated (where appropriate) -alternative hypothesis. Unless conclusive information from the collected data is sufficient to reject the null hypothesis, it is assumed that the baseline condition is true.
7: Optimise the design for obtaining data	Sampling design and procedures to be implemented to optimise data collection for achieving the DQOs include the following: • Sampling frequencies in accordance with Section 12 and with reference to other relevant guidance (e.g., NSW EPA (2022), WA (2009), WA (2021), etc.); • Analysis for the COPC at NATA accredited laboratories using NATA endorsed methods to perform laboratory analysis whenever possible; • Adequately experienced environmental scientists/engineers to conduct field work and sample analysis interpretation; • Visual inspections by the Environmental Consultant of the cap construction and / or where asbestos impacted soils have been removed with reference to Section 12.3; and • Survey of the capping layer and areas of asbestos impacted soils have been removed in accordance with Section 10.

Appendix J

Site Management Plan

Appendix J
Site Management Plan
Proposed Upgrade of Narrabeen North Public School
Narrabeen Education Precinct, Namona Street, Narrabeen

J1.0 Introduction

This site[1] management plan (SMP) has been developed to assist with minimising potentially adverse impacts on the environment, and worker and public health as a result of the proposed remediation works.

The Remediation Contractor must have in place a construction environmental management plan (CEMP) (or similar) which is specific to the equipment used for the remediation and the proposed methods to be adopted by the Remediation Contractor. This SMP has been prepared to augment the Remediation Contractor's CEMP and contains general details for aspects of the work, as per reporting requirements for a remediation action plan (RAP) under NSW EPA *Guidelines for Consultants Reporting on Contaminated Land* (NSW EPA, 2020).

Apart from the management principles outlined in this SMP, the Remediation Contractor must also ensure compliance with all relevant environmental legislation and regulations, including (but not limited to) the following:

- *Contaminated Land Management Act 1997* NSW (CLM Act);
- *Protection of the Environment Operations Act 1997* NSW (POEO Act);
- *Protection of the Environment Legislation Amendment Act 2011* NSW;
- *Protection of the Environment Operations Amendment (Scheduled Activities and Waste) Regulation 2008* NSW;
- *Environmentally Hazardous Chemicals Act 1985* NSW;
- *Environmental Offences and Penalties Act 1989* NSW;
- *Pesticide Act 1999* NSW and *Pesticides Regulation 2017*; and
- *Work Health and Safety Act 2011* NSW (as updated 2020) and *Work Health and Safety Regulation 2017* NSW (as updated 2022).

[1] Site for the purpose of this appendix refers to the areas of works associated with the proposed NNPS upgrade works.

J2.0 Roles and Responsibilities

J2.1 Principal

The Principal (NSW Department of Education) is responsible for the environmental performance of the proposed remediation works, including implementation of acceptable environmental controls during remediation works. The Principal retains the overall responsibility for ensuring this RAP is appropriately implemented. The Principal is to nominate a representative (the Principal's Representative), who is responsible for overseeing the implementation of this RAP.

The actual implementation of the RAP may, however, be conducted by the Principal Contractor on behalf of the Principal. Whilst this is the expected preferred approach, the arrangement is to be confirmed between the Principal and Principal Contractor at the time of the Principal Contractor's engagement.

The Principal is responsible for providing appropriate information to the Principal Contractor to allow them to safely plan the required works. This includes the existing asbestos register and management plan for the school and this RAP.

The Principal is also responsible for implementing an appropriate communications plan.

J2.2 Principal Contractor

The Principal Contractor is expected to be the party responsible for daily implementation of this RAP (see Section J2.1) and shall fulfil the responsibilities of the Principal Contractor as defined by SafeWork NSW. It is noted that the Principal Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the procedures. The Principal Contractor will appoint a Site Manager.

In addition to the implementation of the RAP it is the Principal Contractor's responsibility to *inter alia*:

- Obtain / ensure relevant sub-contractors obtain specific related approvals as necessary to implement the earthworks, including for example, permits for removal of asbestos-containing material, SafeWork NSW notification, etc.;
- Develop or request and review any site plans required to manage the works to be conducted;
- Ensure that all remediation works and other related activities are undertaken in accordance with this RAP;
- Maintain all site records related to the implementation of this RAP;
- Ensure sufficient information is provided to engage or direct all required parties, including sub-contractors, to implement the requirements of the RAP other than those that are the direct responsibility of the Principal Contractor;
- Manage the implementation of any recommendation made by those parties in relation to work undertaken in accordance with the RAP;
- Inform, if appropriate, the relevant regulatory authorities of any non-conformances with the procedures and requirements of the RAP in accordance with the procedures outlined in this document;

- Retain records of any contingency actions;
- On completion of the project, to review the RAP records for completeness and update as necessary; and
- Recommend any modification to general documentation which would further improve the environmental outcomes of this RAP.

J2.3 Surveyor

The project surveyor will be a registered surveyor engaged by the Principal Contractor to undertake surveying works as required by this RAP.

J2.4 Remediation Contractor

The Remediation Contractor is foreseen to be the party responsible for the general remediation works. It is noted that the Remediation Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the remediation works.

In addition to the implementation of the RAP it is the Remediation Contractor's responsibility to *inter alia*:

- Obtain specific related approvals as necessary to implement the works that are the direct responsibility of the Remediation Contractor;
- Ensure work health safety (WHS) site monitoring and mitigation practices are being undertaken as required by the Occupation Hygienist (and Environmental Consultant where appropriate);
- Undertake testing of imported materials (e.g., soils, aggregates, etc.);
- Keep records of materials being imported and removed from site;
- Keep records, testing results and surveys for placed cap;
- Keep records of soil remediation works including excavations;
- Develop or request and review plans to manage remediation works;
- Undertake surveys and providing surveys to the Principal Contractor;
- Check all site works, and other related activities are undertaken in accordance with this RAP;
- Maintain all site records related to the implementation of remedial works as outlined herein;
- Review and approve all quality assurance documentation prior to providing to the Principal Contractor and Environmental Consultant;
- Providing documentation to the Principal Contractor and Environmental Consultant for review and approval (e.g., products specifications);
- That sufficient information has been provided to engage or direct all required parties, including sub-contractors, to implement the requirements of the remedial works required under the RAP that are the direct responsibility of the Remediation Contractor;
- Inform the Principal Contractor any non-conformances with the procedures and requirements of the RAP in accordance with the procedures outlined in this document;

- Retain records of any contingency, unexpected finds protocol and asbestos finds protocol actions;
- On completion of the remedial works, to review the RAP records for completeness and update as necessary that are the direct responsibility of the Remediation Contractor; and
- To recommend any modification to general documentation which would further improve the environmental outcomes of this RAP.

The Remediation Contractor may be the same entity as the Principal Contractor or Asbestos Contractor.

J2.5 Asbestos Contractor

The Asbestos Contractor is responsible for undertaking all asbestos work involving any asbestos impacted filling and is to hold a Class A licence for the removal of asbestos (issued by SafeWork NSW), on the basis that the asbestos identified at the site to date has included both friable and bonded asbestos.

The Asbestos Contractor can be the same entity as the Remediation Contractor.

J2.6 Sub-contractors

All sub-contractors are to be inducted onto the site, informed of their responsibilities in relation to this RAP and sign their agreement to abide by the RAP requirements. Signing of the site induction is to include agreement by the sub-contractors to abide by the RAP requirements. Where necessary, sub-contractors are also to be trained in accordance with the requirements of this document. All sub-contractors must conduct their operations in accordance with the RAP as well as all applicable regulatory requirements.

J2.7 Environmental Consultant

The Environmental Consultant is to provide advice on implementing the RAP. The Environmental Consultant is responsible for *inter alia*:

- Undertaking any required assessments where applicable (e.g., waste classification, validation sampling, assessments of soil treatment, etc.);
- Undertaking inspections as part of the validation process;
- Providing advice and recommendations arising from inspections;
- Reviewing documentation and results provided by the Principal Contractor and Remediation Contractor (e.g., surveys);
- Notifying their client with the results of any assessments and any observed non-conformances in a timely manner;
- Preparation of a final validation report confirming the suitability of the area subject to remediation for its continued use as a primary school; and

- Preparation of a long term environmental management plan or updated to the school's existing asbestos management plan (AMP).

J2.8 Licenced Asbestos Assessor

A Licenced Asbestos Assessor will be required to be engaged independently of the Asbestos Contractor to undertake the following *inter alia*:

- Review and approve documentation prepared by the Asbestos Contractor;
- Preparation of the construction phase AMP;
- Prepare any WHS plans and advice required by the aforementioned contractor(s);
- Undertake airborne asbestos monitoring;
- Undertake clearance inspections;
- Provide advice and recommendations arising from monitoring and/or inspections; and
- Notify their client with the results of any assessments and any observed non-conformances in a timely manner.

The Environmental Consultant and Occupational Hygienist can be the same entity.

J2.9 Site Workers

All workers on the site are responsible for observing the requirements of this RAP and other management plans. These responsibilities include the following:

- Being inducted on the site and advised of the general nature of the remediation/environmental issues at the site;
- Being aware of the requirements of this plan;
- Wearing appropriate personal protective equipment (PPE);
- Only entering restricted areas when permitted; and
- Requesting clarification when unclear of requirements of this or any other plans (e.g., safe work method statements (SWMS)).

J3.0 Stormwater Management

J3.1 Stormwater

Stormwater must be managed during the remediation works such that potential adverse impacts from surface runoff (e.g., cross contamination, mobilisation of contaminants in soil particles, etc.) are appropriately mitigated. Accordingly, the Remediation Contractor is to take appropriate measures which may include:

- Construction, where necessary, of stormwater diversion channels, bunding and linear drainage sumps with catch pits in and around the remediation areas to divert stormwater from the contaminated areas;
- Provision of appropriately located sediment traps including geotextiles; and
- Discharge of excess water in excavations / low points on a regular basis to limit the potential for flooding.

J3.2 Dewatering of Excavations

Any runoff or seepage water accumulated in site excavations that requires removal must initially be sampled and tested for suspended solids, pH and any contaminants of potential concern (COPC) as identified by the Environmental Consultant. The options for management of excavation pump-out water, dependent upon the test results, are for disposal of the water as follows:

- Discharge to stormwater with prior approval from Council. Provided the test results comply with relevant ANZG *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) guidance, or any other compliance requirements stipulated by Council. The Environmental Consultant must consider the most appropriate criteria to be used; or
- Discharge to sewer, as industrial trade wastewater, with prior approval from Sydney Water. This option would require the analysis of a larger list of analytes, and compliance with the Sydney Water acceptance standards; or
- Pumping by a liquid waste contractor for removal of the water off-site, in accordance with regulatory requirements.

Note that, depending on the type and scale of the dewatering required, a permit (water use approval) may need to be obtained through NSW Water. In this regard, obtaining permits from aforementioned organisations can take significant time periods and hence this should be considered during project planning.

J4.0 Soil Management Plan

J4.1 Excavation and Stockpiling of Contaminated Material

Contaminated material shall be excavated and stockpiled at suitably segregated locations away from sensitive areas (e.g., water bodies, drainage lines, stormwater pits, etc.) and ongoing excavations, and in a manner that will minimise nuisance to the neighbouring properties and school users. Soil stockpiles are to be managed as follows:

- All stockpiles of contaminated material shall be surrounded by star pickets and marking tape or other suitable material to clearly delineate their boundaries;
- Stockpiles shall be lightly conditioned by sprinkler or covered by geotextile or similar cover to prevent dust generation;
- Any stockpile to remain on-site overnight should be adequately secured in order to reduce the risk of sediment runoff; and
- Should the stockpile remain on-site for over 24 hours, geotextile silt fences are to be erected to prevent losses by surface erosion.

All movement of soil within the site and off-site is to be tracked by the Remediation Contractor, from cradle to grave. Copies of tracking records must be provided to the Environmental Consultant.

J4.2 Loading and Transport of Soil

Transport of soils (including aggregates and landscaping materials) to and from the site shall be via a clearly delineated haul route and this route shall be used exclusively for entry and egress of vehicles used to transport contaminated materials within and away from the site. The proposed transport route (to be determined by the Remediation Contractor) is to be notified to Council and truck dispatch shall be logged and recorded by the Remediation Contractor for each load leaving the site. A record of the truck dispatch is to be provided to the Environmental Consultant.

All haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site should be selected to meet the following objectives:

- Comply with all road traffic rules;
- Minimise noise, vibration and dust to adjacent premises; and
- Utilise State roads and minimise use of local roads as far as practicable.

The remediation work is to be conducted such that all vehicles:

- Conduct deliveries of soil, materials, equipment or machinery only during the specified hours of remediation;
- Have securely covered loads to prevent any dust or odour emissions during transportation; and
- Exit the site in a forward direction.

In addition, measures are to be implemented to minimise the potential for material to be spilled onto public roadways or tracked off-site on vehicle wheels. Roadways will be kept clean throughout the remediation works and are to be broomed, if necessary, to achieve a clean environment.

All loads are to be securely covered and may be lightly wetted, if required, to ensure that no materials or dust are dropped or deposited outside or within the site. Prior to exiting the site each truck should be inspected by Remediation Contractor personnel and either noted as clean (wheels and chassis) or broomed prior to leaving the site. Any soil spilled onto surrounding streets will be cleaned by mechanical or hand methods, on a daily basis.

Removal of waste materials from the site shall only be carried out by contractors holding the appropriate license(s), consent or approvals to dispose the waste materials according to the waste classification and with the appropriate approvals obtained from the EPA, were required. It is noted that any asbestos waste / asbestos impacted soil transported in NSW weighing more than 100 kg or consisting of more than 10 m^2 of asbestos sheeting in one load is required to be recorded utilising the NSW EPA tool, WasteLocate.

J5.0 Noise and Vibration Control Plan

All equipment and machinery should be operated in an efficient manner to minimise the emission of noise. The use of any plant and / or machinery should not cause unacceptable vibrations to nearby properties and are to meet Council requirements.

J6.0 Dust Control Plan

Dust emissions are to be confined within the site boundary as far as is practicable. The following example dust control procedures could be employed to comply with this requirement, as necessary:

- Erection of dust screens around the perimeter of the site (as applicable);
- Securely covering all loads entering or exiting the site;
- Use of water sprays across the site to suppress dust;
- Covering of all stockpiles of contaminated soil remaining on site more than 24 hours;
- Ceasing works during periods of inclement weather such as high winds;
- Include wheel wash (if applicable); and
- Keeping excavation and stockpile surfaces moist.

Regular checking of the fugitive dust issues is to be undertaken. Remedial measures are to be undertaken to rectify any cases of excessive dust emissions.

J7.0 Odour Control Plan

No odours should be detected at any boundary of the site during remediation works by an authorised Council Officer relying solely on sense of smell. The following example procedures could be employed to comply with this requirement as required:

- Use of appropriate covering techniques such as plastic sheeting, polythene or geotextile membranes to cover excavation faces or stockpiles;
- Fine spray of water and / or hydrocarbon mitigating agent on the impacted areas / materials;
- The use of water spray, as and when appropriate;
- Use of sprays or sprinklers on stockpiles or loads to lightly condition the material;
- Restriction of stockpile heights to ~4 m above surrounding site level. If required, restrict uncovered stockpiles to appropriate sizes to minimise odour generation;
- Ceasing works during periods of inclement weather such as high winds or heavy rain;
- Regular checking of the fugitive dust and odour issues to ensure compliance. Undertake immediate remediation measures to rectify any cases of excessive dust or odour (e.g., use of misting sprays or odour masking agent); and
- Adequate maintenance of equipment and machinery to minimise exhaust emissions.

J8.0 Work Health and Safety Plan

J8.1 General

It is the Principal Contractor's and Remediation Contractor's responsibility to devise a SWMS[2] (or series thereof, for various respective tasks) and to implement proper controls that enable the personnel undertaking the remediation to work in a safe environment. This RAP and SMP does not relieve the Remediation Contractor or other contractors of their ultimate responsibility for occupational health and safety of their workforce and to prevent contamination of areas outside the 'remediation' workspace. To assist this RAP and SMP have set out general procedures and the minimum standards and guidelines for remediation that will need to be used in preparing the safe work method statement.

This outline of a work health safety plan (WHSP) has been prepared with refence to CRC CARE *Remediation Action Plan: Implementation - Guideline on Health and Safety* (CRC CARE, 2019). The requirements of this WHSP must be incorporated into the Remediation Contractor's SWMS.

All site work must be undertaken in a controlled and safe manner with due regard to potential hazards, training and safe work practices. To attain this the SWMS developed by the Remediation Contractor must comply with policies specified in the Work Health and Safety Regulation 2017.

All appropriate permits, licences and notifications required for the remediation activities must be obtained prior to the commencement of remediation works.

[2] Either a SWMS, CEMP, or other equivalent document incorporating health and safety aspects of the proposed remedial works.

J8.2 Site Access

Appropriate fencing and signage is to be installed around and within the site to prevent unauthorised access and restrict access to remediation areas and / or deep excavations. Access restrictions and administrative arrangements for management of entry of workers or related personnel on site is the responsibility of the Principal Contractor and Remediation Contractor.

Any existing pits or unstable areas on site that may generate potential safety, or operational risk should be demarcated and taped off, with appropriate rectification action undertaken (e.g.,backfilling of pits).

J8.3 Personnel and Responsibilities

Before undertaking works on site, all personnel will be made aware of the officer responsible for implementing WHS procedures. All personnel must read and understand this WHSP and over-arching SWMS prior to commencing site works and sign a statement to that effect. Contractors employed at the site will be responsible for ensuring that their employees are aware of, and comply with, the requirements of this WHSP and Remediation Contractor's SWMS.

J8.4 Contamination Hazards

Contamination that may be present in the soils at the site is predominantly asbestos, however contamination may also include other COPC identified in DP (2022). There is also a lower probability of other contaminants being present.

The risks associated with the identified contaminants to site personnel and workers involved in the remediation are considered to be low due to the concentrations within soil and groundwater and limited exposure durations. These risks are associated with:

- Ingestion of contaminated soil and / or water;
- Dermal contact with contaminated soil and / or water; and
- Inhalation of dusts or vapours of the COPC.

Personnel are to endeavour, wherever possible, to avoid direct contact with potentially contaminated material. Workers must avoid the potential exposures listed above as far as is practicable. Appropriate personal protective equipment (PPE) must be used to mitigate potential risks.

J8.5 Physical Hazards

The physical hazards are associated with conditions that may be created during remediation works include (but not limited to):

- Heat exposure;
- Excavations;
- Buried services;

- Noise;
- Dust;
- Electrical equipment;
- Heavy equipment and truck operation; and
- Asbestos.

Safe work practices must be employed to manage the physical risks identified above. For the most part these risks can be managed through appropriate demarcation, access controls and the use of appropriate PPE.

J8.6 Safe Work Practices

The appropriate safe work practices should be clearly defined by the Remediation Contractor in their SWMS. As a minimum, all personnel on site are required to wear the following PPE:

- Steel-capped boots (mandatory);
- High visibility clothing / vest (mandatory);
- Safety glasses or safety goggles with side shields requirements (as necessary);
- Hard hat (as necessary);
- Appropriate respiratory and protective equipment for any works involving asbestos (as necessary); and
- Hearing protection when working in the vicinity of machinery or plant equipment if noise levels exceed exposure standards (as necessary).

Each item of PPE is to meet the corresponding relevant Australian Standard(s).

Specific safe work practices will be adopted when working with asbestos, in accordance with (but not limited to) the following codes of practice:

- SafeWork NSW *Code of Practice, How to Manage and Control Asbestos in the Workplace* (SafeWork NSW, 2019a)
- SafeWork NSW *Code of Practice, How to Safely Remove Asbestos* (SafeWork NSW, 2019b);
- WorkCover NSW *Managing Asbestos in or on Soil* (WorkCover NSW, 2014); and
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Ed* (NOHSC, 2005).

Further information on hazards and safe work practices with respect to asbestos are to be included in the AMP and SWMS to be developed prior to commencing works.

J9.0 Remediation Schedule and Hours of Operation

The remediation works are to be conducted within the days and hours specified in the development consent.

J10.0 Response to Incidents

The key to effective management of incidents is the timely action taken before any situation reaches a reportable or critical level. Therefore, surveillance activities are extremely important, and should be conducted for the measures prescribed herein and any other measures prescribed in any additional environmental management plan developed subsequently. During construction activities on the site, the following inspection or preventative actions is to be performed by the Principal Contractor and Remediation Contractor:

- Regular inspection of works;
- Completion of routine environmental checklists and follow-up of non-compliance situations;
- Maintenance and supervision on-site; and
- An induction process for site personnel involved in the remediation works that includes relevant information on the contamination status of the site, the remediation works being undertaken, worker health and environmental protection requirements and ensures that all site personnel are familiar with the site emergency procedures.

An emergency response plan will be in place for all aspects of site works. Any emergency will be reported immediately to the site office and / or the Site Manager (and Safety Officer), and the appropriate emergency assistance should be sought. The Site Manager should be responsible for initiating an immediate emergency response using the resources available on the site. Where external assistance is required, the relevant emergency services should be contacted. A table such as the example below, containing contact details for key personnel who may be involved in an environmental emergency response should be completed and be readily available to personnel at all times. The table should be completed, and thereafter amended, as required.

The Principal Contractor is to be responsible for ensuring that site personnel are aware of the emergency services available and the appropriate contact details. A site Safety Officer should be contactable, or available, on-site during remediation and development works.

Contact details for key utilities are included in the event of needing to respond to incidents. Blank cells are ‘to be confirmed’ and should be completed prior to works commencing when all entities are confirmed.

Table 1: Summary of Roles and Contact Details

Role	Personnel / Contact	Phone Contact Details
Principal		
Principal's Representative		
Site Manager		
Remediation Contractor and Builder		
Site Office		
Environmental Consultant		
Consent Authority		
Local Council	Northern Beaches Council	1300 434 434
Regulator	NSW EPA (pollution line and general enquiries)	131 555
Utility Provider	Water (Sydney Water Corporation)	13 20 92
Utility Provider	Power (Ausgrid)	13 13 88
Utility Provider	Gas (Jemena Limited)	131 909
Utility Provider	Telecommunications (Telstra Corporation Limited)	13 22 03
Utility Provider	Telecommunications (NBN Co Limited)	1800 687 626

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