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Remediation Action Plan

Surface & Civil Alignment Works (SCAW) Package for
Sydney Metro - Western Sydney Airport (SMWSA)
Area of Environmental Concern (AEC) 36,
Patons Lane, Orchard Hills

Prepared for
CPB Contractors Pty Limited & United Infrastructure
Pty Limited Joint Venture (CPBUI JV)

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

	Signature	Date
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Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

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Executive Summary

Douglas Partners Pty Ltd (DP) has prepared this Remediation Action Plan (RAP) for the Surface and Civil Alignment Works (SCAW) package for Sydney Metro - Western Sydney Airport (SMWSA) at Area of Environmental Concern (AEC) 36, Patons Land, Orchard Hills. The RAP was commissioned by CPBUI JV.

The remediation objectives, devised in accordance with CRC (2019a), are to:

- Address potentially unacceptable risks to relevant environmental values from contamination; and
- Render the site suitable, from a contamination perspective, for the final intended land use.

This RAP provides details of the work that will be required at the site to meet the remediation objectives.

The site at AEC36 is shown on Drawings AEC36-01 to AEC36-04, Appendix A. The remedial boundary for this RAP covers two areas within AEC 36 (within the SCAW project area) as shown on Drawing AEC36-05, Appendix A.

During the detailed site investigation (DSI),

- A fibrous sheet (approximately 50 mm wide) was identified in the fill at AEC36TP71 (depth 0-0.1 m) and was noted to be in 'poor' condition. The fibrous sheet (sample AEC36TP71-PACM) was identified to contain asbestos by the laboratory (and was considered to be in friable form). The laboratory identified asbestos (>7 mm) in the 500 mL soil sample from AEC36TP71, depth 0 – 0.1 m;
- Asbestos (as fibre cement > 7 mm) was identified in the 500 mL sample from AEC36HA78, depth 0 – 0.1 m; and
- Fibre cement sheets were observed on the ground surface at AEC36HA79 next to a (mostly) demolished structure. Asbestos was identified in a fibre-cement sample (PACM79) from the ground surface. The asbestos in the fibre cement was considered to be in bonded form.

The preferred remediation strategy is to excavate and, as much as possible, contain the asbestos contaminated soil within a proposed mound in an area identified as 'PS105' which is within the SCAW project boundaries. The remediation strategy for on-ground asbestos (fibre-cement) is disposal to a licensed landfill facility. The general sequence of remediation will include:

- Task 1: During or following demolition of remnant structures, removal of any visible asbestos from the ground surface (Remediation Area 1). Asbestos impacted soil, if any, is to be relocated to PS105. Removal of asbestos is to be validated;
- Task 2: Excavation and relocation of asbestos contaminated soil (Remediation Area 2 and Remediation Area 3) and validation of its removal; and
- Task 3: Remediation of asbestos identified from a (proposed) data gap investigation (if any) which will further assess the site for asbestos contamination, and site walkover following stripping of vegetation.

The remediation and validation methods and approach (including QA / QC for validation) are documented in this RAP. In addition, this RAP provides a contingency plan and unexpected finds protocol and general site management plan.

It is considered that the site can be made suitable for the final intended land use subject to implementation of this RAP.

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Remediation Action Plan

Surface & Civil Alignment Works (SCAW) Package for Sydney Metro - Western Sydney Airport (SMWSA)

Area of Environmental Concern (AEC) 36, Patons Lane, Orchard Hills

1. Introduction

Douglas Partners Pty Ltd (DP) has prepared this remediation action plan (RAP) for the Surface and Civil Alignment Works (SCAW) package for Sydney Metro - Western Sydney Airport (SMWSA) at Area of Environmental Concern (AEC) 36, Patons Land, Orchard Hills. The RAP was commissioned by CPBUI JV.

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).

The remediation objectives, devised in accordance with CRC (2019a), are to:

- Address potentially unacceptable risks to relevant environmental values from contamination; and
- Render the site suitable, from a contamination perspective, for the final intended land use.

This RAP provides details of the work that will be required at the site to meet the remediation objectives.

CPBUI JV has engaged NSW EPA accredited site auditor, Melissa Porter, to complete a site audit under the *Contaminated Land Management Act 1997* (NSW), which involves review of this RAP and associated reports.

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 site remediation can be achieved.

The site at AEC36 is shown on Drawings AEC36-01 to AEC36-04, Appendix A. This report must be read in conjunction with all appendices including the notes provided in Appendix B.

2. Site Identification and Proposed Development

Table 1 provides a summary of information for site identification. The site at AEC36 is shown on Drawings AEC36-01 to AEC36-04. The remedial boundary for this RAP covers two areas within AEC 36 (within the SCAW project area) as shown on Drawing AEC36-05, Appendix A.

Table 1: Site Identification Information

Item	Details
Address of site at AEC 36 (from SIX Maps)	Patons Lane, Orchard Hills; and 122C Patons Lane, Orchard Hills
Legal description of site at AEC 36 (from SIX Maps)	(Part of) Lot 111 Deposited Plan 1276407 (Part of) Lot 115 Deposited Plan 1276407
Approximate area of AEC 36 (in EIS)	19.6 ha
Approximate area of site at AEC 36	12.1 ha
Approximate areas within remedial boundary	Northern area: 0.6 ha Southern area: 0.3 ha Total: 0.9 ha
Zones for site (from ePlanning Spatial Viewer)	Not Zoned along proposed rail line C2: Environmental Conservation
Local Government Area	Penrith City Council
Land owners	Sydney Metro (Lot 111 Deposited Plan 1276407) Department of Defence (Lot 115 Deposited Plan 1276407)

Note: EIS is the M2A Joint Venture, *Sydney Metro – Western Sydney Airport Environmental Impact Statement*, October 2020.

The SCAW package relates to the proposed construction of approximately 10 km of rail alignment between Orchard Hills and the (future) Western Sydney International airport consisting of a combination of viaducts and surface rail. Areas alongside the proposed rail alignment will be used by contractors for staging and maintenance for the Metro.

Cardno, *Human Health and Ecological Risk Assessment, Spoil Re-use Sydney Metro and Western Sydney Airport*, 29 June 2021 (80021888 SMSWA HHERARev3-Issued.docx) (Cardno, 2021a) (HHERA) provides (simple) conceptual site models for different general future land uses for the overall SMWSA project. The two general future land uses associated with the SCAW component of the project are considered to be:

- The rail corridor which will include the rail line, embankments / noise barriers, a stabling yard and maintenance facility and Luddenham station; and
- Passive open space. These are areas immediately adjacent to the rail corridor that may be used for bike / commuter paths. It is assumed that there is absence of buildings in areas of passive open space.

It understood that the site will comprise both of the above-listed land uses for the final intended land use. The alignment of the proposed rail line is shown on Drawings AEC36-01 to AEC36-04, Appendix A. It is assumed that the parts of the site zoned as C2 Environmental Conservation will be adapted to passive open space usage.

The site comprises covers two areas within AEC 36 where soil is proposed to be disturbed for SCAW. Development of these two areas will likely include stripping of topsoil and placement of (geotechnically suitable) soil to raise the ground level (up to approximately 3 m above current ground levels) for the surface rail line. Soil to raise ground levels is likely to be sourced from off-site. Stripped topsoil will be subject to reuse elsewhere for SCAW where considered suitable to do so.

3. Scope of Work

The scope of works to achieve the objective is as follows:

- Summarise the findings of previous investigations used to inform the status of contamination and contamination risk at the site;
- 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;
- Define the anticipated extent of remediation;
- Assess, select and justify a preferred approach to remediation to render the two areas within the remedial boundary to be suitable for its proposed use, and which will minimise potentially unacceptable risk to human health and / or the environment and which includes the consideration of the principles of ecologically sustainable development;
- Select an appropriate remediation strategy to render the two areas with the remedial boundary suitable, from a contamination perspective, for the proposed final intended land use;
- 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;
- Outline environmental safeguards required to complete the remediation works; and
- Include contingency plans and an unexpected finds protocol.

4. Site Condition and Environment Information

Table 2 provides a summary of information relating to the condition and environment relating to the two areas within the remedial boundary.

Table 2: Site Condition and Environment Information

Item	Details
Geology	Bringelly Shale: comprising shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff for the majority of the site. (Penrith 1:100,000 Geology Sheet).
Soil landscape	Blacktown soil landscape which comprises residual soils. (Penrith 1:100,000 Soils Landscape Sheet).
Topography	The areas within the remedial boundary are at approximately 47 m AHD. Slopes are generally down to the west and northwest towards the off-site unnamed creek to the west. (NSW 2 m elevation contours map).
Salinity	The salinity potential ranges from moderate salinity potential to high salinity potential. (Department of Infrastructure Planning and Natural Resources, Salinity Potential in Western Sydney Map).
Acid sulfate soils	AEC 36 is not within an area or close to an area associated with a risk of acid sufate soils (NSW Acid Sulfate Soil Risk map).
Surface water bodies and surface water flow	There are no surface water bodies at the areas within the remedial boundary. An unnamed creek is located approximately 350 m to the west. Much of the rainfall at the areas within the remedial boundary is anticipated to infiltrate permeable ground surfaces. Surface water runoff is expected to flow to the west and north-west towards the unnamed creek.
Groundwater flow direction and discharge	Based on topography, shallow groundwater (if any) is anticipated to flow towards, and potentially discharge at, the unnamed creek to the west.
Registered groundwater bores	There are no registered groundwater bores within 500 m of the areas within the remedial boundary (WaterNSW). The nearest registered bore (GW105382) is located approximately 850 m to the north. The bore was drilled at Osbourne Park, 227 Luddenham Road, Orchard Hills in 2004 to a depth of 252 m for industrial purposes. Water bearing zones were recorded at depths of 144 m to 145 m, 180 m to 181 m, and 240 m to 241 m. A series of registered bores were also installed for industrial and monitoring purposes at Patons Lane Landfill which is located approximately 1.2 km to the north.

Item	Details
Site use and features	The areas with the remedial boundary were part of a Defence Establishment which included a munitions storage facility and was formerly known as RAAF Base Kingswood (EIS). The areas take on the appearance of grazing land as it is mostly grass-covered with some trees. There are some vehicle access tracks and a (mostly) demolished structure (see Drawings AEC36-05, Appendix A)
Surrounding land use	Surrounding land to the north, east and south was part of a Defence Establishment which included a munitions storage facility and was formerly known as RAAF Base Kingswood (although the land takes on the appearance of grazing land). Further to the south are Warragamba to Prospect Water Supply Pipelines easement (running east to west) and Kennetts Airfield (a private airfield). Surrounding land to the east is used for rural purposes. A potential former cattle or sheep dip / spraying area (now demolished) was identified approximately 30 m to the south east (EIS). Drawings AEC36-01 to AEC36-05, Appendix A shows surrounding features.
Information from historical aerial photographs	At AEC 36, there was pastured land with scattered trees and no building structures visible other than fence lines in 1955. A small building was visible at the site in 1980 and 1994 (now mostly demolished) (EIS). The (off-site) pipelines to the south appeared to be under construction in 1955. Kennetts Airstrip, further to the south, has been present since 1980s and was likely to have been grazier land prior to its establishment (EIS).
NSW EPA records	There were no NSW EPA regulated sites (under the Contaminated Land Management Act 1997) within 1 km of the areas within the remedial boundary (EIS). There were no sites notified to the NSW EPA (under the Contaminated Land Management Act 1997) within 1 km of the areas within the remedial boundary (EIS). There were no NSW EPA PFAS investigation sites within 2 km of the areas within the remedial boundary (EIS).

Note: EIS is the M2A Joint Venture, *Sydney Metro – Western Sydney Airport Environmental Impact Statement*, October 2020.

5. Previous Reports

The following previous reports are relevant to this RAP:

- Cardno, *Contamination Assessment Report, Sydney Metro Western Sydney Airport,* 1 September 2021 (80021888-CDO-CAR-RPT-004-RevE) (Cardno, 2021b);
- DP, *Report on Detailed Site Investigation (Contamination), Surface & Civil Alignment Works (SCAW) Package for Sydney Metro - Western Sydney Airport (SMWSA), Area of Environmental Concern (AEC) 36, 37 & 38, Patons Lane & Stockdale Road, Orchard Hills and Luddenham Road, Luddenham,* July 2023 (204814.01.DSI.011.Rev1) (DSI) (DP, 2023a);
- G-tek, *Unexploded Ordnance, Field Validation Survey, Patons Lane, Defence Establishment*, *Orchard Hills, NSW*, 26 March 2021, (project 20142SYME, V1.02) (G-tek, 2021); and
- G-tek, *Works Area Review, 22129CPBU, Defence Establishment Orchard Hills,* 8 December 2022 (review number 22129_001) (G-tek, 2022).

5.1 Cardno Investigations

Cardno (2021b) contains investigation results across a wide area for SMWSA. Although no soil samples were collected from the areas within the remedial boundary, asbestos was detected in fibre cement sample ACM01_300321. Although little information was reported by Cardno on the fibre-cement find, it appears that the sample was collected from the ground surface at the location of the demolished structure. The approximate sample location for ACM01_300321 is shown on Drawing AEC36-03, Appendix A.

5.2 G-tek Survey

G-tek (2021) provides the outcomes of a 10% unexploded ordnance (UXO) Field Validation Survey (FVS) at AEC 36 between 16 and 18 February 2021. For the FVS, G-tek operators conducted both visual and instrumental searches in parallel transects approximately 10 m apart over the entire AEC 36 area apart from three fenced-off, inaccessible areas. No UXO or explosive ordnance (EO) related material were identified during the FVS. It was concluded that, based on the FVS, the survey area (AEC 36) had not been used for the use or storage of explosive ordnance or related material. It was recommended that Sydney Metro activities at the survey area (AEC 36) be conducted without further unexploded ordnance works or support.

G-tek (2022) is a letter that includes the results of a review of G-tek (2021) and a site walkover on 8 December 2022. From a UXO perspective, it was considered that the conclusions and recommendations of G-tek (2021) remain valid and the survey area (AEC 36) is suitable for the proposed development works to be safely conducted.

5.3 DSI

The DSI was for a much larger site area (approximately 14.5 ha) than the areas subject to this RAP. The site area for the DSI covered parts of AEC 37 and AEC 38 as well as a large part of AEC 36.

The scope of work for the DSI (DP, 2023a) included the collection of soil samples using an excavator and hand auger; collection of a creek sediment sample; collection of a creek water sample; installation and development of groundwater monitoring wells; and collection of groundwater samples. Sample locations at AEC36 are shown on Drawings AEC36-01 to AEC36-04, Appendix A. Sample locations at the areas within the remedial boundary included test pits AEC36TP67, AEC36TP69, AEC36TP71 and AEC36TP72; hand auger boreholes AEC36HA76 to AEC36HA82; and groundwater monitoring well AEC36BH03. The test pit and borehole logs are provided in Appendix C.

The soil profile encountered at test pits and hand auger boreholes at the areas within the remedial boundary is summarised as follows:

- Fill comprising silty sand was encountered at all test pits and hand auger boreholes, between 0.2 m and 0.4 m thick; and
- Fill was observed to be underlain by silty clay at all test pits and hand auger boreholes. Silty clay was encountered up to depths of 1.2 m below ground level.

A fibrous sheet (approximately 50 mm wide) was identified in the fill at AEC36TP71 (depth 0-0.1 m) and was noted to be in 'poor' condition. Fibre-cement sheets were observed on the ground surface at AEC36HA79 (next to the demolished structure).

The borehole for groundwater monitoring well AEC36BH03 was drilled through a surface layer of silty sand fill (0.3 m thick). Fill was underlain by sandy gravel to a depth of 0.8 m, then silty clay to a depth of 3.5 m and then sandstone and siltstone to a depth of 10 m. At the time of groundwater sampling (1 February 2023), the measured groundwater depth was 5.49 m.

Selected soil samples were analysed for: metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); total recoverable hydrocarbons (TRH); benzene, toluene ethylbenzene and xylenes (BTEX); polycyclic aromatic hydrocarbons (PAH); organochlorine pesticides (OCP), organophosphorus pesticides (OPP); polychlorinated biphenyl (PCB), total phenols, asbestos and per- and polyfluoroalkyl substances (PFAS). The fibre-cement sample (AEC36TP71-PACM) collected from a depth of 0 - 0.1 m at AEC36TP71 was analysed for asbestos. The fibre-cement sample from the demolished structure (PACM79) was also analysed for asbestos. A summary of analytical results for soil samples from the areas within remedial boundary is provided in Tables I1 and I3, Appendix D. Concentrations of chemicals were within the site assessment criteria adopted for the DSI. Asbestos was detected in:

- The 500 mL sample from AEC36TP71, depth 0 – 0.1 m. The asbestos was identified in fibre cement material > 7 mm;
- The fibrous sheet sample AEC36TP71-PACM collected from sieving the bulk fill sample (depth 0 - 0.1 m) at AEC36TP71. The asbestos in this sample appeared to be in friable form (i.e., not bonded). The sample weighed 6 g which equates to a concentration of 0.006% w/w in the bulk sample (assuming 15% asbestos in the fibrous sheet which may be an underestimate). This concentration is above the adopted health screening level (0.001% w/w);
- The 500 mL sample from AEC36HA78, depth 0 – 0.1 m. The asbestos was identified in fibre cement material > 7 mm; and

- Fibre cement sample PACM79, collected from the ground surface at the (mostly) demolished structure near AEC36HA79. The asbestos in the fibre cement was considered to be in bonded form.

The asbestos identified at AEC36TP71 may either be associated with the fill (of unknown origin) or as a result of fly tipping (dumping) as this sample location is close to structures and an access track adjacent the site to the east. The asbestos identified at AEC36HA78 may be associated with the fill (of unknown origin), or as a result of fly tipping (dumping) as this location is near an access track, or as a result of nearby demolition of the former structure where PACM79 was found.

Analytical results for groundwater samples collected from the areas within the remedial boundary are summarised in Table I2, Appendix D. Concentrations of chemicals were within the SAC for the DSI except for some metals, however, recorded concentrations of metals were considered to be within background ranges.

6. Conceptual Site Model

The data collected during previous investigations generally confirmed that for certain potential contaminant sources outlined in the preliminary CSM in the DSI, potentially complete pathways to the identified receptors exist, whereas for others, they do not. The source, pathway and receptor linkages are summarised in Table 3.

Potential Sources

Based on the investigations, the following sources of contamination have been identified:

- S1: Asbestos identified in fill at AEC36TP71 and AEC36HA78 potentially associated with fill of unknown origin or as a result of fly tipping; and
- S2: Asbestos identified at the ground surface (samples AEC01-300321 and PACM79) as a result of a demolished structure next to AEC36HA79.

Potential Receptors

The following potential human receptors have been identified:

- R1: Construction workers for SMWSA;
- R2: Maintenance workers (following construction of SMWSA);
- R3: Future site users (e.g., pedestrians, rail workers and visitors); and
- R4: Adjacent site users.

Potential Pathways

The following potential pathways have been identified:

- P1: Inhalation of dust.

A summary of the potentially complete exposure pathways for the proposed land use is shown in the table below.

Table 3: Summary of Potentially Complete Exposure Pathways (Proposed Land Use)

Source	Transport Pathway	Receptor
S1: Asbestos identified in fill S2: Asbestos identified at the ground surface	P1: Inhalation of dust	R1: Construction workers for SMWSA; R2: Maintenance workers (following construction of SMWSA); R3: Future site users (e.g., pedestrians, rail workers and visitors); and R4: Adjacent site users.

7. Remediation Extent

Based on the findings of the DSI, the extent of remediation comprises

- Remediation Area 1: The area at and around the demolished structure where asbestos containing materials (fibre-cement) were observed on the ground surface. The approximate extent of Remediation Area 1 is shown on Drawing AEC36-06, Appendix A, and is an approximate 15 m radius around the remnants of the structure (within the site boundary). The actual extent (the final remediation extent) is not known at this stage and will be established at the completion of the excavation of the area during remediation;
- Remediation Area 2: The area of impacted fill at AEC36HA78. The area covers a triangular area of approximately 1000 m^2 as shown on Drawing AEC36-06, Appendix A. The vertical extent is to a depth of approximately 0.3 m. The actual extent (the final remediation extent) is not known at this stage and will be established at the completion of the excavation of the area during remediation. It is noted that the remediation extent terminates at the site boundary at the east; and
- Remediation Area 3: The area of impacted fill at AEC36HA71. The area covers a triangular area of approximately 900 m^2 as shown on Drawing AEC36-06, Appendix A. The vertical extent is to a depth of approximately 0.3 m. The actual extent (the final remediation extent) is not known at this stage and will be established at the completion of the excavation of the area during remediation. It is also noted that the remediation extent terminates at the site boundary at the east.

8. Remediation Options Assessment

Section 6 (16) of Volume 1 of NEPC (2013) lists the *preferred hierarchy of options for site clean-up 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 the above 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.*

For the asbestos contaminated soil, it is noted that:

- The NSW EPA, *Position Statement - WA guidelines for asbestos contaminated sites* (April 2022) states that emu picking of asbestos is not permitted where asbestos is identified as FA / AF or as a remedial approach to 'clean' asbestos contaminated soils for reuse on site. The asbestos cannot be destroyed by treatment;
- On-site containment of asbestos contaminated soil would consist of the placement of a layer of clean soil or a permanent pavement cap over contaminated soils remaining at the site so as to contain the soil contamination within a barrier. Any retained contaminated soils would need to be subject to ongoing management, typically under an environmental management plan (EMP), which would need to be legally enforceable. Containment of the asbestos contaminated soil within the SCAW project boundaries is considered to be a suitable option for remediation of the asbestos contaminated soils given that there is likely to be sufficient space. It is noted that containment at the site (within AEC 36) is considered not to be practicable given the construction requirements for SCAW. The benefit of containment is that there may be some beneficial reuse of the contaminated soil at the SCAW project. The disadvantage of containment is the need for ongoing management;
- Removal of contaminated material to an approved facility (licensed landfill) is considered to be an appropriate option. The benefits of this option include that the potential exposure risk is removed and ongoing management is negated. The disadvantages of this option include that it does not follow the principal of sustainability as the soils are not subject to re-use at the site (or elsewhere) and the movement of trucks to and from the landfill can create traffic issues (which have other general environmental impacts); and
- Management without remediation is considered to not be appropriate for the proposed development given that excavation works at the asbestos contaminated area are proposed and these works may result in an exposure risk to the identified potential receptors.

Note that the on-ground fibre-cement (asbestos) at the demolished structure (Remediation Area 1) will need to be removed and disposed off-site as asbestos waste to a landfill authorised to accept asbestos waste (as per *Work Health and Safety Regulation 2017*).

9. Remediation Strategy

The preferred remediation strategy for Remediation Area 2 and Remediation Area 3, as agreed with CPBUI JV and Sydney Metro, is to excavate and, as much as possible, contain the asbestos contaminated soil within a proposed mound at the northern part of Lot 51 Deposited Plan 1276956 (which has street address 43B Luddenham Road, Orchard Hills), in an area identified as 'PS105' which is within the SCAW project boundaries. It is noted that NSW EPA Environment Protection Licence (EPL) 21695 allows for excavated material suitable for re-use within the SCAW project boundaries to be transported to another area within the SCAW project boundaries by road. The dimensions and encapsulation structure of the proposed mound is yet to be determined as CPBUI JV plan to stockpile asbestos contaminated material encountered from all parts of the SCAW project at PS105 and then determine the volume of asbestos contaminated soil requiring encapsulation for design of the mound. The capping material is likely to comprise 'clean' soil with grass coverage. The design and plan for encapsulating the soil, including a validation plan, is to be captured in a remediation action plan (that is separate to this document and is to be prepared at a later time). Sydney Metro would be responsible for maintenance and management of the completed mound under an asbestos management plan or environmental management plan (which will pe prepared at a later time). The proposed location for the future mound and associated stockpiling area is shown on Drawing A1, Appendix A.

The remediation strategy for on-ground asbestos (fibre-cement) is disposal to a licensed landfill facility. If it is found that soil is impacted with asbestos following removal of visible asbestos, the soil will be subject to the same remediation strategy as for asbestos contaminated soil at Remediation Area 2 and Remediation Area 3.

The remediation strategy does not include a methodology for the removal of any hazardous building materials from existing above-ground structures.

An *Asbestos Management Plan* (AMP) for *Sydney Metro Western Sydney Airport Surface and Civil Alignment Works (SCAW)* has been prepared by Tetra Tech Coffey Pty Ltd. Reference is to be made to the AMP when undertaking remediation works for asbestos contamination.

9.1 Sequence of Remediation

The general sequence of remediation shall be determined by the Contractor (CPBUI JV) and should consider the following sequence:

- Task 1: During or following demolition of remnant structures, removal of any visible asbestos from the ground surface at Remediation Area 1. Asbestos impacted soil, if any, is to be relocated to PS105. Removal of asbestos is to be validated;
- Task 2: Excavation and relocation of asbestos contaminated soil (Remediation Area 2 and Remediation Area 3) and validation of its removal; and
- Task 3: Remediation of asbestos identified from a (proposed) data gap investigation (if any) which will further assess the areas within the remedial boundary for asbestos contamination, and site walkover following stripping of vegetation.

9.1.1 Task 1: Remediation Area 1

The actual sequence of works will depend on the programme of the (Class A or B licensed) Asbestos Contactor, however, it is foreseen to include the sequence below. All works involving removal of the asbestos must be undertaken by the Asbestos Contractor. The sequence does not comment on demolition works of remnant structures and is limited to on-ground asbestos.

The proposed sequence comprises the following:

- Notification and site establishment works in accordance with the WHS Regulations. SafeWork NSW is to be notified in writing at least five days before the licensed asbestos removal work commences. An asbestos removal control plan (ARCP) is to be prepared for the asbestos removal work by the licensed asbestos removal contractor (Asbestos Contractor);
- All works will be conducted in a safe manner and to minimise environmental impacts (see Section 15);
- During and / or following demolition works for the remnant structure, the Asbestos Contractor is to remove all visible asbestos on the ground by 'emu-picking'. Fragments of fibre-cement should be wetted (using a water spray bottle) and then picked up and placed in 200-micron thick plastic bags which has the appropriate warning labels for asbestos waste. Bags are to be sealed with duct tape with bag openings to be tightly twisted and folded over to form a 'goose neck'. Each sealed bag is to be placed inside a second plastic bag with the appropriate warning labels for asbestos and sealed in the same way. The sealed bags are to be disposed of at an appropriately licensed landfill. Bags of asbestos that are awaiting disposal, should be stored in a secure location;
- Upon completion of the asbestos removal works, the area (Remediation Area 1) will be subject to a visual clearance inspection undertaken by the Occupational Hygienist;
- Once all asbestos materials have been removed and this has been confirmed through visual means, a clearance certificate report will be prepared by the Occupational Hygienist; and
- Following clearance, validation inspection and sampling is to be undertaken by the Environmental Consultant (see Section 11.3.1). Advice for further work is to be provided by the Environmental Consultant where validation results indicate that asbestos contamination is present.

It is noted that the on-ground asbestos at Remediation Area 1 is considered to be in 'good' condition and in non-friable form. In the case, that friable asbestos is identified, the asbestos removal work (as listed above) must be undertaken by an Asbestos Contractor with a Class A licence. In addition, air monitoring, clearance inspections and the issue of clearance certificates is to be done by a licensed Asbestos Assessor.

Where asbestos is identified in soil from validation soil sampling, the remediation approach (to be advised by the Environmental Consultant) is likely to be similar to that for Remediation Area 2 and Remediation Area 3 described below.

All works associated with the removal and validation of the asbestos is to be appropriately documented for inclusion in the validation report for the site.

9.1.2 Task 2: Remediation Area 2 and Remediation Area 3

It is assumed that any trees at Remediation Area 2 and Remediation Area 3 will be removed to ground level prior to commencing the work described below.

The remediation of asbestos contaminated fill identified thus far at Remediation Area 2 and Remediation Area 3 will be undertaken as follows:

- An asbestos removal control plan (ARCP) is to be prepared for the asbestos removal work by the licensed asbestos removal contractor (Asbestos Contractor). The work associated with asbestos remediation will be undertaken by an Asbestos Contractor holding a Class A licence. SafeWork NSW is to be notified in writing at least five days before the licensed asbestos removal work commences. Monitoring for airborne asbestos fibres is to be carried out by a licensed Asbestos Assessor (Occupational Hygienist) during the excavation and removal of asbestos contaminated materials;
- All works will be conducted in a safe manner and to minimise environmental impacts (see Section 15);
- The initial excavation areas at Remediation Area 2 and Remediation Area 3 will be marked out and cover the areas as shown on Drawing AEC36-06, Appendix A. (Note that the actual remediation areas may extend beyond these arbitrary areas);
- Excavation of identified contaminated soils, extending over the initial areas and to a minimum depth of 0.1 m into natural soil (which is anticipated to be approximately 0.3 m to 0.5 m below ground level based on the test pit logs);
- The extent of the excavation(s) may need to be increased (vertically or horizontally) where signs of contamination (possible ACM) are identified by the licensed Asbestos Assessor and / or Environmental Consultant;
- Stockpiling of the excavated soil on an area covered with a suitable plastic membrane to minimise the potential for contaminating soils beneath. In dry and windy conditions, the stockpile will be lightly wetted and covered with plastic whilst awaiting disposal;
- Upon completion of the excavation works, the excavation area will be subject to final visual clearance inspection of exposed areas undertaken by the Occupational Hygienist. Once all asbestos materials have been removed from the excavated area and this has been confirmed through visual and analytical means (where applicable), a clearance certificate report (or interim clearance report) will be prepared by the Occupational Hygienist;
- Validation samples from the excavation pit are to be collected by the Environmental Consultant (as per Section 11.3.2);
- Samples are to be collected from the stockpile by the Environmental Consultant at the sampling frequency provided in Section 12). From the results of sampling and testing, the Environmental Consultant is to provide advice on:
  - Suitability to be reused elsewhere on the SCAW project site;
  - Suitability to be transported to the PS105 stockpiling area for future encapsulation; or
  - The appropriate waste classification for off-site disposal.

- The excavation(s) is to be expanded under the direction of the Environmental Consultant where test results of validation samples do not meet the remediation acceptance criteria. Subsequent clearance inspection of exposed areas of the excavation is to be undertaken by the Occupational Hygienist and a (interim) clearance certificate is to be provided. Validation sampling of the expanded excavation is to be undertaken by the Environmental Consultant. Additional testing of the excavated soil may be required for suitability for reuse or waste classification assessments. This process may need to be repeated until all results meet the remediation acceptance criteria;
- At the completion of excavation works and removal of the asbestos impacted stockpile to PS105 or to a licensed landfill, a final clearance inspection is to be carried out and written certification is to be provided by the Occupational Hygienist that the area is safe to be accessed and worked. Following clearance, the area may be reopened for further general excavation or construction work; and
- If required, backfilling of the excavations with suitable material (deemed suitable by the Environmental Consultant and, if required, a geotechnical engineer).

Asbestos contaminated soil transported to PS105 is to be stockpiled on geofabric and covered in geofabric and secured to prevent the geofabric cover from being removed by wind. Sediment controls (hay bales, sandbags and/or silt fencing) are to be used around stockpiles at the stockpiling area. Stockpiles are to be clearly labelled (pegged or spray painted on the geofabric) and a site record is to be kept including the source location of each stockpile, the position of each stockpile (e.g., coordinates) at PS105 and date of its placement at PS105. This information is to be provided to the Environmental Consultant for validation reporting. (Further information on stockpiling requirements is provided in the Site Management Plan, Appendix E).

9.1.3 Task 3: Remediation of Asbestos Identified in Proposed Test Pits or Site Walkover

Section 11.4 describes the validation sampling plan for any asbestos found in additional test pits needed to characterise the areas within the remedial boundary. Where asbestos contamination is identified, it is likely that the procedures described in Section 9.1.2 will need to be adopted. Advice will also need to be provided by the Environmental Consultant to confirm the method of remediation and the initial extent of impacted fill and related remediation.

10. Assessment Criteria

10.1 Remediation Acceptance Criteria

The remediation acceptance criteria which are health screening levels sourced from NEPC (2013), for the remediation works described in Section 9 are as follows:

- Bonded asbestos: 0.02% w/w;
- Fibrous asbestos (FA) and asbestos fines (AF): 0.001% w/w; and
- No visible asbestos for surface soil for all forms of asbestos.

The health screening level for bonded asbestos is for a generic recreational land use to account for the passive open space component of the proposed development (which is a more sensitive land use than the rail corridor). The health screening level for bonded asbestos for a commercial / industrial land use (0.05% w/w) may be applicable in some circumstances (i.e., where soil is to remain within the rail corridor), however, given that the surficial soil / fill is proposed to be stripped and relocated, the less conservative health screening level has not been adopted as the primary criterion.

10.2 Site Assessment Criteria

Additional area(s) of contamination encountered beyond those outlined in Section 7, during the course of remediation and excavation works will be subject to the contingency plan or unexpected find protocol (Appendix F) and assessed using the SAC in Appendix G. This is on the provision that other considerations such as risks to groundwater are also taken into account. The SAC were adopted for the DSI and are also shown on the analytical results summary tables in Appendix D.

The SAC should also be used as part of the assessment framework for imported soils.

11. Validation Plan

11.1 Data Quality Objectives

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

11.2 Validation Assessment Requirements

The following validation work will be required:

- Field assessment by the Environmental Consultant comprising:
  - Visual inspections, including taking photographs for record purposes;
  - Collection of validation samples from excavations and stockpiles (and stockpile footprints) resulting from the removal of contaminated soils;
  - Collection of soil samples from test pits across the site for assessment for asbestos; and
  - Visual inspections following vegetation removal.
- Laboratory analysis of validation samples at a NATA accredited laboratory (generally for asbestos, the contaminant of concern relevant to the remediation area);
- Comparison by the Environmental Consultant of the laboratory results with the RAC and / or SAC as appropriate (refer to Section 10);
- Review of clearance inspection reports (prepared by the Occupational Hygienist) by the Environmental Consultant; and

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

Field assessment validation works are discussed in the following sections.

11.3 Validation of Remediation Areas

11.3.1 Remediation Area 1

Following the removal of fibre-cement (asbestos) fragments from the ground surface across Remediation Area 1, the area is to be subject to visual assessment by the Environmental Consultant. (It is noted that the Occupational Hygienist is to conduct visual inspections to provide prior clearance). The walkover of the area is to be conducted on an approximate 1 m by 1 m grid.

Validation sampling will be undertaken by the Environmental Consultant. The sampling will target the footprint of the remnant structure (subject to demolition works) and any ground surface soils which are observed to contain building rubble or anthropogenic materials. Sampling at these areas (including the remnant structure footprint) will be at a rate of one soil sample per 25 m^2, with a minimum of three soil samples from the footprint of the remnant structure. Samples will comprise 10 L bulk soil samples and 500 mL soil samples for analysis for asbestos. The bulk samples will be subject to onsite screening / sieving for ACM as described in Section 11.4. Laboratory analysis will be undertaken at a NATA accredited laboratory.

Validation sample test results will be compared to the RAC. Where the RAC are considered to have not been met, advice will be provided by the Environmental Consultant for the 'chase-out' (excavation) of impacted soil. The process of validation sampling and excavation of impacted material will be repeated until the impacted material has been fully chased out.

11.3.2 Remediation Area 2 & Remediation Area 3

Following the excavation of asbestos impacted soil, Remediation Area 2 and Remediation Area 3 are to be subject to visual assessment by the Environmental Consultant. (It is noted that the Occupational Hygienist is to conduct visual inspections to provide prior clearance). The walkover of the area is to be conducted on a 1 m by 1 m grid.

Validation sampling at Remediation Area 2 and Remediation Area 3 will be undertaken by the Environmental Consultant. The sampling frequency will depend on the volume or area to be assessed and the previous results. The following sampling frequencies will be adopted but may be modified by the Environmental Consultant to take into account previous results, where applicable:

- Base of excavation: one sample per 25 m^2 on a general grid pattern (with a minimum of three samples collected); and
- Sides of excavation: one sample per 5 m length. Samples will be collected from the depth of concern (which is expected to be 0-0.1 m depth).

The above sampling frequency may be modified by the Environmental Consultant based on observations. For natural soils, samples will comprise 500 mL soil samples which will be analysed for asbestos. For fill, samples will comprise 10 L bulk soil samples and 500 mL soil samples for analysis for asbestos. The bulk samples will be subject to onsite screening / sieving for ACM as described in Section 11.4. Laboratory analysis will be undertaken at a NATA accredited laboratory.

Where contaminated soils are stored on bare soils, the footprint of the stockpile will require validation following removal of the contaminated soils. The sampling frequency will be one sample per 25 m^2 on a general grid pattern across the stockpile footprint. Samples will comprise 500 mL soil samples which will be analysed for asbestos (and other contaminants of concern if identified during the remediation work).

Validation sample test results will be compared to the RAC. Where the RAC are considered to have not been met, the remediation excavation(s) will be expanded to 'chase-out' impacted material, as instructed by the Environmental Consultant, with the validation sampling then continuing into the extended excavation. This process will continue until the impacted material has been fully chased out.

11.4 Test Pits

According to NSW EPA, *Sampling Design Part 1 - application, Contaminated Land Guidelines,* 2022 (NSW EPA, 2022), greater sampling densities should generally be used for asbestos compared to those considered appropriate for other purposes. This is because asbestos can occur widely and unpredictably and, as a discrete contaminant, it can be hard to detect using conventional sampling regimes (according to Western Australian Department of Health, *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*, May 2009 (WA DOH, 2009)[1] which is referenced in NEPC (2013)). WA DOH (2009) recommends a minimum of 30 sample points for an area covering 0.6 ha and a minimum of 18 sample points for an area covering 0.3 ha where there is known asbestos. To achieve the recommended minimum sample density at each area within the remedial boundary, an additional 37 test pits (23 at the northern area and 14 at the southern area) are to be excavated. The positions of the proposed test pits are to completement the previous sample locations (where asbestos has been tested). Proposed test pit locations are shown on Drawing AEC36-06, Appendix A. The test pit positions may be adjusted slightly to target areas that are observed to have a higher potential for asbestos contamination, such as where surface soil is observed to contain building rubble or other debris.

Test pits will be excavated into the top of natural soil to confirm the depth of fill (which, based on the DSI results, is likely to be less than 0.5 m deep). At least one sample of fill (or surface soil if no fill is present) is to be collected by the Environmental Consultant from each location with additional samples to be collected for each different fill layer and at least one sample per 1 m depth of fill. Fill samples will be subject to screening / sieving as per the following procedure (from NEPC, 2013):

[1] It is noted that WAH DOH (2009) has been superseded by WA DOH, *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*, 2021 (WA DPOH, 2021). At the time of preparing this RAP, according to the Position Statement on the NSW EPA website, NSW EPA was in support of the proposed number of sampling points for the sites larger than 0.2 ha specified in Tables 4 and 5 of WA DOH 2021. With reference to these tables, the recommended sample density for a 0.3 ha site (or greater) where asbestos is known is the same in WA DOH (2009) and WA DOH (2021).

- Weigh the 10 L bulk sample;
- Each bulk sample is to be sieved through a 7 mm aperture sieve. Components of the soil larger than 7 mm can be removed from the sieve by hand. Clods of soil are to be broken by hand and inspected by hand; and
- Potential ACM retained on the sieve are to be collected as a sample and weighed. The condition of the ACM is recorded on field notes. (Representative samples of potential ACM will be subject to laboratory analysis to determine the presence of asbestos).

Where building rubble / anthropogenic materials are not observed in the fill / surface soil in a test pit, the soil sample will be collected from a depth of 0 - 0.1 m.

500 mL soil samples from each test pit location will be analysed at the laboratory for asbestos. Laboratory analysis will be undertaken at a NATA accredited laboratory.

Validation sample test results will be compared to the RAC. Where the remediation criteria are considered to have not been met, the Environmental Consultant is to provide advice on how remediation and validation is to be undertaken (which is likely to be similar to that for Remediation Area 2 and Remediation Area 3).

12. Waste Removal and Disposal

Disposal of waste (outside of the SCAW project area) 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. Any waste disposed outside of the SCAW project area 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); 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)].

Samples will be collected from stockpiles 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 contaminants of potential concern other than asbestos, sourced from NSW EPA (2022)[2], for the initial assessment of stockpiles comprising similar materials shall be:

- For stockpiles up to 200 m^3: one sample per 25 m^3, with a minimum of three per stockpile;
- For stockpiles of 200 m^3 to 2500 m^3: a minimum of 10 samples for application of statistics; and
- For stockpiles of greater than 2500 m^3: one sample per 250 m^3 or part thereof.

[2] The sampling densities sourced from NSW EPA (2022) are also presented in Table 2 and Table 3 of EPA Victoria, Industrial Waste Resource Guidelines, 2009.

Where asbestos is suspected of being present (but not known) the following sample densities are required for asbestos testing:

- For disposal to a licensed landfill: three samples for stockpiles less than 75 m^3, plus one sample for every additional 75 m^3 with each sample comprising a 500 mL sample for AF / FA analysis and a 10 L bulk sample for asbestos sieving / screening as per the method described in NEPC (2013); and
- For transport to a licensed recycling facility: one sample per 25 m^3 with each sample comprising a 500 mL sample for AF / FA analysis and a 10 L bulk sample for asbestos sieving / screening as per the method described in NEPC (2013).

Laboratory analysis of samples will be determined by the Environmental Consultant following a review of any applicable previous results. The general analytical suite will likely comprise metals (arsenic, cadmium, chromium, lead, mercury and nickel), TRH, BTEX, PAH, OCP, OPP, PCB, phenols, PFAS and asbestos. Analysis will be undertaken at NATA accredited laboratories.

Although not applicable for asbestos contaminated soil, it may be possible to classify excavated soil / fill for reuse on another site under a relevant NSW EPA resource recovery order (RRO) so that it can be used on other sites under the requirements of the corresponding NSW EPA resource recovery exemption (RRE). For this option, the frequency of sampling should be in accordance with the relevant RRO and the contaminants to be analysed will be determined by the Environmental Consultant. The Environmental Consult will provide a report confirming the suitability of the spoil for reuse under a RRO, or otherwise.

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 Environmental Consultant for inclusion in the validation report.

13. Imported Material

Any soil, aggregate, etc., imported for the remediation works must have contaminant concentrations that meet the relevant criteria outlined in Section 10 and have no aesthetic issues of concern. Imported materials will only be accepted for use at the site if:

- It can legally be accepted onto the site. For example:
  - The material is classified as virgin excavated natural material (VENM) and is accompanied by a report / certificate prepared by a qualified environmental consultant;
  - The material classified under a NSW EPA RRO, provided the material can be used on site in accordance with the corresponding RRE. This could include excavated natural material (ENM), classified under NSW EPA Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, *The excavated natural material order 2014* (NSW EPA, 2014d); and

- It is permitted by a condition of the NSW EPA Environmental Protection Licence 21695 which is for the SCAW project. It is noted in the licence (dated 21 September 2022*) that excavated material suitable for re-use within the premises may be transported to another part of the premises or from the Sydney Metro Western Sydney Airport Project including on-airport sites, to the premises by road*. [The 'premises' is defined as the Sydney Metro Western Sydney Airport SCAW package footprint].

- 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;
- Have no aesthetic issues of concern; 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 (including quarried material) 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.

For the importation of quarried (virgin excavated) material, the imported material is to be inspected by the environmental consultant, however, validation sampling and analysis need not be undertaken where no signs of contamination are noted.

For VENM (not from a quarry) or ENM, the validation sampling and analysis undertaken by the environmental consultant will generally be:

- Inspection of the material at the source site;
- Check sampling at a rate of one sample per 200 m^3 to 1000 m^3, with a minimum of five samples for each source site, for material that has been imported to the site, depending on the risk of contamination at the source site; and
- Laboratory analysis of samples for potential contaminants based on source site history (from supplier documentation). This may include eight priority metals, PAH, TRH, BTEX, OPP, OCP, PCB, phenols, PFAS and asbestos.

For RRO materials other than ENM, the validation sampling and analysis will need to be determined by the Environmental Consultant and will depend on the source of the material and adequacy of the supporting documentation provided. Any recycled materials (such as recycled aggregates) must be sampled at a minimum frequency of one sample per 25 m^3 for imported material, with a minimum of three samples per imported batch. Analysis for recycled materials will generally be for asbestos, PCB, eight priority metals, TRH, OCP and PFAS and any other potential contaminants identified by the Environmental Consultant. The recycled material will not be permitted to be used on site until the results of the inspection and laboratory analysis have been approved in writing by the Environmental Consultant. Prior inspection of the material at the source site by the Environment Consultant is recommended where a batch (stockpile) has been designated for import to the site.

For material to be imported to site from other areas of the SCAW package, the requirement for check sampling by the Environmental Consultant will be determined based on the type of material and the supporting documentation (relating to the source of the material). Uncontaminated virgin excavated material (which has been tested and documented) may be subject to check sampling and analysis similar to that for VENM above. Fill (or topsoil) that has been or is to be imported from elsewhere should be sampled at a rate of one sample per 25 m^3. Laboratory analysis will depend on the potential contaminants associated with the source location. Typically, samples will be analysed for eight priority metals, PAH, TRH, BTEX, OPP, OCP, PCB, PFAS and asbestos.

14. Quality Assurance and Quality Control

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

Samples analysed for asbestos will not be subject to inter-laboratory or intra-laboratory replicate analysis. To avoid the need for decontamination, samples for asbestos analysis will be collected using disposable nitrile gloves, changed for the collection of each sample.

For analysis of chemical contaminants (i.e., excluding asbestos analysis), field quality assurance and quality control (QA / QC) testing will include the following:

- 10% replicate sample analysis;
- Rinsate samples (where re-useable sampling equipment is used), analysed for the suite of analytes analysed by the majority of the primary samples; and
- Trip spike and trip blank samples (analysed for BTEX) (approximately one per batch of samples) where volatile organic compounds are considered to be a contaminant.

The laboratory will undertake analysis in accordance with its NATA accreditation, including in-house QA / QC procedures.

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

- Sampling location rationale met the sampling objective;
- Standard operating procedures (SOP) 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;
- Field replicate samples will have a precision average of 30% relative percentage difference (RPD); and
- Rinsate samples will show 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 demineralised water.

Limits for laboratory QA / QC samples will depend on the laboratories' internal QA / QC system. Typical laboratory limits for laboratory QA / QC samples are as follows:

- Blank: less than the PQL;
- Duplicate: for >10 x PQL, the RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range of 20 - 50%;
- Matrix Spike: generally 70-130% recovery for inorganics / metals and 60-140% recovery for organics;
- Laboratory Control Sample (LCS): generally 70-130% recovery for inorganics/metals and 60-140% recovery for organics; and
- Surrogate Spike: generally 70-130% recovery for inorganics / metals and 60-140% recovery for organics.

Field and laboratory test may be considered useable for the validation assessment after evaluation against the following data quality indicators (DQIs):

- Precision – a measure of variability or reproducibility of data;
- Accuracy – a measure of closeness of the data to the 'true' value;
- Representativeness – the confidence (qualitative) of data representativeness of media present on site;
- Completeness – a measure of the amount of usable data from a data collection activity; and
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event.

15. Management and Responsibilities

15.1 Site Management Plan

A general site management plan for the operational phase of site remediation is included in Appendix E. The management plan includes soil, noise, dust, work health safety (WHS), 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 construction environmental management plan (CEMP).

Site management is to be in accordance with the Environmental Protection Licence (21695).

15.2 Site Responsibilities

The site management plan (Appendix E) 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.

15.3 Contingency Plan and Unexpected Finds Protocol

Plans for contingency situations (e.g., encountering asbestos in fill), along with an unexpected finds protocol for dealing with unexpected finds during remediation work / earthworks, are included in Appendix F.

16. Validation Reporting

16.1 Documentation

The following documents will need 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 disposal off-site. The Remediation Contractor will supply records for any soil disposed off-site including 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 on request;
- Imported materials records: records for any soil imported onto the site, including source site, classification reports, inspection records of soil upon receipt at site and transportation records;
- Records relating to any unexpected finds and contingency plans implemented;
- Laboratory certificates and chain-of-custody documentation;
- Inspections records from the Environmental Consultant;
- Photographic records by all contractors and consultants of the works undertaken within their purview of responsibilities;
- Airborne asbestos monitoring records (when asbestos related works are undertaken); and
- Interim / final visual and sampling clearances for any asbestos related works (in the event that asbestos works are undertaken).

16.2 Reporting

A validation assessment report will be prepared by the Environmental Consultant in accordance with 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 site for the final intended land use.

17. Conclusions

It is considered that the site can be made suitable for the final intended land use subject to implementation of this RAP.

18. References

CRC CARE. (2019a). *Remediation Action Plan: Development - Guideline on Establishing Remediation Objectives.* National Remediation Framework: CRC for Contamination Assessment and Remediation of the Environment.

CRC CARE. (2019b). *Remediation Action Plan: Development - Guideline on Performing Remediation Options Assessment.* National Remediation Framework: CRC for Contamination Assessment and Remediation of the Environment.

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM].* Australian Government Publishing Services Canberra: National Environment Protection Council.

NSW EPA. (2014a). *Waste Classification Guidelines, Part 1: Classifying Waste.* NSW Environment Protection Authority.

NSW EPA. (2014b). *Waste Classification Guidelines, Part 2: Immobilisation of Waste.* NSW Environment Protection Authority.

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NSW EPA. (2014d). *Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, The excavated natural material order 2014.* NSW Environment Protection Authority.

NSW EPA. (2016). *Addendum to the Waste Classification Guidelines (2014) - Part 1: Classifying Waste.* NSW Environment Protection Authority.

NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land.* Contaminated Land Guidelines: NSW Environment Protection Authority.

NSW EPA. (2022). *Sampling Design, Part 1: Application; Part 2: Interpretation.* NSW Environment Protection Authority.

19. Limitations

Douglas Partners (DP) has prepared this report (or services) for the SCAW project for SMWSA. The work was carried out under a Services Contract. This report is provided for the exclusive use of CPBUI JV for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and / or their agents.

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

DP's advice is based upon the conditions encountered during the previous 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.

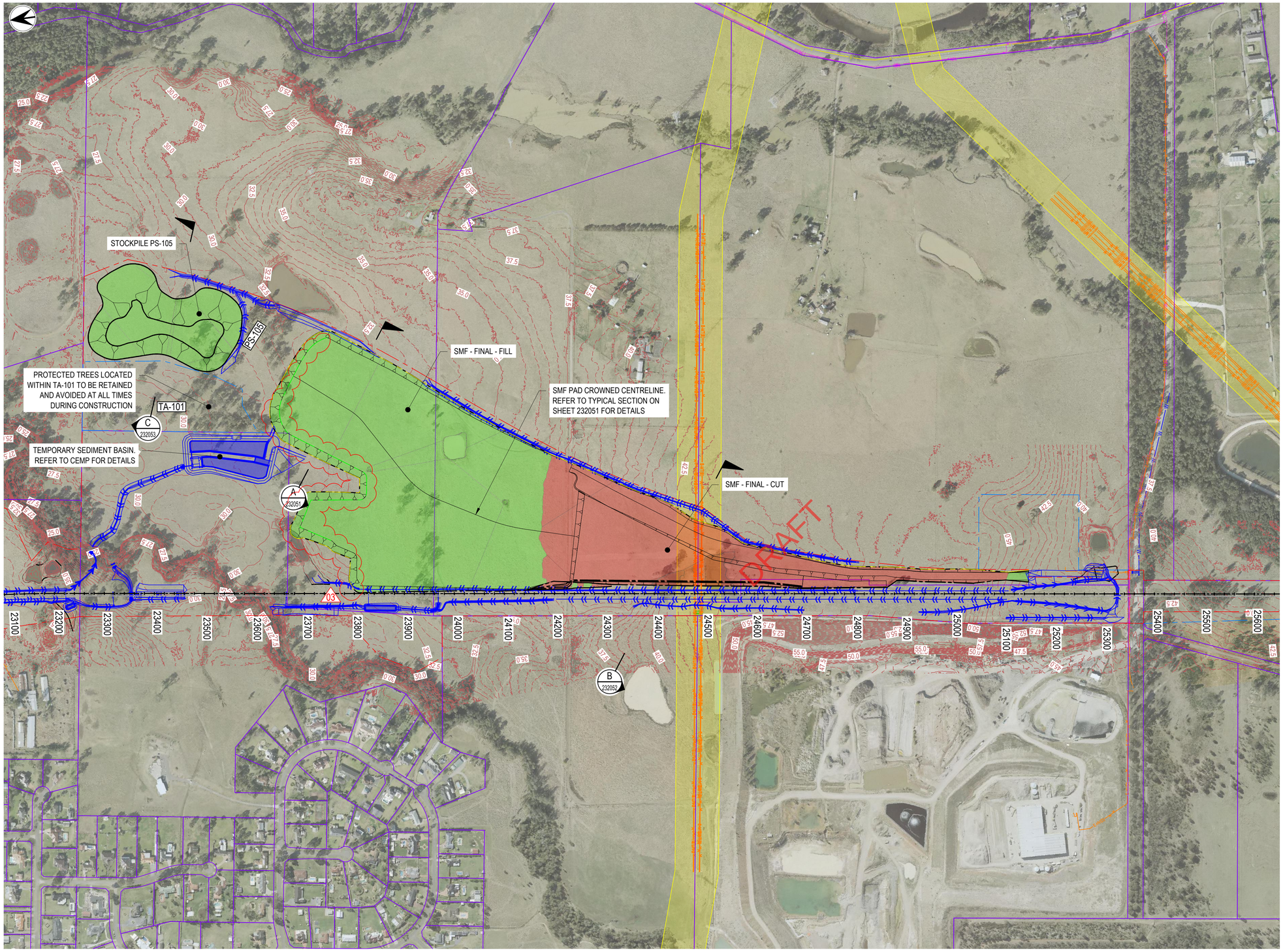
This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation,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



GENERAL ARRANGEMENT PLAN
SCALE 1:4000

LEGEND

GENERAL

- CADASTRAL BOUNDARIES
- EXISTING MAJOR CONTOURS SHOWN AT 2.5m INTERVALS
- EXISTING MINOR CONTOURS SHOWN AT 0.5m INTERVALS
- PROPOSED TRACK FORMATION DESIGN (AS PART OF PWA FORMATION PACKAGE - SCATR2220)
- MAIN LINE TRACKS (TRACK AND SLAB DESIGN BY SSTOM CONTRACTOR)
- SCAW PROJECT BOUNDARY
- TEMPORARY BOUNDARY FOR CONSTRUCTION
- SMF SET-OUT BOUNDARY
- REQUIRED TOP OF EMBANKMENT
- RAIL MAIN ALIGNMENT
- DESIGN CUTTING
- DESIGN FILLING
- TRANSGRID EASEMENT

DRAINAGE (REFER TO PACKAGES SCASD2410 AND SCASD2420)

- DRAINAGE CULVERT
- DRAINAGE PIPE WITH PIT AND HEADWALL
- DRAINAGE GRASS CHANNEL
- DRAINAGE ROCK CHANNEL
- DRAINAGE BIO-FILTRATION CHANNEL
- DRAINAGE BASIN
- DRAINAGE RIPRAP

NOTES

1. FOR UTILITIES LEGEND REFER TO DRAWING No. SMWSASCA-CPU-OHE-SF153-EW-DRG-232011
2. FOR UTILITIES SET REFER TO DRAWINGS SERIES EW000-UT-DRG-SCAUU5000 PACKAGE

FOR CONSTRUCTION

REV.	AMENDMENT DESCRIPTION	Design by	Verified by	Approved by	Date
03	RE-ISSUED FOR CONSTRUCTION	P.S.	T.W.	R.M.	13.07.23
02	RE-ISSUED FOR CONSTRUCTION	P.S.	T.W.	R.M.	20.06.23
01	RE-ISSUED FOR CONSTRUCTION	P.S.	T.W.	R.M.	25.04.23
00	ISSUED FOR CONSTRUCTION	P.S.	T.W.	R.M.	22.02.23

SCALE: 1:4000

40 0 80 160m
SCALE 1:4000

A1 Original | Co-ordinate System: GDA2020 MGA ZONE 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

CLIENT: NSW GOVERNMENT | sydney METRO

NAS: 131479 / IC: SMWSASCA-SKB-SWD-CV-CER-232001

AURECON HATCH JOINT VENTURE
CIVIL

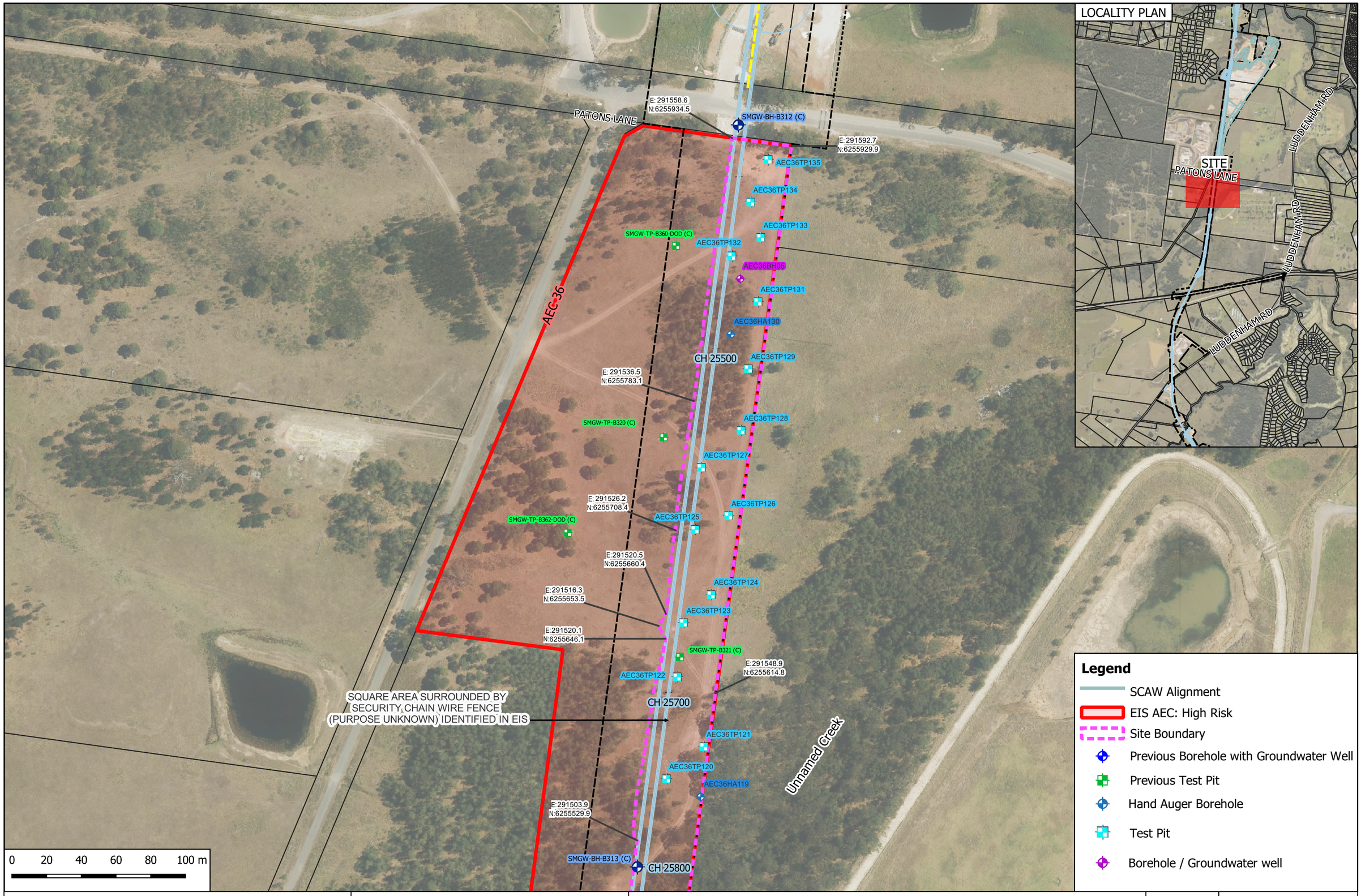
DRAWN	ANTHONY VIZL	13.07.2023
DESIGNED	PATRICK SHEIL	13.07.2023
DRG CHECK	LUBOS AVUK	13.07.2023
DESIGN CHECK	TIM WALTON	13.07.2023
APPROVED	ROB MUNRO	13.07.2023

SYDNEY METRO WESTERN SYDNEY AIRPORT
SURFACE AND CIVIL ALIGNMENT WORKS
CIVIL
SCAEW2320 SCAW STABLING AND MAINTENANCE FACILITY FINAL PACKAGE
GENERAL ARRANGEMENT PLAN

FILE No: | SHEET: 1 OF 1 | ©
STATUS: FOR CONSTRUCTION | EDMS No:
DRG No: SMWSASCA-CPU-OHE-SF153-EW-DRG-232081 | REV 03 | VER

100mm AT FULL SIZE

Title block Revision: v6.1



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	CPBUI JV		
OFFICE:	Sydney	DRAWN BY:	MG/MN
SCALE:	1:2000 @ A3	DATE:	14/07/2023

TITLE: **AEC36 Test Location Plan**
Sydney Metro Western Sydney Airport - SCAW
Stockdale Road, Orchard Hills

N

PROJECT No:	204814.01
DRAWING No:	AEC36-01
REVISION:	0

SMGW-BH-B313 (C)
CH 25800
AEC36HA118
E:291494.5
N:6255462
AEC36SW1
AEC36SED1
E:291474.9
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AEC36HA116
AEC36HA117
AEC36HA114
AEC36HA115
CH 25900
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AEC36TP108
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CH 26000
AEC36TP107
AEC36TP106
AEC-36
AEC36TP105
AEC36BH04
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AEC36TP103
CH 26100
AEC36TP102
AEC36TP101
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AEC36TP99
AEC36TP98
AEC36TP97
AEC36TP96
E:291421.1
N:6255052.8
AEC36TP95
E:291424.2
N:6255039
AEC36TP94

0 20 40 60 80 100 m

LOCALITY PLAN

PATONS LANE
SITE
LUDDENHAM RD
LUDDENHAM RD
LUDDENHAM RD

Legend

- SCAW Alignment
- EIS AEC: High Risk
- Site Boundary
- Previous Borehole with Groundwater Well
- Hand Auger Borehole
- Borehole / Groundwater Well
- Test Pit
- Sediment Sample
- Surface Water Sample

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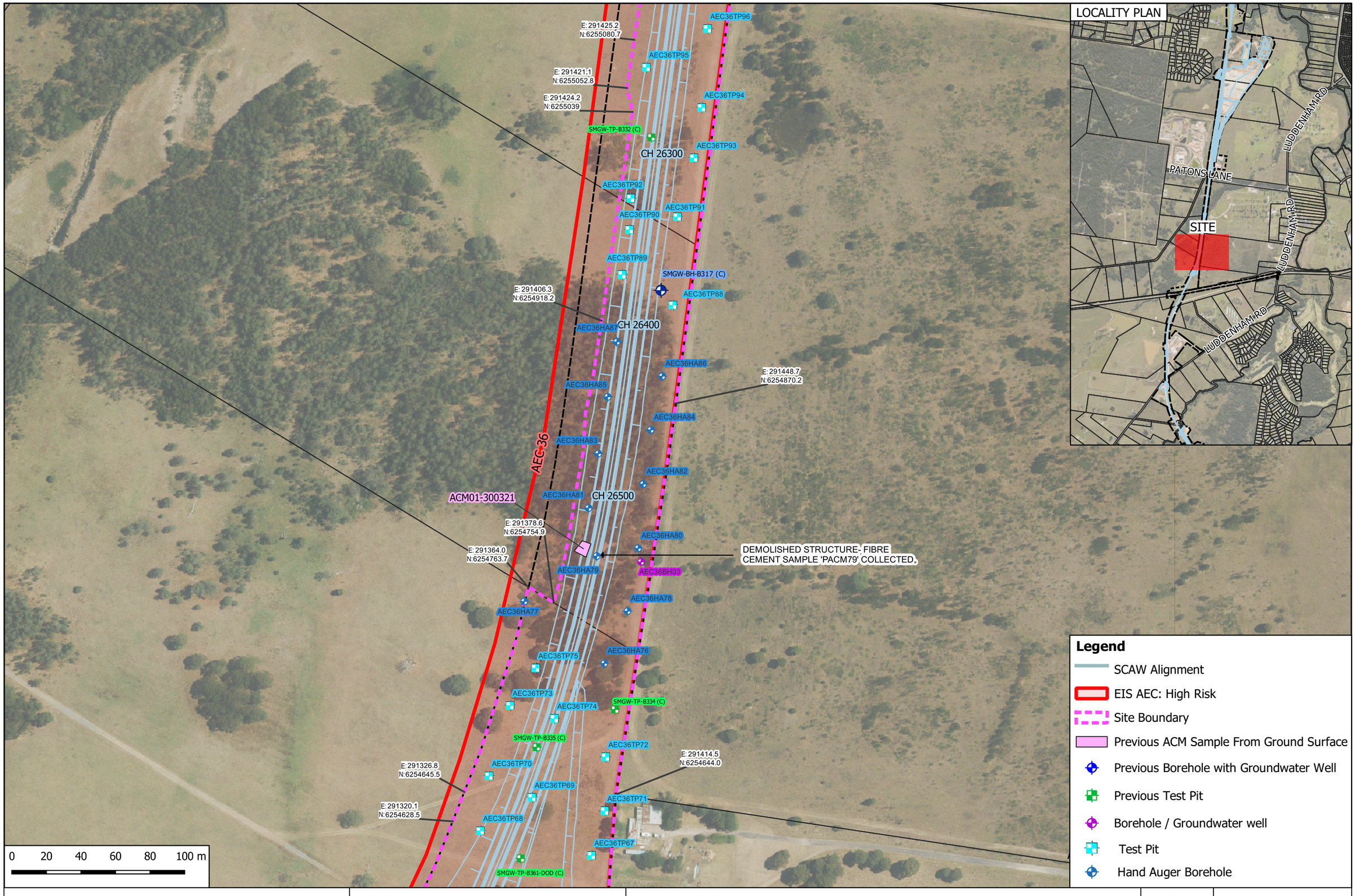
Geotechnics / Environment / Groundwater

CLIENT:	CPBUI JV		
OFFICE:	Sydney	DRAWN BY:	MG/MN
SCALE:	1:2000 @ A3	DATE:	14/07/2023

TITLE: **AEC36 Test Location Plan**
Sydney Metro Western Sydney Airport - SCAW
Stockdale Road, Orchard Hills

N

PROJECT No:	204814.01
DRAWING No:	AEC36-02
REVISION:	0

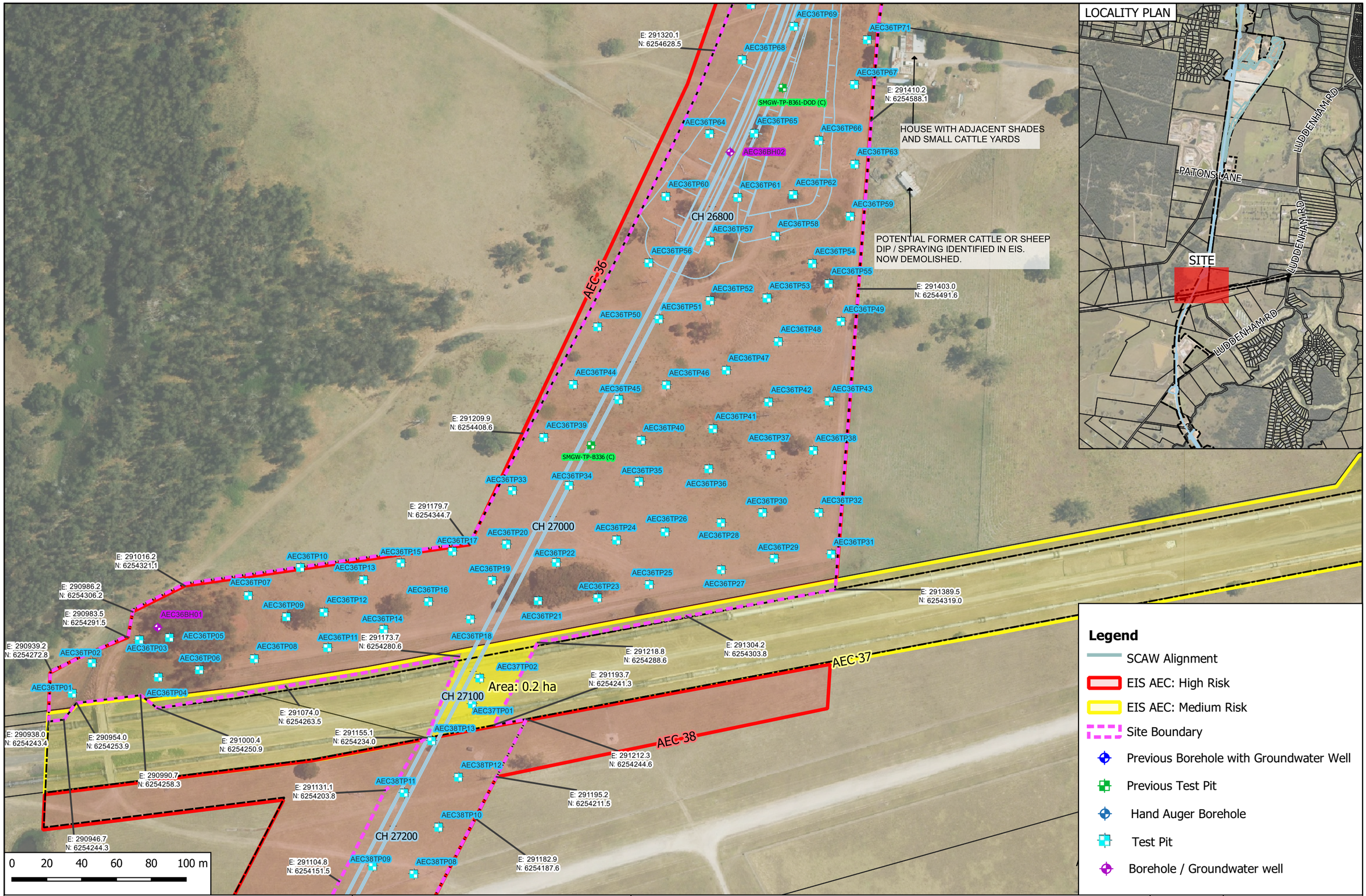


Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	CPBUI JV		
OFFICE:	Sydney	DRAWN BY:	MG/MN
SCALE:	1:2000 @ A3	DATE:	14/07/2023

TITLE: **AEC36 Test Location Plan**
Sydney Metro Western Sydney Airport - SCAW
Stockdale Road, Orchard Hills

PROJECT No:	204814.01
DRAWING No:	AEC36-03
REVISION:	1

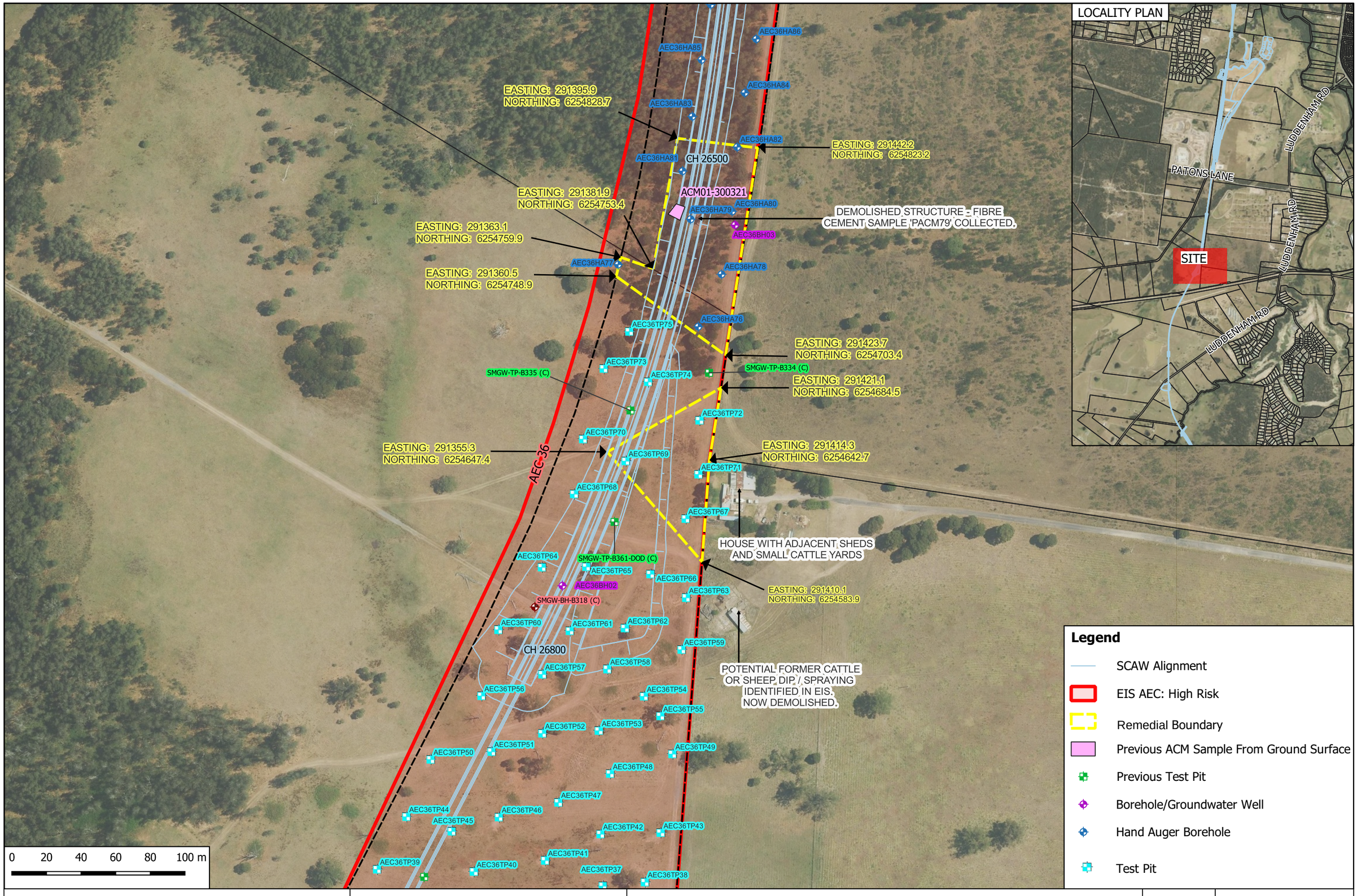


Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	CPBUI JV		
OFFICE:	Sydney	DRAWN BY:	MG/MN
SCALE:	1:2000 @ A3	DATE:	17/07/2023

TITLE: **AEC36 Test Location Plan**
Sydney Metro Western Sydney Airport - SCAW
Stockdale Road, Orchard Hills

PROJECT No:	204814.01
DRAWING No:	AEC36-04
REVISION:	0



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: CPBUI JV		TITLE: AEC36 RAP Site and Test Location Plan Sydney Metro Western Sydney Airport - SCAW Patons Lane, Orchard Hills
OFFICE: Sydney	DRAWN BY: MG/MN	
SCALE: 1:2000 @ A3	DATE: 13/07/2023	

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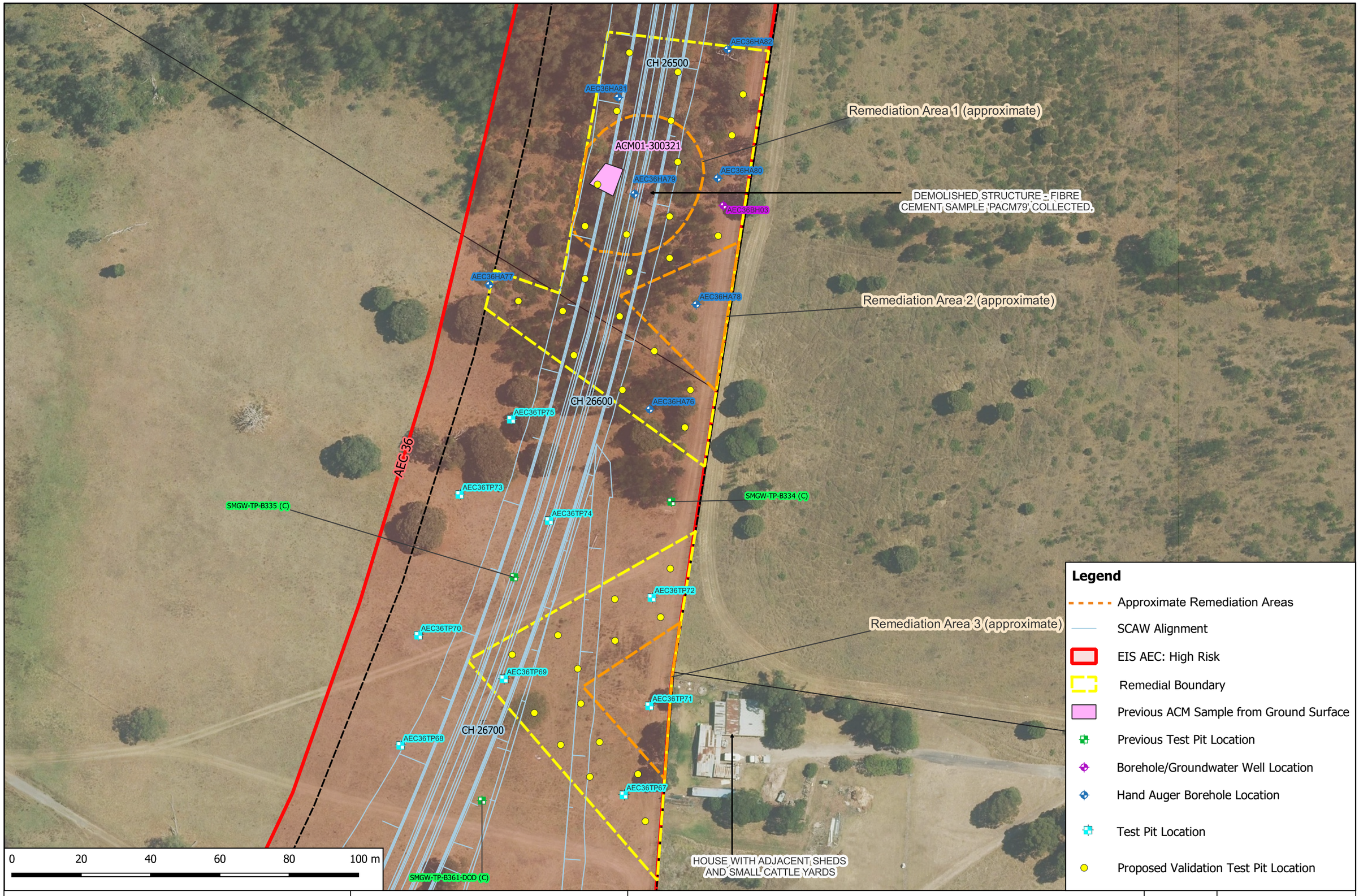
PROJECT No: 204814.01
DRAWING No: AEC36-05
REVISION: 0



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: CPBUI JV		TITLE: Proposed Remediation Areas and Validation Test Pits Sydney Metro Western Sydney Airport - SCAW Patons Lane, Orchard Hills
OFFICE: Sydney	DRAWN BY: MG/MN	
SCALE: 1:1000 @ A3	DATE: 13/07/2023	

N

PROJECT No: 204814.01
DRAWING No: AEC36-06
REVISION: 1

Appendix B

About this Report

About this Report

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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.

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.

The soil group symbol classifications are given as follows based on two major soil divisions:

- Coarse-grained soils
- Fine-grained soils

Major Divisions				Description	
				Group Symbol*	Typical Name
COARSE-GRAINED SOILS	More than 65% by dry mass, (excluding that larger than 63 mm) is greater than 0.075 mm	GRAVEL	More than 50% of coarse grains are greater than 2.36 mm	GW	Well graded gravels and gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
		GRAVELLY SOILS		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clay gravels, gravel-sand-clay mixtures.
		SAND	More than 50% of coarse grains are less than 2.36 mm	SW	Well graded sands and gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands, little or no fines.
		SANDY SOILS		SM	Silty sand, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.

* For coarse grained soils where the fines content is between 5% and 12%, the soil shall be given a dual classification eg GP-GM.

FINE-GRAINED SOILS	More than 35% by dry mass, (excluding that larger than 63 mm) is less than 0.075 mm	Liquid Limit less than 35%	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity
		35% <LL< 50%	CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Liquid Limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity.
			Pt	Peat muck and other highly organic soils.

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, 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, 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, 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.

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:

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

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

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

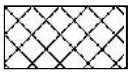
Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete

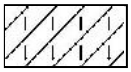

Filling

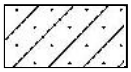
Soils


Topsoil

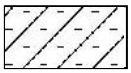

Peat


Clay

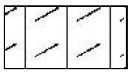

Silty clay

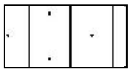

Sandy clay

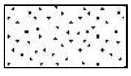

Gravelly clay

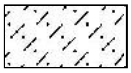

Shaly clay

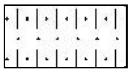

Silt


Clayey silt


Sandy silt

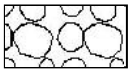

Sand

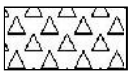

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

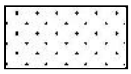

Talus

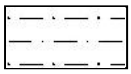
Sedimentary Rocks

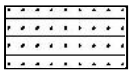

Boulder conglomerate

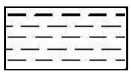

Conglomerate


Conglomeratic sandstone

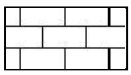

Sandstone


Siltstone

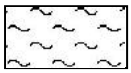

Laminite

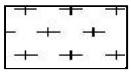

Mudstone, claystone, shale

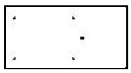

Coal


Limestone

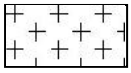
Metamorphic Rocks

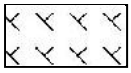

Slate, phyllite, schist


Gneiss

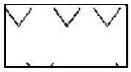

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

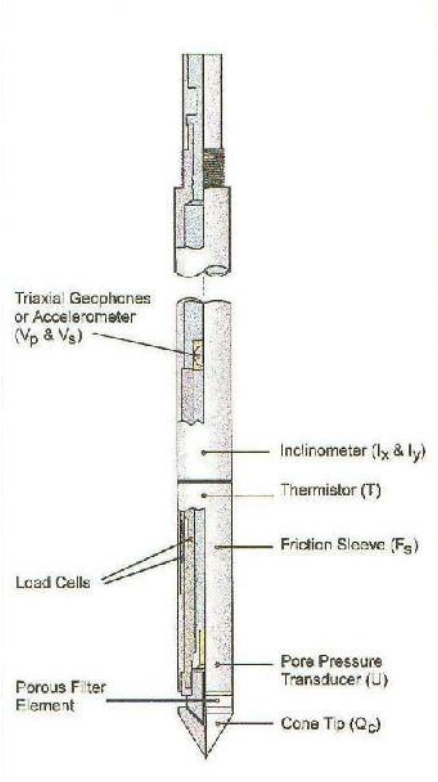


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

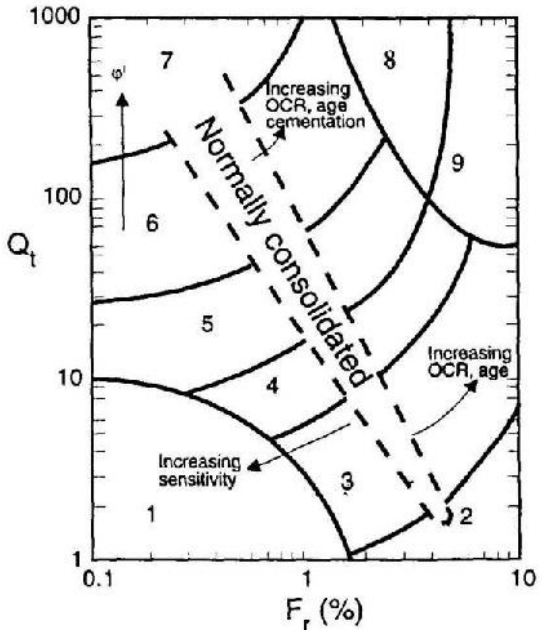


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

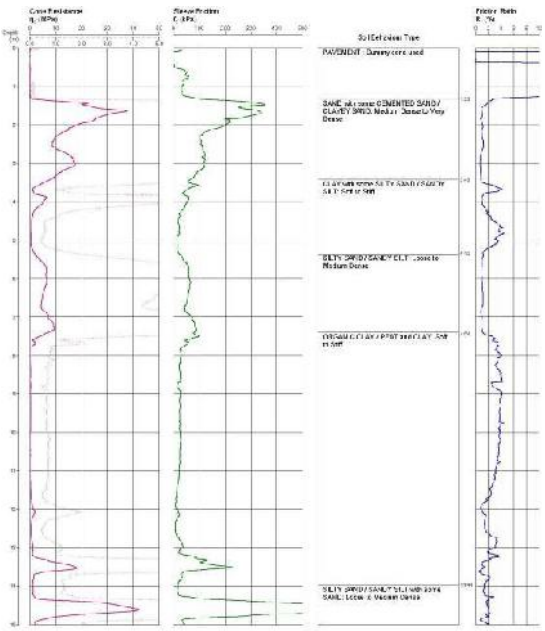


Figure 4: Sample Cone Plot

Appendix C

Previous Borehole and Test Pit Logs

PIEZOMETER CONSTRUCTION

HOLE NO : AEC36-BH03
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Patons Lane - Orchard Hills

POSITION : E: 291429.2, N: 6254778.6 (56 MGA2020) SURFACE ELEVATION : 47.70 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : HANJIN DB8 MOUNTING : Track CONTRACTOR : Rockwell

DATE STARTED : 23/01/23 DATE COMPLETED : 23/01/23 DATE LOGGED : 23/01/23 LOGGED BY : LL CHECKED BY : MB

DRILLING				MATERIAL			PIEZOMETER CONSTRUCTION DETAILS
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	GROUND WATER LEVELS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL (See geotechnical log for soil/rock detail)	
AD/T		01/02/23	0.0				ID 1 Type: Standpipe Piezometer; Stick Up & RL: 1.00 m 46.70 m mAHD; Tip Depth & RL: 10.00 m 37.70 mAHD; Installation Date: 23/01/2023; Static Water Level
						0.30m FILL: silty SAND: dark brown, fine to medium grained sand, trace rootlets	Bentonite Plug
					GC	Sandy GRAVEL: brown, fine to medium gravel, sub-rounded, fine to medium	
						0.80m	1.00m (46.70)
			2.0		CI-CH	Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel	Solid PVC Casing
						3.00m	
						3.50m	
						SANDSTONE: fine to medium grained, pale brown, apparently very low strength	
			4.0			4.00m	
						SILTSTONE: pale grey, apparently very low to low strength	5mm Gravel
			6.0				Slotted PVC Pipe
			8.0				
			10.0			10.00m	10.00m (37.70) End Cap
						AEC36-BH03 TERMINATED AT 10.00 m Target depth	
			12.0				
			14.0				

This report of well/VWP installation must be read in conjunction with accompanying notes and abbreviations. The geotechnical log is a summary only and the detailed log should be referred to for strata details and any core loss zones.

Douglas Partners
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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : AEC36HA76
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291407.9, N: 6254719.9 (56 MGA2020) SURFACE ELEVATION : 49.00 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/01/23 DATE COMPLETED : 18/01/23 DATE LOGGED : 18/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) / RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		H	Not Observed	ES 0.10m	0.0 49.0			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D		FILL 0.00: PID<5 Field Replicate BD1/20230118 taken at 0.0-0.1m
				0.40m ES 0.50m				0.30m			
					0.5 48.5		CI-CH	Silty CLAY: medium to high plasticity, red-brown with pale grey, trace fine to medium ironstone gravel	w<PL	St to VSt	RESIDUAL SOIL 0.40: PID<5
								0.70m			
								BOREHOLE AEC36HA76 TERMINATED AT 0.70 m Refusal Ironstone band present			
					1.0 48.0						
					1.5 47.5						
					2.0 47.0						
					2.5 46.5						
					3.0 46.0						
					3.5 45.5						
					4.0 45.0						
					4.5 44.5						
					5.0 44.0						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **AEC36HA77**
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291361.6, N: 6254755.8 (56 MGA2020) SURFACE ELEVATION : 46.60 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/01/23 DATE COMPLETED : 18/01/23 DATE LOGGED : 18/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		F	Not Observed	ES 0.10m	0.0 46.6			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D		FILL 0.00: PID<5 Field Replicate BD2/20230118 taken at 0.0-0.1m
				0.30m ES 0.40m	0.25m						
					0.5 46.1		CI-CH	Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel	w~PL	F to St	RESIDUAL SOIL 0.30: PID<5
				0.80m ES 0.90m				At 0.7m: mottled pale grey			0.80: PID<5
					1.00m 1.0 45.6			BOREHOLE AEC36HA77 TERMINATED AT 1.00 m Target depth			
					1.5 45.1						
					2.0 44.6						
					2.5 44.1						
					3.0 43.6						
					3.5 43.1						
					4.0 42.6						
					4.5 42.1						
					5.0 41.6						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : **AEC36HA78**
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291421.4, N: 6254750.1 (56 MGA2020) SURFACE ELEVATION : 48.20 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/01/23 DATE COMPLETED : 18/01/23 DATE LOGGED : 18/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		F	Not Observed	ES 0.10m	0.0 48.2			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D		FILL 0.00: PID<5
				0.30m ES 0.40m				0.25m Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel			RESIDUAL SOIL 0.30: PID<5
				0.80m ES 0.90m	0.5 47.7		CI-CH	At 0.7m: mottled pale grey	w~PL	F to St	0.80: PID<5
					1.0 47.2			0.90m BOREHOLE AEC36HA78 TERMINATED AT 0.90 m Target depth			
					1.5 46.7						
					2.0 46.2						
					2.5 45.7						
					3.0 45.2						
					3.5 44.7						
					4.0 44.2						
					4.5 43.7						
					5.0 43.2						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : AEC36HA79
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291403.5, N: 6254782.0 (56 MGA2020) SURFACE ELEVATION : 46.90 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/1/23 DATE COMPLETED : 18/1/23 DATE LOGGED : 18/1/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		H	Not Observed	ES 0.10m	0.0 46.9			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D		FILL 0.00: Sample of fibre-cement 'PACM2' collected from ground surface 0.00: PID<5
				0.30m ES 0.40m	0.20m			Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel	w<PL	F to St	Field Replicate BD3/20230118 taken at 0.0-0.1m RESIDUAL SOIL 0.30: PID<5
					0.5 46.4 0.50m		CI-CH	BOREHOLE AEC36HA79 TERMINATED AT 0.50 m Refusal Tree roots present Test location estimated from site features and surface elevation extracted from LiDAR data			
					1.0 45.9						
					1.5 45.4						
					2.0 44.9						
					2.5 44.4						
					3.0 43.9						
					3.5 43.4						
					4.0 42.9						
					4.5 42.4						
					5.0 41.9						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : AEC36HA80
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291427.5, N: 6254786.5 (56 MGA2020) SURFACE ELEVATION : 47.30 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/01/23 DATE COMPLETED : 18/01/23 DATE LOGGED : 18/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		F	Not Observed	ES 0.10m	0.0 47.3			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D		FILL 0.00: PID<5 Field Replicate BD4/20230118 taken at 0.0-0.1m
				0.40m ES 0.50m	0.35m			Silty CLAY: red-brown, trace fine to medium ironstone gravel			RESIDUAL SOIL 0.40: PID<5
				0.90m ES 1.00m	0.5 46.8		CI-CH		w<PL	F	0.90: PID<5
					1.0 46.3						
					1.20m			BOREHOLE AEC36HA80 TERMINATED AT 1.20 m Target depth			
					1.5 45.8						
					2.0 45.3						
					2.5 44.8						
					3.0 44.3						
					3.5 43.8						
					4.0 43.3						
					4.5 42.8						
					5.0 42.3						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : AEC36HA81
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291398.8, N: 6254809.8 (56 MGA2020) SURFACE ELEVATION : 46.10 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 18/01/23 DATE COMPLETED : 18/01/23 DATE LOGGED : 18/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		F	Not Observed	ES 0.10m	0.0 46.1			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets and fine gravel	D		FILL 0.00: PID<5
				0.30m ES 0.40m				0.25m Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel			RESIDUAL SOIL 0.30: PID<5
				0.80m ES 0.90m	0.5 45.6		CI-CH		w<PL	F to St	0.80: PID<5
					1.0 45.1			1.00m BOREHOLE AEC36HA81 TERMINATED AT 1.00 m Target depth			
					1.5 44.6						
					2.0 44.1						
					2.5 43.6						
					3.0 43.1						
					3.5 42.6						
					4.0 42.1						
					4.5 41.6						
					5.0 41.1						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : AEC36HA82
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291430.4, N: 6254823.7 (56 MGA2020) SURFACE ELEVATION : 46.40 (mAHD) ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Hand Tools MOUNTING : Hand Tools CONTRACTOR : Douglas Partners DRILLER : PJ

DATE STARTED : 20/01/23 DATE COMPLETED : 20/01/23 DATE LOGGED : 20/01/23 LOGGED BY : PJ CHECKED BY : MB

DRILLING						MATERIAL					
PROGRESS: DRILLING & CASING	PROGRESS: WATER LOSS	DRILLING PENETRATION	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m) RL (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
HA		F	Not Observed	ES 0.10m	0.0 46.4			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	M		FILL 0.00: PID<5 Field Replicate BD1/20230120 taken at 0.0-0.1m
				0.30m ES 0.40m	0.25m			Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel			RESIDUAL SOIL 0.30: PID<5
				0.80m ES 0.90m	0.5 45.9		CI-CH		w~PL	F to St	0.80: PID<5
					1.00m 1.0 45.4			BOREHOLE AEC36HA82 TERMINATED AT 1.00 m Target depth			
					1.5 44.9						
					2.0 44.4						
					2.5 43.9						
					3.0 43.4						
					3.5 42.9						
					4.0 42.4						
					4.5 41.9						
					5.0 41.4						

See Explanatory Notes for details of abbreviations & basis of descriptions.

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EXCAVATION - GEOLOGICAL LOG

PIT NO : AEC36TP67

FILE / JOB NO : 204814.01

SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works

LOCATION : Luddenham Road - Luddenham

POSITION : E: 291400.2, N: 6254608.5 (56 MGA2020)	SURFACE ELEVATION : 51.20 (mAHD)	
EQUIPMENT TYPE : 8 tonne Excavator	METHOD : 800mm bucket	
DATE EXCAVATED : 20/12/22	LOGGED BY : PJ	CHECKED BY : MB
EXCAVATION DIMENSIONS : 1.00 m LONG 0.80 m WIDE		

DRILLING | MATERIAL

VE / PENETRATION E F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa 100 200 300 400	STRUCTURE & Other Observations
		Not Observed	ES 0.10m	0.0			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets and red-brown clay (reworked natural)	D			FILL 0.00: PID<5 Field Replicate BD10/20221220 taken at 0.0-0.1m
			0.40m ES 0.50m	0.5		CI-CH	0.30m Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel and roots	w~PL	St to VSt	×	RESIDUAL SOIL 0.40: HP =220 kPa 0.40: PID<5
			0.90m ES 1.00m	1.0			1.20m EXCAVATION AEC36TP67 TERMINATED AT 1.20 m Target depth			×	0.90: HP =190 kPa 0.90: PID<5
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							
				4.0							
				4.5							
				5.0							

PHOTOGRAPHS NOTES ☒ YES ☐ NO

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION

WATER

SAMPLES & FIELD TESTS
- U50 - Undisturbed Sample 50 mm diameter
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

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EXCAVATION - GEOLOGICAL LOG

PIT NO : AEC36TP69
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291365.7, N: 6254641.9 (56 MGA2020)	SURFACE ELEVATION : 49.70 (mAHD)	
EQUIPMENT TYPE : 8 tonne Excavator	METHOD : 800mm bucket	
DATE EXCAVATED : 20/12/22	LOGGED BY : PJ	CHECKED BY : MB
EXCAVATION DIMENSIONS : 1.00 m LONG 0.80 m WIDE		

DRILLING | MATERIAL

VE / PENETRATION / E / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa	STRUCTURE & Other Observations
		Not Observed	ES 0.10m	0.0			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets	D			FILL 0.00: PID<5
			0.30m ES 0.40m	0.25m			Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel	w~PL	St to VSt	×	Field Replicate BD11/20221220 taken at 0.0-0.1m RESIDUAL SOIL 0.30: HP =190 kPa 0.30: PID<5
			0.80m ES 0.90m	0.5		CI-CH	At 0.75m: pale grey mottled orange-brown			×	0.80: HP =190 kPa 0.80: PID<5
				1.00m 1.0			EXCAVATION AEC36TP69 TERMINATED AT 1.00 m Target depth				
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							
				4.0							
				4.5							
				5.0							

PHOTOGRAPHS NOTES ☒ YES ☐ NO

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U50 - Undisturbed Sample 50 mm diameter
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

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EXCAVATION - GEOLOGICAL LOG

PIT NO : AEC36TP71
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291407.7, N: 6254634.2 (56 MGA2020)	SURFACE ELEVATION : 51.30 (mAHD)	
EQUIPMENT TYPE : 8 tonne Excavator	METHOD : 800mm bucket	
DATE EXCAVATED : 20/12/22	LOGGED BY : PJ	CHECKED BY : MB
EXCAVATION DIMENSIONS : 1.00 m LONG 0.80 m WIDE		

DRILLING | MATERIAL

VE / PENETRATION (E, F, H)	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	HAND PENETROMETER (kPa)	STRUCTURE & Other Observations
		Not Observed	ES 0.10m	0.0			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets At 0-0.1m: fibrous sheet	D			FILL 0.00: PID<5
							0.30m				
			0.40m ES 0.50m	0.5		CI-CH	Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel	w~PL	VSt	× 220	RESIDUAL SOIL 0.40: HP =220 kPa 0.40: PID<5
			0.90m ES 1.00m	1.0			1.00m EXCAVATION AEC36TP71 TERMINATED AT 1.00 m Target depth			× 240	0.90: HP =240 kPa 0.90: PID<5
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							
				4.0							
				4.5							
				5.0							

PHOTOGRAPHS NOTES ☒ YES ☐ NO

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U50 - Undisturbed Sample 50 mm diameter
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

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EXCAVATION - GEOLOGICAL LOG

PIT NO : AEC36TP72
FILE / JOB NO : 204814.01
SHEET : 1 OF 1

PROJECT : Sydney Metro Western Sydney Airport - Surface and Civil Alignment Works
LOCATION : Luddenham Road - Luddenham

POSITION : E: 291408.4, N: 6254665.4 (56 MGA2020)	SURFACE ELEVATION : 50.80 (mAHD)	
EQUIPMENT TYPE : 8 tonne Excavator	METHOD : 800mm bucket	
DATE EXCAVATED : 12/01/23	LOGGED BY : PJ	CHECKED BY : MB
EXCAVATION DIMENSIONS : 1.00 m LONG 0.80 m WIDE		

DRILLING | MATERIAL

VE / PENETRATION E F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER 100 200 300 400 kPa	STRUCTURE & Other Observations
		Not Observed	ES 0.10m	0.0			FILL: silty SAND: brown, fine to medium grained sand, low to medium plasticity silt, trace rootlets and fine to medium gravel At 0.2m: grading to light brown	M			FILL 0.00: PID<5 Field Replicate BD1/20230112 taken at 0.0-0.1m
			0.50m ES 0.60m	0.5		CI-CH	Silty CLAY: medium to high plasticity, red-brown, trace fine to medium ironstone gravel At 0.8m: mottled pale grey	w~PL	St to VSt	×	RESIDUAL SOIL 0.50: HP =200 kPa 0.50: PID<5
			1.00m ES 1.10m	1.0			EXCAVATION AEC36TP72 TERMINATED AT 1.10 m Target depth			×	1.00: HP =170 kPa 1.00: PID<5
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							
				4.0							
				4.5							
				5.0							

PHOTOGRAPHS NOTES ☒ YES ☐ NO

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U50 - Undisturbed Sample 50 mm diameter
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

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Appendix D

Tabulated Summaries of Previous Results

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Table I1: Summary of Laboratory Results for Soil – Metals, TRH, BTEX, PAH

				Metals								TRH						BTEX				PAH			
				Arsenic	Cadmium	Total Chromium	Copper	Lead	Mercury (inorganic)	Nickel	Zinc	TRH C6 - C10	TRH >C10-C16	TRH C6-C10 less BTEX	TRH >C10-C16 less Naphthalene	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene [b]	Benzo(a)pyrene (BaP)	Benzo(a)pyrene TEQ	Total PAH
Sample ID	Depth	Sample Date	Soil type	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
AEC36TP67	0 - 0.1 m	20/12/22	Fill	11	<0.4	25	17	20	<0.1	3	20	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36TP69	0 - 0.1 m	20/12/22	Fill	8	<0.4	23	10	18	<0.1	4	20	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36TP71	0 - 0.1 m	20/12/22	Fill	7	<0.4	26	13	23	<0.1	4	38	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36TP71-PACM	0 - 0.1 m	12/01/23	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36TP72	0 - 0.1 m	12/01/23	Fill	7	<0.4	25	7	17	<0.1	4	9	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
BD1/20230112	0 - 0.1 m	12/01/23	Fill	8	<0.4	27	9	19	<0.1	4	12	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA76	0 - 0.1 m	18/01/2023	Fill	7	<0.4	21	9	16	<0.1	4	9	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
BD1/20230118	0 - 0.1 m	18 Jan 2023	Fill	20	<0.4	57	19	27	<0.1	10	22	<20	<50	<20	<50	<100	<100	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA77	0 - 0.1 m	18/01/2023	Fill	5	<0.4	14	8	11	<0.1	6	16	<25	<50	<25	<50	120	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
BD2/20230118	0 - 0.1 m	18/01/2023	Fill	7	<0.4	19	10	14	<0.1	8	18	<25	<50	<25	<50	120	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA78	0 - 0.1 m	18/01/2023	Fill	9	<0.4	30	9	18	<0.1	5	10	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA78	0.3 - 0.4 m	18/01/2023	Natural	7	<0.4	27	14	14	<0.1	4	12	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA79	0 - 0.1 m	18/01/2023	Fill	7	<0.4	20	8	31	<0.1	4	41	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
PACM79	0 m	18/01/2023	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA80	0 - 0.1 m	18/01/2023	Fill	7	<0.4	24	6	15	<0.1	4	8	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA81	0 - 0.1 m	18/01/2023	Fill	9	<0.4	33	7	24	<0.1	5	19	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
AEC36HA82	0 - 0.1 m	20/01/2023	Fill	7	<0.4	30	5	16	<0.1	4	9	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -
BD1/20230120	0 - 0.1 m	20/01/2023	Fill	8	<0.4	34	6	19	<0.1	5	7	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.05	<0.5	<0.05
				300 100	90 -	300 190	17000 210	600 1100	80 -	1200 180	30000 490	- -	- 120	260 180	NL -	- 300	- 2800	3 50	NL 85	NL 70	230 105	NL 170	- 0.7	3 -	300 -

Lab result

HIL/HSL value EIL/ESL value

HIL/HSL exceedance EIL/ESL exceedance HIL/HSL and EIL/ESL exceedance ML exceedance ML and HIL/HSL or EIL/ESL exceedance

Indicates that asbestos has been detected by the lab, refer to the lab report **Blue** = DC exceedance HSL 0-<1 Exceedance

Bold = Lab detections - = Not tested or No HIL/HSL/EIL/ESL (as applicable) or Not applicable NL = Non limiting AD = Asbestos detected NAD = No Asbestos detected

HIL = Health investigation level HSL = Health screening level (excluding DC) EIL = Ecological investigation level ESL = Ecological screening level ML = Management Limit DC = Direct Contact HSL

Notes: QA/QC replicate of sample listed directly below the primary sample

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Table I1 (continued): Summary of Laboratory Results for Soil (continued) – Phenols, OCP, OPP, PCB, Asbestos, PFAS, phthalates

				Phenols					OCP										OPP		PCB	Asbestos	Asbestos			PFAS				Phthalates
				Total Phenols	Phenol	Pentachlorophenol	Cresols	Other phenols	DDT+DDE+DDD [c]	DDT	Aldrin & Dieldrin	Total Chlordane	Endrin	Total Endosulfan	Heptachlor	Hexachlorobenzene	Methoxychlor	Other OCP	Chlorpyriphos	Other OPP	Total PCB	Trace Analysis	ACM >7mm	FA and AF Estimation	FA and AF Estimation	PFOS	PFOA	PFOS and PFHxS	Total Positive PFAS	All phthalates
Sample ID	Depth	Sample Date	Soil type	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	-	g	%(w/w)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
AEC36TP67	0 - 0.1 m	20/12/22	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD10/20221220	0 - 0.1 m	20/12/22	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.05	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP68	0.4 - 0.5 m	20/12/22	Natural	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP69	0 - 0.1 m	20/12/22	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP70	0 - 0.1 m	20/12/22	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP71	0 - 0.1 m	20/12/22	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	AD	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP71-PACM	0 - 0.1 m	12/01/23	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AD	-	-	-	-	-	-	-	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36TP72	0 - 0.1 m	12/01/23	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD1/20230112	0 - 0.1 m	12/01/23	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA76	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD1/20230118	0 - 0.1 m	18 Jan 2023	Fill	-	<0.5	<1	<0.5	<PQL	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<PQL	<0.2	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.05	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA77	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD2/20230118	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA78	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	AD	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA78	0.3 - 0.4 m	18/01/2023	Natural	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA79	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD3/20230118	0 - 0.1 m	18/01/2023	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
PACM79	0 m	18/01/2023	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AD	-	-	-	-	-	-	-	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA80	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD4/20230118	0 - 0.1 m	18/01/2023	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.05	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA81	0 - 0.1 m	18/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
AEC36HA82	0 - 0.1 m	20/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	<0.001	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -
BD1/20230120	0 - 0.1 m	20/01/2023	Fill	<5	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<PQL	<0.1	<PQL	<0.1	-	-	-	-	<0.005	<0.005	<0.005	<0.005	-
				120 -	40000 -	120 -	4000 -	- -	400 180	- 180	10 -	70 -	20 -	340 -	10 -	10 -	400 -	- -	250 -	- -	1 -					- 0.01	10 10	1	- -	- -

Lab result
HIL/HSL value EIL/ESL value

HIL/HSL exceedance EIL/ESL exceedance HIL/HSL and EIL/ESL exceedance ML exceedance ML and HIL/HSL or EIL/ESL exceedance

Indicates that asbestos has been detected by the lab, refer to the lab report **Blue** = DC exceedance HSL 0-<1 Exceedance

Bold = Lab detections - = Not tested or No HIL/HSL/EIL/ESL (as applicable) or Not applicable NL = Non limiting AD = Asbestos detected NAD = No Asbestos detected

HIL = Health investigation level HSL = Health screening level (excluding DC) EIL = Ecological investigation level ESL = Ecological screening level ML = Management Limit DC = Direct Contact HSL

Notes: QA/QC replicate of sample listed directly below the primary sample

Douglas Partners

Table I2: Summary of Results of Groundwater and Surface Water Analysis (All results in µg/L)

Sample Location / Identification (Borehole or Replicate)	Sample Date	Metals (dissolved) Arsenic	Cadmium	Chromium (III + VI)	Copper	Lead	Mercury	Nickel	Zinc	Metals (total) Arsenic	Cadmium	Chromium (III + VI)	Copper	Lead	Mercury	Nickel	Zinc
AEC36BH03	1/02/2023	5	**0.8**	<1	**3**	<1	<0.05	**12**	**35**	-	-	-	-	-	-	-	-
Assessment Criteria																	
Freshwater DGV		24 for As(III) 13 for As(V)	0.2*	3.3* for Cr(III) 1.0 for Cr(VI)	1.4	3.4*	0.06	11*	8*	24 for As(III) 13 for As(V)	0.2*	3.3* for Cr(III) 1.0 for Cr(VI)	1.4	3.4*	0.06	11*	8*
Guidelines for Recreational Water	**Health**	100	20	500 for Cr(VI)	20000	100	10	200	-	100	20	500 for Cr(VI)	20000	100	10	200	-
	Aesthetic	-	-	-	1000	-	-	-	3000	-	-	-	1000	-	-	-	3000
HSL D for Vapour Intrusion, Clay (depth 2 m to <4 m)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sample Location / Identification (Borehole or Replicate)	Sample Date	PAH Naphthalene	Anthracene	Fluoranthene	Benzo(a)pyrene	Phenanthrene	Other PAH	TRH C6-C10 less BTEX	TRH >C10-C16 less Naphthalene	TRH C6-C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toulene	Ethylbenzene	o-xylene	m+p-xylene
AEC36BH03	1/02/2023	<0.02	<0.01	<0.01	<0.01	<0.01	<PQL	<10	<50	<10	<50	<100	<100	<1	<1	<1	<1	<2
Assessment Criteria																		
Freshwater DGV		16	0.01	1	0.1	0.6	-	-	-	-	-	-	-	950	180	80	350	75 for m-xylene 200 for p-xylene
Guidelines for Recreational Water	**Health**	-	-	-	0.1	-	-	-	-	-	-	-	-	10	8000	3000	6000	
	Aesthetic	-	-	-	-	-	-	-	-	-	-	-	-	-	25	3	20	
HSL D for Vapour Intrusion, Clay (depth 2 m to <4 m)		NL	-	-	-	-	-	NL	NL	-	-	-	-	30000	NL	NL	NL	
Recreational Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Freshwater Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Sample Location / Identification (Borehole or Replicate)	Sample Date	Isopropylbenzene	1,1-Dichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	cis-1,3-Dichloropropene	Vinyl chloride	Tetrachloroethene	Trichloroethene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Chlorobenzene
AEC36BH03	1/02/2023	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1
Assessment Criteria																
Freshwater DGV		30	700	-	-	-		100	70	330	3	85	160	260	60	55
Guidelines for Recreational Water	**Health**	-	300	600		1000		3	500	-	300		15000	-	400	3000
	Aesthetic	-	-	-		-		-	-	-	5		1	20	0.3	10
HSL D for Vapour Intrusion, Clay (depth 2 m to <4 m)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sample Location / Identification (Borehole or Replicate)	Sample Date	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,2-Dichloroethane	Carbon tetrachloride	Chloroform	Bromodichloromethane	Dibromochloromethane	Bromoform	1,2-Dichloropropane	1,3-Dichloropropane	Styrene	Hexachlorobutadiene	Carbon disulfide	Dichloromethane (methylene chloride)	Other VOC
AEC36BH03	1/02/2023	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	<PQL
Assessment Criteria																	
Freshwater DGV		400	270	6500	1900	240	370	-	-	-	900	1100	-	-	20	-	-
Guidelines for Recreational Water	**Health**	-	-	-	30	30	2500				-	-	300	7	-	40	-
	Aesthetic	-	-	-	-	-	-				-	-	4	-	-	-	-
HSL D for Vapour Intrusion, Clay (depth 2 m to <4 m)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

PQL Practical Quantitation Limit

\- not defined/ not analysed/ not applicable

* May be adjusted for hardness

NL Not Limiting

(green) Exceedance of DGV or Freshwater Quality Guideline

(orange) Exceedance of DGV and Drinking Water Guideline

Table I2 (continued): Summary of Results of Groundwater and Surface Water Analysis (All results in µg/L)

Sample Location / Identification (Borehole or Replicate)	Sample Date	Organochlorine Pesticides												Organophosphorus Pesticides																				Polychlorinated Biphenyls			Phenols												PFAS									Phthalates				
		Aldrin	Dieldrin	gamma-Chlordane	alpha-Chlordane	Total Chlordanes	pp-DDT	Endosulfan I	Endosulfan II	Endrin	Heptachlor	Methoxychlor	Lindane	Other OCP	Azinphos-methyl	Bromophos-ethyl	Chlorpyrifos	Chlorfenvinphos	Diazinon	Dichlorvos	Dimethoate	Disulfoton	Ethion	Ethoprophos (Ethoprop)	Fenitrothion	Fensulfothion	Fenthion	Malathion	Mevinphos (Phosdrin)	Monocrotophos	Omethoate	Parathion	Methyl Parathion	Pyrazophos	Terbufos	Tetrachlorvinphos	Pirimiphos-methyl	Other OPP	Aroclor 1242	Aroclor 1254	Other PCB	Phenol	2,4,6-Trichlorophenol	2,4-Dinitrophenol	4-Nitrophenol	2,3,4,6-Tetrachlorophenol	Total Tetrachlorophenols	Pentachlorophenol	2-Chlorophenol	2,4-Dimethylphenol	2,4-Dichlorophenol	2,6-Dichlorophenol	2-Methylphenol (6-Cresol)	Other Phenols	Perfluorohexanesulfonic acid - PFHxS	Perfluorooctanesulfonic acid PFOS	Total Positive PFHxS & PFOS	Perfluorooctanoic acid PFOA	6:2 FTS	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorobutanoic acid (PFBA)	Other PFAS	Diethylphthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di(2-ethylhexyl)phthalate	Other Phthalates
AEC36BH02	1/02/2023	<0.01	<0.01	<0.01	<0.01	<PQL	<0.006	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<PQL	<0.02	<0.2	<0.01	-	<0.01	<0.2	<0.15	-	<0.2	-	<0.2	-	-	<0.05	-	-	-	<0.01	<0.2	-	-	-	-	<PQL	<0.1	<0.1	<PQL	<20	<20	<400	<400	<20	-	<100	<20	<20	<20	<20	<20	<PQL	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0004	<0.004	<PQL	-	-	-	-	-
AEC36BH03	1/02/2023	<0.01	<0.01	<0.01	<0.01	<PQL	<0.006	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<PQL	<0.02	<0.2	<0.01	-	<0.01	<0.2	<0.15	-	<0.2	-	<0.2	-	-	<0.05	-	-	-	<0.01	<0.2	-	-	-	-	<PQL	<0.1	<0.1	<PQL	<1	<1	<20	<20	<1	-	<5	<1	<1	<1	<1	<1	<PQL	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0004	<0.01	<PQL	-	-	-	-	-
Assessment Criteria																																																															
Freshwater DGV		0.001	0.01	0.03			0.006	0.03		0.01	0.01	0.005	0.2	-	0.01	-	0.01	-	0.01	-	0.15	-	-	-	0.2	-	-	0.05	-	-	-	0.004	-	-	-	-	-	-	0.3	0.01	-	320	3	45	58	10	0.2	3.6	340	2	120	34	-	-	-	-	-	-	-	-	-	-	1000	3700	10	1	-
Guidelines for Recreational Water	Health	3		20			90	200		-	3	3000	100	-	300	100	100	20	40	50	70	40	40	10	70	100	70	700	50	20	10	200	7	200	9	1000	900	-	-	-	-	-	200	-	-	-	-	100	3000	-	2000	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-
	Aesthetic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HSL D for Vapour Intrusion, Clay (depth 2 m to <4 m)		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational Water Quality Guideline - NEMP 2.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

PQL Practical Quantitation Limit

\- not defined/ not analysed/ not applicable

Exceedance of DGV or freshwater quality guideline

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Table I3: Summary of Laboratory Results for Waste Classification – Metals, TRH, BTEX, PAH, Phenol, OCP, OPP, PCB, Asbestos, PFAS

				Metals								TRH		BTEX				PAH			Phenol						OCP		OPP		PCB	Asbestos	PFAS		pH
				Arsenic	Cadmium	Total Chromium	Copper	Lead	Mercury (inorganic)	Nickel	Zinc	TRH C6 - C9	TRH C10-C36	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Benzo(a)pyrene	Benzo(a)pyrene inTCLP	Total PAHs	2-Methylphenol (o-Cresol)	Cresol (total)	Total Phenols	2,4,5-trichlorophenol	2,4,6-trichlorophenol	Phenol	Total Endosulfan	Total Analysed OCP	Chlorpyriphos	Total Analysed OPP	Total PCB	Total Asbestos	PFOA	PFOS+PFHxS	pH
Sample ID	Depth	Sample Date	Soil type	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	µg/kg	µg/kg	pH units
AEC36TP67	0 - 0.1 m	20/12/22	Fill	11	<0.4	25	17	20	<0.1	3	20	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD10/20221220	0 - 0.1 m	20/12/22	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	
AEC36TP69	0 - 0.1 m	20/12/22	Fill	8	<0.4	23	10	18	<0.1	4	20	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
AEC36TP70	0 - 0.1 m	20/12/22	Fill	7	<0.4	28	6	15	<0.1	3	8	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
AEC36TP71	0 - 0.1 m	20/12/22	Fill	7	<0.4	26	13	23	<0.1	4	38	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	AD	<5	<5	
AEC36TP71-PACM	0 - 0.1 m	12/01/23	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AD	-	-	
AEC36TP72	0 - 0.1 m	12/01/23	Fill	7	<0.4	25	7	17	<0.1	4	9	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD1/20230112	0 - 0.1 m	12/01/23	Fill	8	<0.4	27	9	19	<0.1	4	12	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<5	<5	
AEC36HA76	0 - 0.1 m	18/01/2023	Fill	7	<0.4	21	9	16	<0.1	4	9	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD1/20230118	0 - 0.1 m	18 Jan 2023	Fill	20	<0.4	57	19	27	<0.1	10	22	<20	<50	<0.1	<0.1	<0.1	<0.3	<0.5	-	<0.5	<0.2	<0.5	-	<1	<1	<0.5	<0.05	<0.05	<0.2	<0.2	<0.1	-	<5	<5	
AEC36HA77	0 - 0.1 m	18/01/2023	Fill	5	<0.4	14	8	11	<0.1	6	16	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD2/20230118	0 - 0.1 m	18/01/2023	Fill	7	<0.4	19	10	14	<0.1	8	18	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<5	<5	
AEC36HA78	0 - 0.1 m	18/01/2023	Fill	9	<0.4	30	9	18	<0.1	5	10	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	AD	<5	<5	
AEC36HA78	0.3 - 0.4 m	18/01/2023	Natural	7	<0.4	27	14	14	<0.1	4	12	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<5	<5	
AEC36HA79	0 - 0.1 m	18/01/2023	Fill	7	<0.4	20	8	31	<0.1	4	41	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD3/20230118	0 - 0.1 m	18/01/2023	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	
PACM79	0 m	18/01/2023	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AD	-	-	
AEC36HA80	0 - 0.1 m	18/01/2023	Fill	7	<0.4	24	6	15	<0.1	4	8	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD4/20230118	0 - 0.1 m	18/01/2023	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	
AEC36HA81	0 - 0.1 m	18/01/2023	Fill	9	<0.4	33	7	24	<0.1	5	19	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
AEC36HA82	0 - 0.1 m	20/01/2023	Fill	7	<0.4	30	5	16	<0.1	4	9	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	<5	<5	
BD1/20230120	0 - 0.1 m	20/01/2023	Fill	8	<0.4	34	6	19	<0.1	5	7	<25	<50	<0.2	<0.5	<1	<1	<0.05	-	<0.05	-	-	<5	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<5	<5	
Waste Classification Criteria [f]																																		
CT1				100	20	100	NC	100	4	40	NC	650	10000	10	288	600	1000	0.8	N/A	200	4000	4000	288	8000	40	288	60	<50	4	4	<50	NC	N/A	N/A	-
SCC1				500	100	1900	NC	1500	50	1050	NC	650	10000	18	518	1080	1800	10	N/A	200	7200	200	518	14400	72	518	108	<50	7.5	7.5	<50	NC	18000	1800	-
TCLP1				N/A	N/A	N/A	NC	N/A	N/A	N/A	NC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	-
CT2				400	80	400	NC	400	16	160	NC	2600	40000	40	1152	2400	4000	3.2	N/A	800	16000	16000	1152	32000	160	1152	240	<50	16	16	<50	NC	N/A	N/A	-
SCC2				2000	400	7600	NC	6000	200	4200	NC	2600	40000	72	2073	4320	7200	23	N/A	800	28800	28800	2073	57600	288	2073	432	<50	30	30	<50	NC	72000	7200	-
TCLP2				N/A	N/A	N/A	NC	N/A	N/A	N/A	NC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	-
Excavated Natural Material (ENM) Order Assessment Criteria																																		
Maximum average concentration				20	0.5	75	100	50	0.5	30	150	NC	250	N/A	N/A	N/A	N/A	0.5	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5 to 9**
Absolute maximum concentration				40	1	150	200	100	1	60	300	NC	500	0.5	65	25	15	1	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4.5 to 10**

CT1 exceedance TCLP1 and/or SCC1 exceedance CT2 exceedance TCLP2 and/or SCC2 exceedance Asbestos detection

NT = Not tested NL = Non limiting NC = No criteria NA = Not applicable

Notes:

a	QA/QC replicate of sample listed directly below the primary sample
b	Total chromium used as initial screen for chromium(VI).
c	Total recoverable hydrocarbons (TRH) used as an initial screen for total petroleum hydrocarbons (TPH)
d	Criteria for scheduled chemicals used as an initial screen
e	Criteria for Chlorpyrifos used as initial screen
f	All criteria are in the same units as the reported results
PQL	Practical quantitation limit
CT1	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values of specific contaminant concentration (SCC) for classification without TCLP: General solid waste
SCC1	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values for leachable concentration (TCLP) and specific contaminant concentration (SCC) when used together: General solid waste
TCLP1	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values for leachable concentration (TCLP) and specific contaminant concentration (SCC) when used together: General solid waste
CT2	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values of specific contaminant concentration (SCC) for classification without TCLP: Restricted solid waste
SCC2	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values for leachable concentration (TCLP) and specific contaminant concentration (SCC) when used together: Restricted solid waste
TCLP2	NSW EPA, 2014, Waste Classification Guidelines Part 1; Classifying Waste, Maximum values for leachable concentration (TCLP) and specific contaminant concentration (SCC) when used together: Restricted solid waste

Appendix E

Site Management Plan

Site Management Plan
RAP for AEC 36, Patons Lane, Orchard Hills
SCAW Package for SMWSA

1. Introduction

This general site management plan (SMP) has been developed to minimise potentially adverse impacts on the environment, and worker and public health as a result of the proposed remediation works.

The 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 Contractor. This SMP has been prepared to augment the 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).

Works are to comply with the Environmental Protection Licence (21695) for the SCAW project.

Apart from the management principles outlined in this SMP, the 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* NDSW (WHS Act) and *Work Health and Safety Regulations 2011* NSW.

2. Roles and Responsibilities

With respect to contamination land management at the site, Sydney Metro (SM) is the Principal, CPBUI JV is the Principal Contractor; and Melissa Porter (of Senversa) is the Site Auditor accredited by NSW EPA under the CLM Act.

The Principal will retain the overall responsibility for ensuring this RAP is appropriately implemented, however, the actual implementation of the RAP will be conducted by the Principal Contractor. Roles and responsibilities for implementing this RAP are discussed below.

2.1 Principal Contractor

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

In addition to the implementation of the RAP, it will be the Contractor's responsibility to:

- Obtain / ensure relevant sub-contractors obtain specific related approvals as necessary to implement the earthworks including permits for removal of asbestos-containing material, SafeWork NSW notification etc.;
- Develop or request and review any site plans 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 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.

The Principal Contractor will be responsible for ensuring the contamination testing and management is carried out in accordance with the Environmental Protection Licence (21695).

2.2 Asbestos Contractor

The Asbestos Contractor will be responsible for undertaking all asbestos work involving any asbestos impacted filling and will hold the appropriate licence for the removal of asbestos (issued by SafeWork NSW). It is noted that the asbestos identified at the site to date has included both friable and bonded asbestos. A Class A licence will be required for friable asbestos removal work. (A minimum of) a Class B licence will be required for bonded asbestos removal work.

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

2.3 Sub-contractors

All sub-contractors will be inducted onto the site, informed of their responsibilities in relation to this RAP and sign their agreement to abide by the RAP requirements. Where necessary, sub-contractors will also 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.

2.4 Environmental Consultant

The Environmental Consultant will provide advice on implementing the RAP. The Environmental Consultant will be responsible for:

- Undertake any required assessments where applicable (e.g., waste classification, validation, etc.);
- Provide advice and recommendations arising from monitoring and/or inspections, including unexpected finds; and
- Notify the client of any results of assessments, and any observed non-conformances.

2.5 Occupational Hygienist

The Occupational Hygienist will be required to be engaged independently of the Asbestos Contractor to undertake the following:

- Review and approve documentation prepared by the Asbestos Contractor;
- Prepare any WHS plans and advice required by the Contractor;
- Undertake airborne asbestos monitoring;
- Undertake clearance inspections;
- Provide advice and recommendations arising from monitoring and/or inspections; and
- Notify the client of results of any assessments and any observed non-conformances.

The Occupational Hygienist will be a licensed Asbestos Assessor for friable asbestos removal work.

2.6 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)).

3. Water Management

3.1 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. Discharges of water must be in accordance with the Environmental Protection Licence (21695).

The Contractor will 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.

Where water is not suitable for discharge to the stormwater system, a liquid waste contractor may be required to remove the water for disposal in accordance with regulatory requirements.

3.2 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), 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 and takes time to obtain relevant approvals; 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.

4. Soil Management Plan

The Contractor is to include a plan to mitigate cross contamination as part of the CEMP (or similar document) to be implemented throughout the works. An *Asbestos Management Plan* (AMP) for *Sydney Metro Western Sydney Airport Surface and Civil Alignment Works (SCAW)* has been prepared by Tetra Tech Coffey Pty Ltd. Reference is to be made to the AMP when undertaking remediation works for asbestos contamination.

4.1 Excavation and Stockpiling of Contaminated Material

Contaminated material shall be excavated and stockpiled at a suitably segregated location(s) away from sensitive areas (e.g., water bodies, drainage lines, stormwater pits, etc.) and ongoing excavations, and in a manner that will not cause nuisance to the neighbouring properties. Soil stockpiles are to be managed as follows:

- An impermeable membrane such as plastic sheeting should be provided at the surface by the Contractor prior to stockpiling. Plastic sheeting should be taped at joins, as necessary;
- 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;
- Stockpiles impacted, or potentially impacted, with asbestos must be covered by geotextile;
- Any stockpile to remain on-site overnight should be adequately secured in order to reduce the risk of sediment runoff;
- Measures should be taken by the Contractor to prevent the migration of stockpile materials (i.e., perimeter bunds, hay bales, silt fences, etc.);
- Should the stockpile remain on-site for over 24 hours, geotextile silt fences must be erected to prevent losses by surface erosion; and
- A record of stockpile locations (stockpile register), dimensions, descriptions, environmental controls, etc. should be maintained by the Contractor.

All movement of soil within the site and off-site is to be tracked by the Contractor, from cradle to grave. Stockpiles kept on site are to be clearly labelled (pegged or spray painted on geofabric) and a site record is to be kept including the source location of each stockpile and the position of each stockpile (with associated dates). Copies of tracking records must be provided to the Environmental Consultant.

4.2 Loading and Transport of Contaminated Material

Transport of contaminated material 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 waste transport route (to be determined by the Contractor) will be notified to Council and truck dispatch shall be logged and recorded by the Contractor for each load leaving the site. A record of the truck dispatch will 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 will 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 will be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Roadways will be kept clean throughout the remediation works and will be broomed, if necessary, to achieve a clean environment.

All loads will 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 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.

5. 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 should meet Council requirements.

6. Dust Control Plan

Dust emissions must 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;

- 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.

7. 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;
- 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.

8. Work Health and Safety Plan

8.1 General

It is the Contractor's responsibility to devise a SWMS[1] (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. This RAP and SMP sets 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 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 Contractor's SWMS.

[1] Either a SWMS or construction environmental management plan (CEMP), or other equivalent document incorporating health and safety aspects of the proposed remedial works.

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 Contractor must comply with policies specified in the *Work Health and Safety Regulation 2011*.

All appropriate permits, licences and notifications required for the remediation activities must be obtained prior to the commencement of remediation works.

8.2 Site Access

Appropriate fencing and signage must be installed around and within the site to prevent unauthorised access and restrict access to remediation areas and / or excavations. Access restrictions and administrative arrangements for management of entry of workers or related personnel on site is the responsibility of the 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).

8.3 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 Contractor's SWMS.

8.4 Chemical and Physical Hazards

The risks associated with chemical soil contaminants to site personnel and workers involved in the remediation are considered to be low due to the recorded soil and groundwater concentrations in the DSI.

The following physical hazards are associated with conditions that may be created during remediation works:

- 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, the chemical and physical hazards can be managed through appropriate demarcation, access controls and the use of appropriate PPE.

8.5 Safe Work Practices

The appropriate safe work practices should be clearly defined by the Contractor in their SWMS. As a minimum, all personnel on site will be 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; 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 should 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);
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Ed* (NOHSC, 2005).

9. Remediation Schedule and Hours of Operation

The remediation works will be conducted within the days and hours specified the Environmental Protection Licence (21695).

10. 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 should be performed by the 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 Table 1 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. Contact details for key utilities are included in the event of needing to respond to incidents.

The Contractor will 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.

Table 1: Summary of Roles and Contact Details

Role	Personnel / Contact	Phone Contact Details
Principal		
Principal's Representative		
Site Manager		
Principal Contractor		
Site Office		
Environmental Consultant		
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

Role	Personnel / Contact	Phone Contact Details
Utility Provider	Telecommunications (Telstra Corporation Limited)	13 22 03
Utility Provider	Telecommunications (Optus)	1800 505 777
Utility Provider	Telecommunications (NBN Co Limited)	1800 687 626

11. References

ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Canberra, ACT: Australian and New Zealand Governments and Australian state and territory governments.

CRC CARE. (2019). *Remediation Action Plan: Implementation - Guideline on Health and Safety.* National Remediation Framework: CRC for Contamination Assessment and Remediation of the Environment.

NOHSC. (2005). *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Ed.* Canberra, April 2005, NOHSC:3003: National Occupational Health and Safety Commission, Commonwealth of Australia.

NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land.* Contaminated Land Guidelines: NSW Environment Protection Authority.

SafeWork NSW. (2019a). *Code of Practice, How to Manage and Control Asbestos in the Workplace.* August 2019.

SafeWork NSW. (2019b). *Code of Practice, How to Safely Remove Asbestos.* August 2019: SafeWork NSW, NSW Government.

WorkCover NSW. (2014). *Managing Asbestos in or on Soil.* March 2014: WorkCover NSW, NSW Government.

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Appendix F

Contingency Plan and Unexpected Finds Protocol

Contingency Plan and Unexpected Finds Protocol
RAP for AEC 36, Patons Lane, Orchard Hills
SCAW Package for SMWSA

1. General

Where the site 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 and inform the Site Auditor. Where necessary the Environmental Consultant will prepare an addendum to, or revision of, this RAP. Any addendum or revision is to be reviewed and agreed by the Site Auditor before its implementation.

2. 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 9 of RAP), is encountered during the remediation works. Any such finds shall be surveyed, and the location documented.

Although the site has been subject to previous investigation(s), there remains a potential for soil contamination to be present between sampled locations. In the event that signs of soil contamination, other than that included in the remediation strategy, are encountered during remediation e.g., evidence of petroleum, or other chemical odours which weren't previously identified, the following protocols will apply:

- The Site Manager is to be notified and the affected area closed off by the use of barrier tape and warning signs;
- 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 will be compiled by the Environmental Consultant and provided to the Principal Contractor;
- The assessment results together with a suitable management plan shall be provided by the Principal Contractor to the Site Auditor (and Principal if required);
- The agreed management / remedial strategy, based on the RAP and relevant guidelines shall be implemented; and
- All details of the assessment and remedial works are to be included in the site validation report.

3. Unexpected Finds Protocol

An *Unexpected Finds Soil Contamination and Asbestos Procedure* has been incorporated into CPBUI JV, *Soil and Water Management Sub-plan, Western Sydney Airport – Surface and Civil Alignment Works,* Project N81150, Revision 1, 4 November 2022, and is to be adopted for the SCAW project. The unexpected finds protocol (UFP) herein has been developed with reference to the *Unexpected Finds Soil Contamination and Asbestos Procedure* to provide guidance on processes to follow if any unexpected find is encountered during the remediation or future civil and construction works. Any unexpected finds should be surveyed, and the location documented.

All site personnel are to be inducted into their responsibilities with regard to unexpected finds procedures.

All site personnel are required to report unexpected signs of environmental concern to the Site Supervisor (and, subsequently the CPBUI JV Environmental Coordinator) 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) or chemical spills.

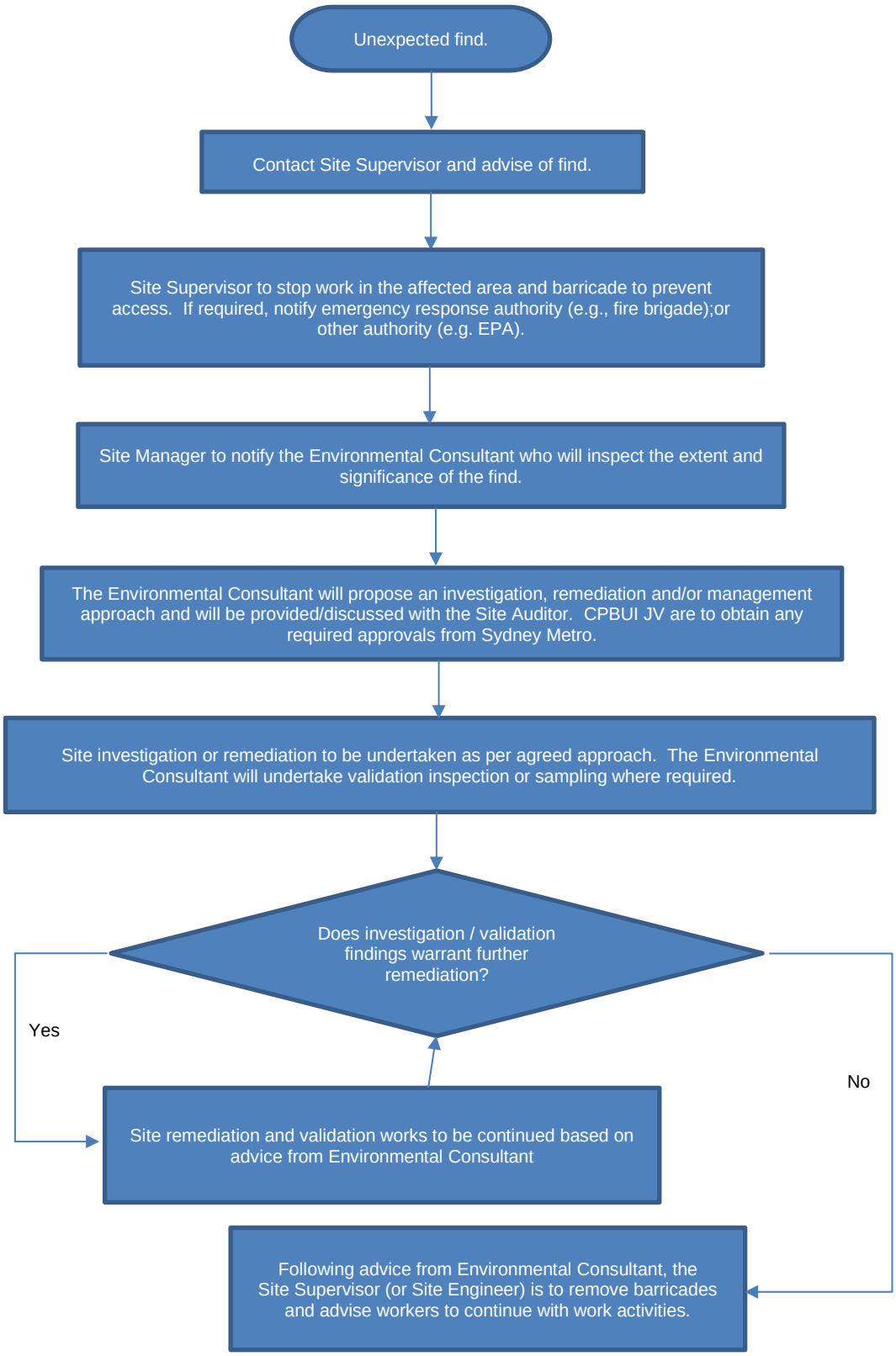
Should signs of concern be observed, the Site Supervisor, as soon as practical, will:

- Stop work in the affected area and ensure the area is barricaded to prevent unauthorised access;
- Notify authorities needed to obtain emergency response for any health or environmental concerns (e.g., fire brigade);
- Notify any of the authorities that the Contractor is legally / contractually required to notify (e.g., EPA);
- Notify the Environmental Consultant of the find; and
- Inform the CPBUI JV Project Manager of the find.

The Environmental Consultant will assess the extent and significance of the find and develop an investigation, remediation or management approach using (where possible) the principles and procedures already outlined in the RAP. The proposed approach will be discussed and agreed with the Site Auditor prior to implementation. Sydney Metro are to be contacted by CPBUI JV to obtain any required approvals for investigation, remediation or management of the contamination.

A flow chart for the unexpected finds protocol is shown below.

Flow Chart for Unexpected Finds Protocol



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Appendix G

Site Assessment Criteria

Site Assessment Criteria for Soil for AEC 36

Surface & Civil Alignment Works (SCAW) Package for Sydney Metro - Western Sydney Airport (SMWSA)

1.0 Introduction

It is understood that the two general future land uses associated at the site will comprise:

- The rail corridor. The rail corridor will include the rail line, embankments / noise barriers, a stabling yard and maintenance facility and stations; and
- Passive open space. These are areas immediately adjacent to the rail corridor that may be used for bike / commuter paths. It is assumed that there is an absence of buildings in areas of passive open space.

The following references were consulted for deriving 'Tier 1' SAC for soil for the two above-listed land uses:

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013);
- CRC CARE *Health screening levels for petroleum hydrocarbons in soil and groundwater* (CRC CARE, 2011); and
- HEPA, *PFAS National Environmental Management Plan* (NEMP) (HEPA, 2020).

Where Tier 1 SAC are exceeded, further assessment may be undertaken using other guidelines, as a 'Tier 2' assessment, such as:

- Cardno (NSW/ACT) Pty Ltd, *Human Health and Ecological Risk Assessment, Spoil Re-use Sydney Metro and Western Sydney Airport*, 80021888, Version 003 (HHERA) (Cardno, 2021); and
- CRC *CARE Risk-based Management and Remediation Guidance for Benzo(a)pyrene. Technical Report no. 39: Cooperative Research Centre for Contamination Assessment and Remediation of the Environment* (CRC CARE, 2017).

HHERA includes a set of criteria for a range of spoil-re-use scenarios for SMWSA. As discussed in the HHERA, particular considerations are required for use of criteria from HHERA (e.g., the presence of capping to prevent erosion and / or infiltration; the potential risk to groundwater and / or surface water; etc.). Given the considerations required for spoil reuse, the criteria from HHERA have not been listed herein and the HHERA should be referred to if it is to be used as a source of criteria for a Tier 2 assessment.

2.0 Human Health-based Criteria

Human health-based SAC for soil and the associated future land uses are listed in Tables 1 to 6. Tier 1 criteria comprise:

- Health Investigation Levels (HIL) for a broad range of metals and organics (Table 1). HIL are applicable for assessing human health risk via all relevant pathways of exposure;
- Health Screening Levels (HSL) for vapour intrusion for selected petroleum hydrocarbons and fractions (Tables 2 and 3). These are applicable for assessing human health via the inhalation pathway. HSL are dependent on soil type and depth. HSL D are applicable to soil / areas to be covered by buildings (e.g., stations, offices and enclosed sheds);
- HSL for direct contact for selected petroleum hydrocarbons and fractions (Table 4). These are applicable for assessing human health via the direct contact pathway;
- Health investigation levels (HIL) for per- and poly-fluoroalkyl substances (PFAS) (Table 5). At the time of preparing this document, screening values were available only for perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS); and
- Health screening levels for asbestos (Table 6).

For HSL for vapour intrusion, HSL for sand and clay soils are shown as these are the predominant soil types at the site.

Table 1: Health Investigation Levels (Tier 1) from NEPM

Contaminant	HIL C for Passive Open Space (mg/kg)	HIL D for Rail Corridor (mg/kg)
Metals and Inorganics		
Arsenic	300	3000
Cadmium	90	900
Chromium (VI)	300	3600
Copper	17 000	240 000
Lead	600	1500
Mercury (inorganic)	80	730
Nickel	1200	6000
Zinc	30 000	400 000
Cyanide (free)	240	1500
Polycyclic Aromatic Hydrocarbons (PAH)		
Benzo(a)pyrene TEQ	3	40
Total PAH	300	4000
Phenols		
Phenol	40 000	240 000
Pentachlorophenol	120	660
Cresols	4000	25 000
Organochlorine Pesticides (OCP)		
DDT+DDE+DDD	400	3600
Aldrin and dieldrin	10	45
Chlordane	70	530

Contaminant	HIL C for Passive Open Space (mg/kg)	HIL D for Rail Corridor (mg/kg)
Endosulfan	340	2000
Endrin	20	100
Heptachlor	10	50
HCB	10	80
Methoxychlor	400	2500
Toxaphene	30	160
Organophosphorus Pesticides (OPP)		
Chlorpyrifos	250	2000
Polychlorinated Biphenyls (PCB)		
PCB	1	7

Table 2: Health Screening Levels (Tier 1) for Vapour Intrusion for Passive Open Space from NEPM

Contaminant	HSL C (mg/kg)	HSL C (mg/kg)	HSL C (mg/kg)	HSL C (mg/kg)
SAND	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	NL	NL	NL	NL
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TPH C6-C10 less BTEX	NL	NL	NL	NL
TPH >C_{10}-C_{16} less naphthalene	NL	NL	NL	NL
CLAY	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	NL	NL	NL	NL
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TPH C6-C10 less BTEX	NL	NL	NL	NL
TPH >C10-C16 less naphthalene	NL	NL	NL	NL

Notes: TPH is total petroleum hydrocarbons

The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'

Table 3: Health Screening Levels (Tier 1) for Vapour Intrusion for Rail Corridor from NEPM

Contaminant	HSL D (mg/kg)	HSL D (mg/kg)	HSL D (mg/kg)	HSL D (mg/kg)
SAND	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	3	3	3	3
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	230	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TPH C6-C10 less BTEX	260	370	630	NL
TPH >C10-C16 less naphthalene	NL	NL	NL	NL
CLAY	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	4	6	9	20
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TPH C6-C10 less BTEX	310	480	NL	NL
TPH >C10-C16 less naphthalene	NL	NL	NL	NL

Notes: TPH is total petroleum hydrocarbons

The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'

Table 4: Health Screening Levels (Tier 1) for Direct Contact from CRC CARE (2011)

Contaminant	HSL C for Passive Open Space (mg/kg)	HSL D for Rail Corridor (mg/kg)
Benzene	120	430
Toluene	18 000	99 000
Ethylbenzene	5300	27 000
Xylenes	15 000	81 000
Naphthalene	1900	11 000
TPH C6-C10 less BTEX	5100	26 000
TPH >C10-C16 less naphthalene	3800	20 000
TPH >C16-C34	5300	27 000
TPH >C34-C40	7400	38 000

Notes: TPH is total petroleum hydrocarbons.

Table 5: Health Investigation Levels (Tier 1) for PFAS from NEMP

Contaminant	HIL C for Passive Open Space (mg/kg)	HIL D for Rail Corridor (mg/kg)
PFOS and PFHxS *	1	20
PFOA	10	50

Notes: * Includes PFOS only, PFHxS only and the sum of the two.

Table 6: Health Screening Levels (Tier 1) for Asbestos from NEPM

Form of Asbestos	Health Screening Level C for Passive Open Space	Health Screening Level D for Rail Corridor
Bonded asbestos containing materials (ACM)	0.02%	0.05%
Fibrous asbestos (FA) and asbestos fines (AF) (friable asbestos)	0.001%	0.001%
All forms of asbestos	No visible asbestos for surface soil	No visible asbestos for surface soil

Notes: FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
AF includes free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.
Surface soils defined as top 10 cm.

3.0 Ecological Criteria

Ecological SAC for soil and the associated future use are listed are listed in Tables 7 to 9. Tier 1 criteria comprise:

- Ecological Investigation Levels (EIL) for arsenic, copper, chromium (III), nickel, lead, zinc, DDT and naphthalene (Table 7). These are derived using the interactive (excel) calculation spreadsheet on the NEPM toolbox website and are used to assess contamination with respect to terrestrial ecosystems. Site specific inputs (including soil parameters) are required to calculate EIL. EIL typically apply to the top 2 m of soil;
- Ecological Screening Levels (ESL) for selected petroleum hydrocarbon compounds and fractions, and benzo(a)pyrene, and are used to assess contamination with respect to terrestrial ecosystems (Table 8). ESL are dependent on soil type and typically apply to the top 2 m of soil; and
- Ecological Soil Guideline Values (EGV) for PFAS (Table 9). At the time of preparing this document, screening values were available only for PFOS and PFOA.

EIL were determined using the NEPC Ecological Investigation Level Spreadsheet based on the following inputs:

- A pH of 6.3;

- A Cation Exchange Capacity (CEC) of 10.3 meq/100g;
- Contamination is assumed to be 'aged' based on site history;
- A (default) organic carbon content value of 1% has been used as a default value;
- A clay content of 1% has been used as a conservative value; and
- The state is NSW and the traffic volume is 'low'.

Sand and clay soils were encountered during the investigation and, so, ESL for coarse and fine soils have been adopted.

Table 7: Ecological Investigation Levels (Tier 1) from NEPM toolbox

Contaminant	Public Open Space EIL for Passive Open Space (mg/kg)	Commercial and Industrial EIL for Rail Corridor (mg/kg)
Metals		
Arsenic	100	160
Copper	210	300
Nickel	180	300
Chromium III	190	320
Lead	1100	1800
Zinc	490	720
PAH		
Naphthalene	170	370
OCP		
DDT	180	640

Table 8: Ecological Screening Levels (Tier 1) from NEPM

Contaminant	Soil Type	Public Open Space ESL for Passive Open Space (mg/kg)	Commercial and Industrial ESL for Rail Corridor (mg/kg)
Benzene	Coarse	50	75
	Fine	65	95
Toluene	Coarse	85	135
	Fine	105	135
Ethylbenzene	Coarse	70	165
	Fine	105	135
Xylenes	Coarse	105	180
	Fine	45	95

Contaminant	Soil Type	Public Open Space ESL for Passive Open Space (mg/kg)	Commercial and Industrial ESL for Rail Corridor (mg/kg)
TPH C6-C10 less BTEX	Coarse/ Fine	180*	215*
TPH >C10-C16	Coarse/ Fine	120*	170*
TPH >C16-C34	Coarse	300	1700
	Fine	1300	2500
TPH >C34-C40	Coarse	2800	3300
	Fine	5600	6600
Benzo(a)pyrene	Coarse / Fine	0.7	1.4

Notes: ESL are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability
TPH is total petroleum hydrocarbons

Table 9: Ecological Soil Guideline Values (Tier 1) from NEMP for all Land Uses

Contaminant	Direct Exposure (mg/kg)	Indirect Exposure (mg/kg)
PFOS	1	0.01
PFOA	10	NC

Notes: NC no criterion
Direct exposure ecological soil guideline applies specifically to protection of organisms that live within, or in close contact with soil, such as earthworms and plants.
The indirect exposure ecological soil guideline accounts for the various pathways through which organisms can be exposed whether or not they are in direct contact with PFAS contaminated soil (i.e. exposure through the food chain). For intensively developed sites with no secondary consumers and minimal potential for indirect ecological exposure, a higher criterion of up to 0.14 mg/kg may be appropriate.

4.0 Management Limits

In addition to appropriate consideration and application of the human health and ecological criteria, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g., penetration of, or damage to, in-ground services.

Management limits are shown in Table 10. Clay (fine soil) and sand (coarse soil) were encountered during the investigation, so, management limits for fine and coarse soils have been adopted.

Table 10: Management Limits for TPH from NEPM (mg/kg)

Contaminant	Soil Type	Public Open Space Management Limits for Passive Open Space (mg/kg)	Commercial and Industrial Management Limit for Rail Corridor (mg/kg)
TPH C6-C10	Coarse	700	700
	Fine	800	800
TRH >C10-C16	Coarse	1000	1000
	Fine	1000	1000
TPH >C16-C34	Coarse	2500	3500
	Fine	3500	5000
TPH >C34-C40	Coarse	10 000	10 000
	Fine	10 000	10 000

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Appendix H

Data Quality Objectives

Data Quality Objectives
RAP for AEC 36, Patons Lane, Orchard Hills
SCAW Package for SMWSA

1. Introduction

The objective of the validation plan is to demonstrate that the site has been made suitable for the proposed development, and to provide information on any environmental impacts which may have resulted from the works.

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

2. Data Quality Objectives

Table 1: Data Quality Objectives

Step	Summary
1: State the problem	The site requires remediation and validation of remediation in order to render it suitable for proposed land use. The objective of the validation plan is to confirm the successful implementation of this remediation action plan. A conceptual site model (CSM) for the proposed development has been prepared in the RAP.
2: Identify the decisions / goal of the study	The CSM identifies the contaminants of potential concern (CoPC) and the likely impacted media. The key contaminant impacting the site is asbestos. The validation sampling results will be compared against the RAC. The preferred remediation strategy as outlined in the RAP is the excavation and containment of contaminated soils elsewhere in the SCAW project boundaries. The success of the remediation and subsequent validation will be based on a comparison of the analytical results to the adopted RAC. Although not appropriate for asbestos, statistical analysis may be utilised for other contaminants.
3: Identify the information inputs	Relevant inputs to the decision include: • The CSM, identifying the contaminant and affected media; • Analysis using NATA accredited laboratories and methods, where possible; • Field and laboratory QA / QC data to assess the suitability of the environmental data for the validation assessment; and • Results compared with the RAC.

Step	Summary
4: Define the study boundaries	The lateral remedial boundaries of the site are shown on Drawings AEC36-05 and AEC36-06, Appendix A, of the RAP. 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.
5: Develop the analytical approach (or decision rule)	The decision rule is to compare all analytical results with the RAC. Initial comparisons will be with individual results. Although not appropriate for asbestos, statistical analysis may be utilised for other contaminants. Quality control results are to be assessed according to their relative percent difference (RPD) values. For field and laboratory duplicate results for chemical analysis, 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 14. It is noted that duplicate samples will not be analysed for asbestos.
6: Specify the performance or acceptance criteria	Baseline condition: Contaminants at the site and / or statistical analysis of data exceed the RAC and pose a potentially unacceptable risk to receptors (null hypothesis). Alternative condition: Contaminants at the site and statistical analysis of data complies with the RAC and as such, do not pose a potentially unacceptable risk to receptors (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 11 and Section 12; • Analysis for the CoPC at NATA accredited laboratories using NATA endorsed methods will be used to perform laboratory analysis whenever possible; and • Adequately experienced environmental scientists/engineers will conduct field work and sample analysis interpretation.

3. References

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM].* Australian Government Publishing Services Canberra: National Environment Protection Council.

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.