SYDNEY METRO - WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

Bringelly Services Facility Detailed Site Investigation

Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works

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Abbreviations

Abbreviation	Definition
AHD	Australian height datum (0 AHD corresponds roughly to mean sea level)
bgs	Below ground surface
bgl	Below ground level
BTEXN	Benzene, toluene, ethylbenzene, xylene, and naphthalene
BSF	Bringelly Service Facility
CMF	Claremont Meadows Service Facility
COPC	Chemicals of potential concern
CPG	CPB Contractors Ghella
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane (organochlorine insecticide)
DPI	NSW Department of Primary Industries
DSI	Detailed site investigation
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ENM	Excavated natural material
EPA	NSW Environment Protection Authority
GDE	Groundwater dependent ecosystem
GDR	Geotechnical Data Report
GWMR	Groundwater Monitoring Report
GSW	General solid waste
m	Metre
mg/L	Milligram per litre
NSW	New South Wales
PAH	Polycyclic aromatic hydrocarbon
PDS	Portal Dive Structure
PFAS	Per and polyfluoroalkyl substances
SBT	Station Boxes and Tunnelling Works
SBT North	Area including STM, CMF and OHE
SBT South	Area including PDS, ATM, BSF and AEC

Abbreviation	Definition
SWA	Sydney Western Airport
TBC	To be completed
TBM	Tunnel boring machine
TCE	Trichloroethylene
TDS	Total dissolved solids
TfNSW	Transport for New South Wales
TRH	Total Recoverable Hydrocarbons
TTC	Tetra Tech Major Projects Pty Ltd (TTMP)
µg/L	Micro gram per litre
UST	Underground storage tank
VENM	Virgin excavated natural material
WAL	Water Access License
WSA	Western Sydney Airport
WSI	Western Sydney International (Airport)

1. Introduction

Sydney Metro has engaged the CPB Ghella Joint Venture (CPG) for the design and construction of the Station Boxes and Tunnelling Works (SBT Works) of the Sydney Metro Western Sydney Airport project (the 'Project').

The SBT Works involves the construction and operation of a new 23km metro rail line from the existing Sydney Trains suburban T1 Western Line (at St Marys) in the north and the Aerotropolis (at Bringelly) in the south. The Project includes tunnels and civil structures, including a viaduct, bridges, and surface and open-cut troughs between the two tunnel sections. **Figure 1.1** shows the proposed alignment and key features of the Project.

The SBT Works are divided into two parts:

- SBT North: St Marys Station to Orchard Hills Station. St Marys Station is an existing heritage-listed suburban rail station. Orchard Hills is a new station for the Sydney Metro line and will include the portal dive structure. Claremont Meadows Services Facility (CMF) is included along this alignment.
- SBT South: Airport business park dive structure to the Western Sydney Airport Aerotropolis station. This section of work is largely greenfield, with construction both on and off-airport land. The Airport Terminal Station (ATM). The **Bringelly Services Facility (BSF)** (the 'site') is included along this alignment.

Key elements on the SBT Works include:

- Two sections of twin tunnels with a combined length of approximately 9.8 km, plus associated portal structures. This includes one section from St Marys to Orchard Hills and the other under Western Sydney International (WSI) airport to the new Aerotropolis Station.
- Excavations at either end to enable trains to turn back, and stub tunnels to enable future extensions
- Station box excavations with temporary ground support for four stations at St Marys, Orchard Hills, Airport Terminal and Aerotropolis
- Excavations for two intermediate services facilities, one in each of the tunnel sections at Claremont and Bringelly.

CPG has engaged Tetra Tech Major Projects Pty Ltd (TTMP) to provide geotechnical, hydrogeological and contaminated land services associated with the design and construction of the SBT Works.

Previous investigations have been conducted at the site (refer to **Section 5**) and have been limited in scope. Based on the potential for contamination at the site from historical land use, further investigation was recommended to refine the understanding of potential contamination risks and to inform the design and construction of the BSF.

This document describes the Detailed Site Investigation (DSI) completed at the site.

This DSI is specific to the shaft and surface construction activities at the site (refer to **Sections 3 and 4**). Separate DSIs are being prepared for the tunnel, other station sites, and CMF. This DSI is specific to the construction phase on the site. Consideration to the use of the site post construction (other than the use of the shaft for commercial/industrial purposes) is outside the scope of the SBT Works.

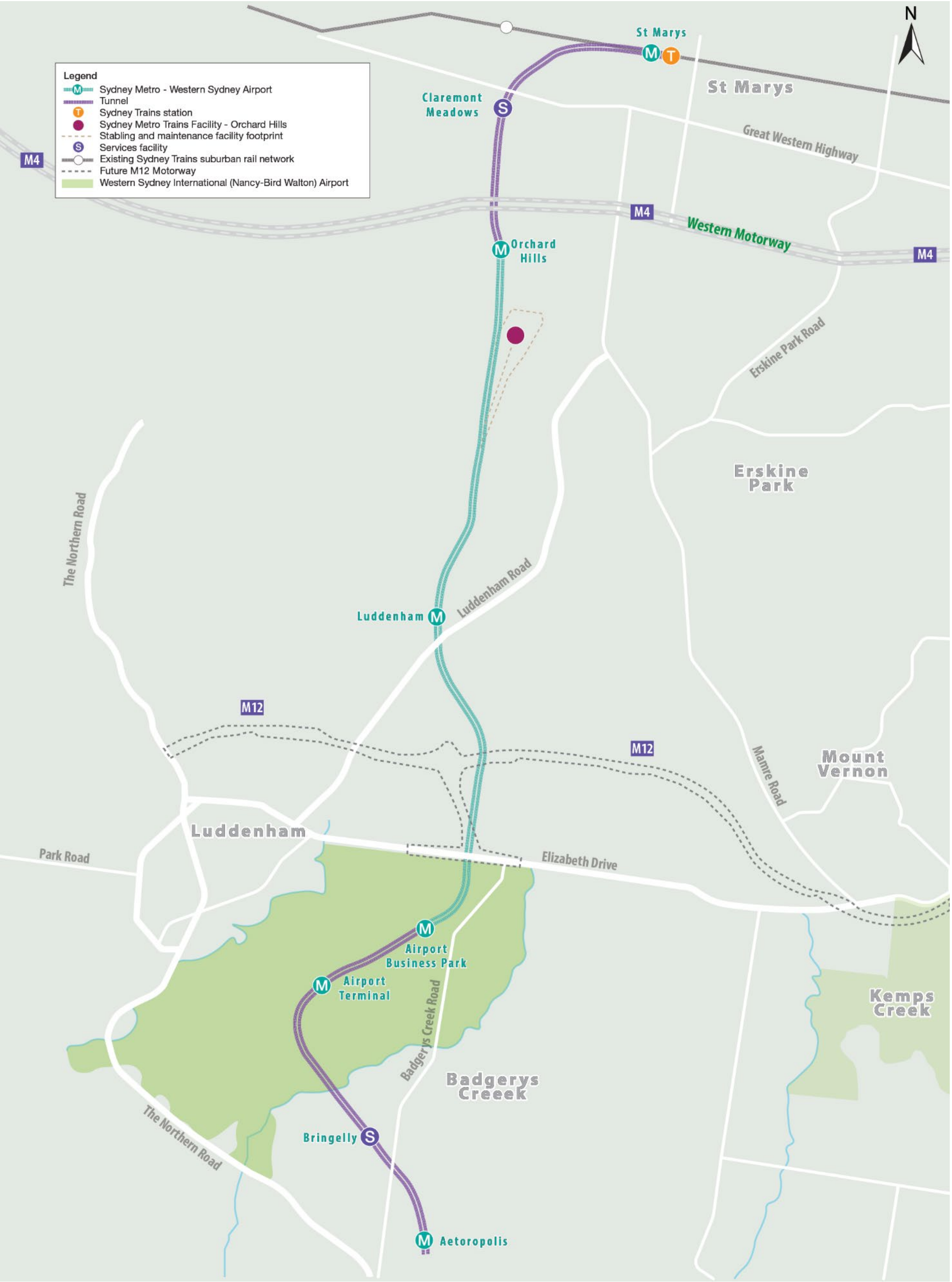


Figure 1.1 Overview of SBT Works

The purpose of this DSI was to:

- Provide data to inform the management of spoil generated during construction for either on-site reuse and / or off-site disposal;
- Inform the required controls which need to be implemented during construction regarding the management of contamination in soil and groundwater; and
- Inform the requirement for remediation and / or management measures which need to be implemented for the design of the BSF.

This DSI was carried out in conjunction with geotechnical and hydrogeological investigations and relevant information from these investigations was included in this report.

The completion of this DSI was a requirement of the Sydney Metro - Western Sydney Airport Station Boxes and Tunnelling Works Design and Construction Deed Contract No: WSA-200-SBT. Under Section 12.19 of this Deed, objectives of the DSI included:

- Investigate areas of proposed excavation or disturbance;
- Investigate land within the construction site and / or surrounding the areas of proposed excavation or disturbance with respect to the potential migration of contamination via groundwater, ground gas and odour into the areas of excavation or disturbance; and
- Provide in-situ classification of solid waste (i.e., spoil).

1.1. Regulatory Framework

This DSI was prepared in general accordance with the following legislation, industry standards, codes of practice, and guidance documents, where relevant:

- ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- Australian Standard (AS) 4482.1, *Guide to Investigation and Sampling of Sites with Potentially Contaminated Soil, Part 1: Non-volatile and Semi-volatile Compounds, 2005* (AS4482.1 – 2005)
- AS 4482.2, *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Substances*, 1999 (AS4482.2-1999)
- *Contaminated Land Management (CLM) Act, 1997* (CLM Act 1997)
- CRC Care Technical Report No. 10, *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, 2011* (CRCCARE 2011)
- Heads of EPAs Australia and New Zealand (HEPA). *PFAS National Environmental Management Plan. Version 2.0 – January 2020* (HEPA NEMP 2020)
- *Protection of the Environment Operations (POEO) Act 1997* (POEO Act 1997)
- *POEO (Underground Petroleum Storage Systems) Regulation 2019* (POEO UPSS Regulation 2019)
- *National Environment Protection Council (NEPC) Act 1994* (NEPC Act 1994)

- *National Environment Protection Council, National Environment Protection (Assessment of Site Contamination) Measure, 1999* (April 2013) (ASC NEPM 2013)
- NSW Department of Environment and Conservation (DEC), *Contaminated Sites Guidelines for the Assessment and Management of Groundwater Contamination, 2007* (DEC 2007)
- NSW EPA (1995) *Contaminated Sites Sampling Design Guidelines*
- NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying waste*
- NSW EPA (2014) *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 (2016) *Addendum to the Waste Classification Guidelines (2014) – Part 1: classifying waste*
- NSW EPA *Contaminated Land Guidelines: Assessment and management of hazardous ground gases, 2020* (NSW EPA 2020)
- NSW EPA (2020), *Contaminated Land Guidelines: Consultants Reporting on Contaminated Land, 2020*.

2. Scope of Work

The scope and rationale for the investigation completed as part of this DSI is set out within the following document:

- TTMP (2022b); *Bringelly, Sampling Analysis and Quality Plan, Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works* (Ref: SMWSASBT-CPG-SWD-SW000-GE-RPT-040502; rev B.01) (the 'SAQP')

In summary, the following scope of work was completed:

- Review of existing information including the previous Preliminary Site Investigation (PSI) and SAQP;
- Intrusive investigation was completed over 19 days and comprised the following:
  - 33 test pits were excavated to depths of between 1.0 m and 2.0 m below ground surface (bgs); and
  - 8 boreholes were drilled to depths of between 14.07 m and 50.24 mbgs and five were converted into groundwater monitoring wells.
- Analysis of soil and groundwater samples for contaminants of potential concern (COPC).
- Preparation of this report discussing the findings of the assessment.

Further detail is provided in Section 9.

3. Site Description

3.1. Site Setting and Features

The site is located on the at the northern end of Derwent Road at Bringelly, as shown in **Figures 1 to 2**, **Appendix 1**.

The site is currently cleared and not in use. Key attributes of the site are summarised in Table 1.

It should be noted that the site is defined as the 'BSF Site Boundary' as shown by the yellow dashed line in Figure 2. Construction activity for the project is shown within the 'Construction Footprint' boundary shown as a red line in Figure 2.

Table 1: Site Information

Attribute	Description
Address	40 Derwent Road, Bringelly NSW 2556
Property Area	The site boundary (property boundary) is approximately 3.9 ha; however, the construction footprint is approximately 2 ha
Title Identification Details	Lot 181 on DP 806012
Current Land Use	Cleared and unused
Current Land Zoning	ENT - Enterprise
Adjoining Land Uses	**North:** Landscape supply business and material storage area. Further north is rural land. **South:** Low rural residential and agricultural areas. Civil earthmoving business to the southwest. **West:** Commercial land uses (e.g., landscaping suppliers, rural residential and agricultural activities. **East:** Derwent Road and beyond lies rural land and agricultural areas

3.2. Site Description

An inspection of the eastern portion of the BSF site (east of the existing water dam) was undertaken on the 22 March 2022.

The site was accessed from Derwent Road, and at the time of inspection, minor excavations, understood to be related to placement of services was being undertaken in the south-east corner of the site.

The topography of the site sloped gently down to the north.

With the exception of the south-east portion of the site, dense weed/grass cover was present across the surface. Due to safety concerns and limited visibility of the ground surface, the site walkover was limited to areas where dense grass cover was not present. The presence of thick ground cover limited visual observations which could be made at the time of the site walkover.

The former structures, inclusive of a residential dwelling and sheds had been removed; the footprint of these former structures and surrounding areas were characterised by bare soil.

Fibre cement debris, suspected of containing ACM was observed in multiple locations within the site within the footprint and surrounds of the former dwelling and southern site shed.

A fenced off area was present in the central portion, with a large dam situated within the fenced off area.

While some general refuse (cardboard and scrap wood) was noted around the site, TTMP did not observe stored chemicals, and stained or malodourous soils (where soils could be observed).

Photographs from the site walkover were included in the SAQP.

A commercial landscape business "Go Gro Organics" is situated on the northern boundary of the proposed site. This business summary described in the white pages is "landscape supplies, garden mix mulch, wood chips, manure pine saw dust & shading."

Adjacent to the south western corner of the site is the business Borg Civil Australia. This business provides earthmoving equipment for hire[1].

3.3. Environmental Site Setting

Table 2 presents a summary of the environmental setting of the site.

Table 2: Environmental site setting

Aspect	Description
Topography	A review of the topographic map of NSW indicates the site is situated at an elevation of approximately 72 to 74 m Australian Height Datum (AHD) (**Appendix 5**). The land slopes north towards Badgery's Creek which is located approximately 400 m north of the site.
Surface Water	A large dam is located on-site in about the centre of the site. Based on observations made during the site walkover, it appeared that the dam was not being used for active irrigation or supply of water to surrounding residential properties. Two dams are located off-site to the south and south-west and are positioned at a slightly higher elevations based on the NSW 2m elevation contour data. Several other dams are also located off-site further to the north, east and south. Refer to Figures 1 and 2 in Appendix 1. These offsite dams are assumed to support the various surrounding agricultural and commercial operations, and possibly potable water for residential dwellings in the surrounding area.
Geology	A review of the Penrith 1:100 000 scale geology map[2] indicates that the site is underlain by Bringelly Shale of the Wianamatta Group which was deposited in a deep marine environment of the Middle Triassic. The Bringelly shale is described as shale, carbonaceous claystone, laminite, lithic sandstone, with rare coal. A geotechnical cross-section of the site is included in **Appendix 1**. Based on previous investigations (refer to Section 5) the geology was expected to be comprise fill material (approx. 0.2 thick) and underlain by residual soils comprised of Silty Clay to Clayey Silt to approximately 3 m below ground surface (bgs) and underlain by the Bringelly Shale.
Hydrogeology	Groundwater at the site has been measured at approximately 67 to 69 m AHD (approximately 5 m bgs). Groundwater is expected to flow in a north-westerly direction towards Badgery's Creek (TTC, 2021)[3].

[1] https://www.borgcivilaust.com.au/ (accessed 31 March 2022)
[2] Geological Survey of Penrith 1991. Surface geology of New South Wales - 1:1 100 000 map. Geological Survey of New South Wales, NSW Department of Primary Industries, Maitland, Australia
[3] TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Hydrogeological Interpretative Report.*

Aspect	Description
Registered Groundwater Bores	The nearest registered groundwater bore (GW112649) is located approximately 1000 m north east of the site. This bore was installed as a monitoring well to 30 mbgs.
Salinity	A review of the map indicates that the site is mapped as having moderate salinity. An extract from the Land Salinity of Western Sydney map for the regional area is in **Appendix 5**.
Acid Sulfate Soils	The Atlas of Australian Acid Sulfate Soil (ASS) compiled by CSIRO[4] was reviewed to assess the probability of occurrence of ASS within the site. The ASS risk plan indicates that the site is located in an area with Extremely Low Probability of Occurrence of ASS.
List of Contaminated Sites Notified to the EPA	A search of the List of NSW Contaminated Sites Notified to NSW EPA[5] (as of 8 March 2022) was carried out on 23 March 2022. The site and surrounding properties are not recorded on the register.
NSW EPA Contaminated Land Public Record	A search of the NSW EPA Contaminated Land Public Record was carried out on 23 March 2022 for declaration notices, orders made by the EPA under the CLM Act 1997, voluntary management proposals approved under the CLM Act 1997, and site audit statements relating to significantly contaminated land. The search of the database revealed that the site, or properties within 250 m of the site, are not listed on the contaminated land public record.

3.4. Site History

The history of the site is described in *Sydney Metro - Western Sydney Airport Technical Paper 8 Contamination (*M2A, 2020) ("the EIS Technical Paper") which is a supporting document to the Sydney Metro – Western Sydney Airport Environmental Impact Statement (Sydney Metro, 2020). The EIS Technical Paper provides a Preliminary Site Investigation (PSI) of the Project footprint.

The following information summarises relevant historical information included in the EIS Technical Paper which was supplemented by a review of historical aerial imagery available through the NSW Government Historical Imagery portal[6] which is summarised in the SAQP.

Historical title information was not included in the EIS Technical Paper.

Historical aerial imagery shows the site was semi-cleared in 1955 for rural land uses. A house is shown on the property in 1984 and three sheds were added in the late 1980s. The site remained in this configuration (low density residential land use) to late 2021 / February 2022 when the house and sheds on the property were removed.

[4] http/www.asris.csiro.au/
[5] https://www.epa.nsw.gov.au/your-environment/contaminated-land/notification-policy/contaminated-sites-list
[6] Historical Imagery (nsw.gov.au)

4. Project Description

4.1. Construction

The proposed layout of the site during construction is provided in Drawing SMWSASBT-CPG-AEC-SF400-MB-DRG-051003 (Rev. 00; Version 1.1) provided in **Appendix 1**. Construction of the site for the SBT Works includes the following:

- Construction of a shaft which has a diameter of 27 m in the centre of the site. Construction of the shaft will require a top-down excavation to approximately 30 mbgs / approximately 42.5 m AHD and generate approximately 22,200 m^3 of spoil (as in-situ volume) which requires off-site disposal. The shaft is to be undrained (tanked) and constructed using secant piles and top-down excavation methods.
- Construction of temporary construction work facilities including:
  - Water treatment plant
  - Crane pad and associated hardstands around the shaft
  - Laydown areas
  - Workshop
  - Offices and car parks
  - Substation.
- Construction of the temporary works areas will require clearing and grubbing of vegetation and surface soils. Subject to the completion of the DSI, it is intended that soil materials stripped for the construction of the temporary works will be stockpiled in the northern portion of the site (and north of the existing dam) for subsequent reuse on-site post construction. Materials which cannot be reused on-site will be removed from site as waste, or beneficially reused as fill at the FS01 site (refer Section 4.3).
- During construction surface water from the construction area will drain to the existing surface water dam located west of the construction area.

4.2. Dewatering

Construction of the shaft will require temporary dewatering during construction.

An assessment of potential groundwater inflow during construction is reported in TTC (2022a) ("the HIR"). The following is a summary of the HIR:

'A pre-development groundwater level of 69 m AHD was adopted for assessment of drawdown impact and construction groundwater seepage inflow based on the records from monitoring location SMGW-BH-D303S.

A sustained construction groundwater seepage inflow of 0.3 L/s is assessed into the base of the excavation during construction with a drawdown response limited to 400 m laterally from the shaft. Drawdown greater than 1 m is assessed to occur within 250 m of the excavation.

Initial inflow would be greater in the short term but is expected to stabilise within the construction timeframe.'

4.3. Re use of Excavated Material within the larger Airport Site

A large part of the larger Western Sydney Airport site is proposed to be filled by up to 8 m (designated the 'FS01 site'). All excavated material from this site which is assessed as suitable is intended to be utilised as fill at the FS01 Site, as shown in Appendix 1. Following development, it is understood that the future use of the FS01 site is commercial / industrial as per the attached Western Sydney Airport Plan.

It should be noted that CPG will need to ensure relevant regulatory requirements (e.g., Protection of the Environment Operations (Waste) Regulation 2014 and Protection of the Environment Operations Act 1997) and / or the Federal Material Import and Reuse Procedures included in Appendix 3 are complied with.

Material which cannot be re-used will be disposed off-site as waste.

5. Summary of Previous Investigations / Plans

The site has been subject to previous preliminary intrusive investigations of soil and groundwater. Data from these investigations is presented within the following reports:

- Cardno (Nov, 2021); *Contamination Assessment Report – Phase D/E, Sydney Metro Western Sydney Airport* (Ref: 80021888; RevB, dated 22nd November 2021)
- Cardno (May, 2021); *Contamination Assessment Report, Sydney Metro Western Sydney Airport* (Ref: 80021888; dated 5th May 2021)
- Golder & Douglas Partners (Feb 2021); *Factual Contamination Report – Preliminary Site Investigation* (Ref: 19122621-003-R-Rev3; Rev3; dated 19th February 2021).

The following sections provide a summary of the previous investigations in regard to soil and groundwater.

5.1. Soil

Analytical data from previous investigations has been collated by TTC and is provided in **Appendix 2**.

The scope of these previous assessments has been summarised in Table **3** and the results summarised in following sub-sections for fill and natural materials. The investigation sampling locations are presented in **Figures 1 and 2**, **Appendix 1**.

Table 3: Summary of Previous Assessments

Report	Scope of Investigation Relevant to Site
Factual Contamination Report (Golder & Douglas Partners, Feb 2021)	• One borehole (SMGW-BH-D103) was drilled and sampled. BH-D103 was drilled within the alignment of the tunnel in the Derwent Road reserve and is located approximately 100 m from the shaft.
Contamination Assessment Report (Cardno, May 2021)	• Two boreholes (SMGW-BH-D303 and SMGW-BH-D303S) were drilled, and samples were collected from SMGW-BH-D303. BH-D303 and BH-D303S are located within the footprint of the shaft. BH-D303 was drilled to 48 m bgs and BH-D303s to 10 m bgs. Deep and shallow monitoring wells were installed in these boreholes (refer to Section 4.2) • One test pit (SMGW-TP-D302) was excavated and sampled. TP-D302 is located within the footprint of the shaft.
Contamination Assessment Report – Phase D/E (Cardno, Nov 2021)	• Three boreholes (SMGW-BH-D340, SMGW-BH-D340S and SMGW-BH-D341) were drilled and sampled. BH-D340 and BH-D340S are located within the tunnel alignment approximately 25 north west of the shaft. BH-D341 is located within the tunnel alignment approximately 60 m south east of the shaft.

Sampling was mainly limited to the collection of soil samples in fill materials, and natural from BH-D303 and BH-D340. Deeper soil and rock samples of natural materials were collected in BH-D303 to 26 m bgs and BH-D340 to 28 m bgs. The following sections provide a summary of the key findings from these investigations.

5.1.1. Fill Materials

Fill material was observed in all previous investigation intrusive locations over the site.

Review of soil descriptions provided in the logs from previous investigations indicates that the thickness of fill was 0.2 m bgs in the areas investigated.

Fill was largely described as a brown, low plasticity clayey silt with roots. Visual/olfactory signs of contamination such as soil staining and hydrocarbon odours were not reported in the logs from previous investigations. Asbestos was not reported in the previous investigations.

A summary of analytical results for fill materials screened against health-based guidelines is provided in Table 4.

Table 4: Fill Materials Analytical Results

Analyte (mg/kg unless shown)	No. Samples / No. Detects	Minimum Value	Maximum Value	Commercial/ Industrial Health Guidelines (Note 1)	No. of Samples Exceeding Commercial/ Industrial Health Guidelines
Arsenic	5 / 5	8	27	3000	Nil
Cadmium	5 / 0	<0.4	<0.4	900	Nil
Chromium (III+VI)	5 / 5	18	48	3600	Nil
Copper	5 / 5	13	25	240000	Nil
Lead	5 / 5	16	28	1500	Nil
Tetraethyl lead	2 / 0	<5	<5		-
Mercury	5 / 0	<0.1	<0.1	730	Nil
Nickel	5 / 5	5.9	12	6000	Nil
Zinc	5 / 5	47	160	400000	Nil
pH (aqueous extract)	1 / 1	6.9	6.9		-
TRH C6 - C10 Fraction F1	5 / 0	<20	<25	260	Nil
TRH C6 - C10 Fraction Less BTEX F1	4 / 0	<20	<20	260	Nil
TRH >C10 - C16 Fraction F2	5 / 0	<50	<50	20000	Nil
TRH >C10 - C16 Fraction Less Naphthalene (F2)	5 / 0	<50	<50	20000	Nil
TRH >C16 - C34 Fraction F3	5 / 1	<100	160	27000	Nil
TRH >C34 - C40 Fraction F4	5 / 0	<100	<100	38000	Nil
TRH C10 - C40 Fraction	5 / 1	<50	160		-
Benzene	5 / 0	<0.1	<0.2	3	Nil
Toluene	5 / 0	<0.1	<0.5	99000	Nil
Ethylbenzene	5 / 0	<0.1	<1	27000	Nil
Xylenes (m & p)	5 / 0	<0.2	<2		-
Xylene (o)	5 / 0	<0.1	<1		-
Xylenes (Total)	4 / 0	<0.3	<0.3	81000	Nil
Naphthalene	5 / 0	<0.1	<0.5	11000	Nil
PAHs (Sum of total)	4 / 0	<0.5	<0.5	4000	Nil
Perfluorooctanesulfonic acid (PFOS)	2 / 2	0.0002	0.0002		-
Perfluorohexanoic acid (PFHxA)	2 / 1	<0.0001	0.0001		-
Sum of PFHxS and PFOS (lab reported)	2 / 2	0.0002	0.0002	20	-
Sum of PFASs (n=28)	2 / 0	<0.0005	<0.0005		-

Note: Commercial/industrial guidelines include the NEPM HIL-D and HSL, PFAS NEMP 2.0, and the CRC Care (2011) petroleum hydrocarbon HSLs for direct contact for commercial industrial workers

In summary the fill material reported analytes (potential contaminants) with low concentrations which were below the adopted commercial industrial health guidelines. Trace concentrations of perfluoroalkyl and polyfluoroalkyl substances (PFAS) were reported in fill materials over the site.

Asbestos was not reported in samples of fill materials from previous investigations. The potential ACM may have been derived from the demolition and removal of the houses and sheds formerly located on the site.

5.1.2. Natural Materials

A summary of analytical results of the natural material is provided in **Table 5**.

Table 5: Natural Materials Analytical Results

Analyte (mg/kg unless shown)	No. Samples / No. Detects	Minimum Value	Maximum Value	Commercial/ Industrial Health Guidelines (Note 1)	No. of Samples Exceeding Commercial/ Industrial Health Guidelines
Arsenic	19 / 17	<2	13	3000	Nil
Cadmium	19 / 0	<0.4	<1	900	Nil
Chromium (III+VI)	19 / 18	<5	19	3600	Nil
Copper	19 / 19	12	75	240000	Nil
Lead	19 / 19	6.1	34	1500	Nil
Mercury	19 / 0	<0.1	<0.1	730	Nil
Nickel	19 / 19	5	36	6000	Nil
Zinc	19 / 19	27	160	400000	Nil
pH (aqueous extract)	17 / 17	5.2	10		-
TRH C6 - C10 Fraction F1	17 / 0	<10	<20	260	Nil
TRH C6 - C10 Fraction Less BTEX F1	17 / 0	<10	<20	260	Nil
TRH >C10 - C16 Fraction F2	17 / 0	<50	<50	20000	Nil
TRH >C10 - C16 Fraction Less Naphthalene (F2)	17 / 0	<50	<100	20000	Nil
TRH >C16 - C34 Fraction F3	17 / 1	<100	120	27000	Nil
TRH >C34 - C40 Fraction F4	17 / 0	<100	<100	38000	Nil
TRH C10 - C40 Fraction	17 / 1	<50	120		-
Benzene	17 / 0	<0.1	<0.2	3	Nil
Toluene	17 / 1	<0.1	1.5	99000	Nil
Ethylbenzene	17 / 1	<0.1	0.2	27000	Nil
Xylenes (m & p)	17 / 2	<0.2	1.6		-
Xylene (o)	17 / 2	<0.1	0.4		-
Xylenes (Total)	17 / 2	<0.3	2	81000	Nil
Naphthalene	17 / 2	<0.1	0.7	11000	Nil
PAHs (Sum of total)	16 / 2	<0.5	0.7	4000	Nil
Total Halogenated Phenol*	8 / 0	<1	<1		-
Total Non-Halogenated Phenol*	8 / 0	<20	<20		-
Perfluorooctanesulfonic acid (PFOS)	14 / 0	<0.0001	<0.0001		-
Perfluorooctanoate (PFOA)	14 / 0	<0.0001	<0.0001		-
Sum of PFHxS and PFOS (lab reported)	14 / 0	<0.0001	<0.0001	20	-
Sum of PFASs (n=28)	14 / 0	<0.0005	<0.0005		-

Note: Commercial/industrial guidelines include the NEPM HIL-D and HSL, PFAS NEMP 2.0, and the CRC Care (2011) petroleum hydrocarbon HSLs for direct contact for commercial industrial workers

5.2. Groundwater

Four monitoring wells have been installed at the Site and the location of these are shown in **Figures 1 and 2**, **Appendix 1**. Well construction information for these wells is summarised in Table 6.

Table 6: Groundwater Monitoring Wells

Monitoring Well	Well Screen (m bgs)	Well Screen (m AHD)	Lithology	Typical Groundwater Level (m AHD)
SMGW-BH-D303	13 to 22	51 to 60	Weathered Sandstone / Siltstone	68.6 (Note 1)
SMGW-BH-D303S	3.1 to 9.1	63.9 to 69.9	Siltstone with a band of interbedded and laminated sandstone and siltstone	67.5 (Note 1)
SMGW-BH-D340	6 to 12	59 to 65	Sandstone / Siltstone	67.0 (Note 2)
SMGW-BH-D340S	1.5 to 4.5	66.5 to 69.5	Residual silty clay	67.2 (Note 2)
SMGW-BH-D103-1	-	VWP 64.7	Interbedded Siltstone and Sandstone	68.8 (Note 1)
SMGW-BH-D103-2	-	VWP 49.7	Siltstone	67.5 (Note 1)
SMGW-BH-D103-2	-	VWP 34.7	Siltstone	67.0 (Note 1)

Notes:

1. TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Hydrogeological Interpretative Report*

2. Cardno (2021) *Geotechnical data Report for Additional Phases 4D & 4E, 19 November 2021*

Groundwater elevation at the site has been recorded at approximately 67 m to 69 m AHD and is expected to flow in a northwest direction towards Badgery's Creek, with the flow within the area temporarily affected by drawdown during construction expected to be toward the excavation.

Analytical data from previous investigations has been collated and is provided in **Appendix 2**. For preliminary screening purposes the analytical data was compared to Toxicant default guideline values (DGVs) present in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). Freshwater guidelines with 95% species protection were selected based on Badgerys Creek being located in a modified ecosystem. A summary of the laboratory analytical data is provided in Table 7.

Table 7: Groundwater Summary Table

Analyte	Units	No. Samples / No. Detects	Minimum Value	Maximum Value	ANZG (2018) Freshwater 95% toxicant DGVs	No. of Samples Exceeding ANZG (2018) Freshwater 95% toxicant DGVs
Aluminium (Filtered)	mg/L	8 / 0	<0.01	<0.05	0.055	Nil
Arsenic (Filtered)	mg/L	8 / 4	<0.001	0.003		-
Beryllium	mg/L	8 / 0	<0.0005	<0.001		-
Beryllium (Filtered)	mg/L	8 / 0	<0.0005	<0.001		-
Boron (Filtered)	mg/L	7 / 5	<0.08	0.09	0.37	Nil
Cadmium (Filtered)	mg/L	8 / 0	<0.0001	<0.0002	0.0002	Nil
Chromium (III+VI) (Filtered)	mg/L	8 / 0	<0.001	<0.001		-
Cobalt (Filtered)	mg/L	8 / 7	<0.001	0.005		-
Copper (Filtered)	mg/L	5 / 2	<0.001	0.004	0.0014	1
Iron (Filtered)	mg/L	8 / 4	<0.01	0.68		-
Lead (Filtered)	mg/L	8 / 0	<0.001	<0.001	0.0034	Nil

Analyte	Units	No. Samples / No. Detects	Minimum Value	Maximum Value	ANZG (2018) Freshwater 95% toxicant DGVs	No. of Samples Exceeding ANZG (2018) Freshwater 95% toxicant DGVs
Manganese (Filtered)	mg/L	7 / 7	0.19	1.6	1.9	Nil
Mercury (Filtered)	mg/L	8 / 0	<0.00005	<0.0001	0.0006	Nil
Molybdenum (Filtered)	mg/L	8 / 1	<0.001	0.001		-
Nickel (Filtered)	mg/L	7 / 7	0.006	0.095	0.011	1
Selenium (Filtered)	mg/L	8 / 2	<0.001	0.002	0.011	Nil
Strontium (Filtered)	mg/L	8 / 8	14	27		-
Tin (Filtered)	mg/L	1 / 0	<0.005	<0.005		-
Vanadium (Filtered)	mg/L	8 / 0	<0.001	<0.005		-
Zinc (Filtered)	mg/L	4 / 4	0.003	0.04	0.008	3
Electrical Conductivity @ 25C (lab)	µS/cm	8 / 8	21000	32000		-
Total Dissolved Solids (TDS)	mg/L	2 / 2	14000	17000		-
pH (lab)	pH_unit	8 / 8	7	7.8		-
Alkalinity (total as CaCO3)	mg/L	7 / 7	760	1200		-
Bicarbonate Alkalinity as CaCO3	mg/L	2 / 2	760	920		-
Carbonate Alkalinity as CaCO3	mg/L	8 / 0	<5	<10		-
Hardness as CaCO3	mg/L	4 / 4	4300	9100		-
Ammonia as N	mg/L	8 / 8	0.07	4.4	0.9	3
Nitrite + Nitrate as N	mg/L	4 / 0	<0.05	<0.05		-
Nitrate (as NO3-N)	mg/L	8 / 0	<0.005	<0.02		-
Nitrite (as NO2-N)	mg/L	8 / 0	<0.005	<0.02		-
Nitrogen (Total)	mg/L	2 / 2	2.9	3.4		-
Perfluorooctanesulfonic acid (PFOS)	µg/L	2 / 0	<0.0001	<0.0001		-
Sum of PFASs (n=28)	µg/L	2 / 0	<0.005	<0.005		-
Benzene	µg/L	2 / 0	<1	<1	950	Nil
Toluene	µg/L	2 / 0	<1	<1		-
Ethylbenzene	µg/L	2 / 0	<1	<1		-
Xylene (o)	µg/L	2 / 0	<1	<1	350	Nil
Xylene (m & p)	µg/L	2 / 0	<2	<2		-
Xylene Total	µg/L	2 / 0	<3	<3		-
F1 (C6 - C10)	µg/L	2 / 0	<20	<20		-
F1 (C6 - C10) less BTEX	µg/L	2 / 0	<20	<20		-
F2 (C10 - C16)	µg/L	2 / 0	<50	<50		-
F2 C10 - C16 (minus Naphthalene)	µg/L	2 / 0	<50	<50		-
F3 (C16 - C34)	µg/L	2 / 0	<100	<100		-
F4 (C34 - C40)	µg/L	2 / 0	<100	<100		-
C10 - C40 (Sum of total)	µg/L	2 / 0	<100	<100		-
PAHs (Sum of total)	µg/L	4 / 0	<0.01	<1		-
Methane	µg/L	2 / 0	<0.05	<0.05		-

The COPC in groundwater identified in the area include Ammonia and metals (Copper, Nickel and Zinc), which may derive from diffuse sources associated with the former agricultural use of land and uncontrolled filling of land.

Within the site, data is available from two co-located groundwater monitoring wells installed in the facility construction area; namely, SMGW-BH-D303 (to 22 m bgs) and SMGW-BH-D303S (to 9.1 m bgs) respectively.

Although there is no indication of significant groundwater contamination based on the nested wells within the excavation area, no groundwater data is available from elsewhere within the excavation or predicted groundwater drawdown area, including to the north where work sheds are present and commercial soil supply/stockpiling appears to be occurring. It is therefore not known whether higher

COPC concentrations are present within the drawdown area which may be mobilised during construction. In addition, no groundwater samples have been analysed for herbicides or pesticides, which are COPCs in this area.

PFAS was not detected in the groundwater samples analysed from the site. However positive detection of trace PFAS (PFOS 0.0002 µg/L) was reported in SMGW-BH-D305 which is located approximately 600 m south east of the site.

6. Preliminary Conceptual Site Model and Data Gaps

6.1. Preliminary Conceptual Site Model

Based on the findings of previous investigations completed, the following Preliminary Conceptual Site Model (CSM) was developed for the Site.

Table 8 presents the CSM.

Potential **primary sources** of contamination:

- Uncontrolled fill material;
- Previous agricultural land uses;
- Demolition materials from previous buildings and structures; and
- Commercial landscaping business located on an adjacent property north of the site.

Potential **secondary sources** of contamination include:

- Contamination present in soil, surface water and groundwater as a result of exposure to the above primary sources of contamination.

Once in soil, contamination has the potential to be distributed through **transportation pathways** such as erosion and deposition (wind and water) and the leaching / migration of contaminants in groundwater and surface water, and construction activities which involve the movement of soil materials during the construction of the project.

Transportation pathways can also be considered as secondary sources of contamination (e.g., contamination in groundwater). During construction of the proposed shaft, contamination in groundwater has the potential to be drawn into the shaft which requires management during construction. However, the shaft is proposed to be undrained (tanked) which will mitigate groundwater ingress during operation.

Receptors could potentially be exposed to contaminants derived from the disturbance of contaminants present in within soil and groundwater.

Potential receptors considered applicable during construction works at the site include:

- Workers involved with the site construction work;
- General public and neighbouring landowners including persons who could be subject to contaminated media generated during redevelopment (e.g., dust, runoff);
- Ecological receptors including native and domestic terrestrial flora and fauna; and
- Groundwater and surface water receptors (existing dam on-site and several off-site).

Post-development, the site will be used for the maintenance of the rail infrastructure and will not be accessible to the general public. Potential receptors which may be exposed to contaminants post-development include:

- Persons involved with maintenance of the rail infrastructure;
- Persons who could be subject to contaminated media generated from the site (e.g., dust);
- Ecological receptors including terrestrial and aquatic flora and fauna (including native and domestic terrestrial fauna); and
- Groundwater and surface water receptors.

Table 8: Preliminary Conceptual Site Model

Potential Contamination Source	Contaminants of Potential Concern and Affected Media	Plausible Exposure Pathways & Transport Mechanisms	Receptors
Uncontrolled Fill Material	TRH, BTEX, heavy metals, PAH, pesticides (OCP/OPP), PCB and asbestos	Inhalation of soil and fibres Ingestion of soil Dermal contact Plant Uptake Infiltration Lateral Groundwater Migration Surface Water Flow	Workers involved with the site construction work; General public including persons who could be subject to contaminated media generated during redevelopment Ecological receptors including native and domestic terrestrial flora and fauna Groundwater and surface water receptors (existing on-site dam and several off-site dams). Future persons involved with maintenance of the rail infrastructure
Previous Agriculture Land Use	OPP/OCP Nutrients (Ammonia, nitrates)	Inhalation of soil Ingestion of soil Dermal contact Plant Uptake Infiltration Lateral Groundwater Migration Surface Water Flow	
Demolition materials form Previous Buildings and Structures	Asbestos and lead (lead-based paint)	Inhalation of soil and fibres Ingestion of soil Plant uptake (lead only)	
Commercial landscaping business located on an adjacent property north of the site	TRH, BTEX, heavy metals, PAH, pesticides (OCP/OPP), PCB and asbestos	Inhalation of soil and fibres Ingestion of soil Dermal contact Plant Uptake Infiltration Lateral Groundwater Migration Surface Water Flow	

Notes:

CoPC: Contaminants of Potential Concern

OCP: organochlorine pesticides

OPP: organophosphate pesticides

Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

TRH: Total Recoverable Hydrocarbons.

BTEX: Benzene, Toluene, Ethylbenzene, Xylene.

PAH: Polycyclic Aromatic Hydrocarbons.

PCB: Polychlorinated Biphenyls.

6.2. Data Gaps Identified

Based on the review of available information and observations made during a site walkover, the data gaps and uncertainties are considered to comprise:

- Previous investigations have collected soil samples from four locations and sample locations largely targeted the shaft and the northern boundary of the site along the tunnel alignment, however no samples have been collected from the remainder of the site. Further investigation was required to investigate areas of the site which were not previously investigated and are to be disturbed during construction in both fill and natural materials. This available data from previous investigations is insufficient to inform appropriate management requirements during construction and determine whether the excavated material can potentially be re-used on-site or off-site, and the waste classification of surplus material requiring off-site disposal to landfill.
- Potential exists for ACM to be present on the site in association with the demolition of historical structures. Further investigation is required to assess the presence and potential risk of ACM at the site.
- Fill material has been observed on the site and potential exists for uncontrolled fill materials to have been historically used at the site. Fill material requires further investigation to establish whether contamination in soil is present.
- There is currently limited groundwater data for the site. Further investigation was required to investigate groundwater quality north of the site where commercial soil supply / stockpiling appears to be occurring. Groundwater from this area has the potential to be drawn into the construction area. Additional groundwater sampling should be collected from monitoring wells installed on the site. Initially, it was also proposed to complete groundwater sampling atSMGW-BH-D305 located approximately 600m south-east of the site where positive detection of PFAS was previously reported, however, this was not completed. Positive detection of PFAS has been reported in the monitoring wells at the site (refer to Section 9.3.3) and therefore the requirement for sampling from SMGW-BH-D305 was not considered necessary for this DSI.

7. Adopted Assessment Criteria

7.1. General

To assess the significance of contaminant concentrations in soil, reference was primarily made to NEPM 2013, specifically ‘Schedule B1 Guideline on Investigation Levels for Soil and Groundwater’ (Schedule B1) for assessment criteria, where available. Schedule B1 provides a framework for the use of investigation and screening levels based on human health and ecological risks. In the absence of relative criteria in NEPM 2013, reference was made to other appropriate state, national or international guideline.

Schedule B1 states that ‘*the selection and use of investigation levels should be considered in the context of the iterative development of a Conceptual Site Model*’. Based on the information and drawings provided, and preliminary CSM presented in Section 6, TTMP has considered that the development of the site will include a number of different receptor groups, including:

- Construction workers during site development;
- Future site workers / maintenance workers;
- Site users;
- Neighbouring land users; and
- Ecological receptors.

Given the proposed use of the site, commercial / Industrial land use criteria and intrusive maintenance workers was adopted.

7.2. Soil

7.2.1. Health Based Criteria

Soil health investigation levels (HILs) and soil health screening levels (HSLs) for vapour intrusion (where applicable) were adopted from Schedule B1 of NEPM 2013 while Direct Contact criteria for petroleum hydrocarbons was adopted from CRC CARE 2011.

Human health-based guidance values for direct contact were adopted from PFAS NEMP (HEPA, 2020).

7.2.2. Asbestos

For asbestos in soil, a screening level of 0.1g/kg (0.01 % w/w equivalent) was adopted based on the laboratory detection limit for analysis of asbestos in non-homogenous samples using the methodology outlined in Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples (AS4964-2004). Furthermore, where trace analysis was carried out during analysis, an assessment criterion of ‘no respirable fibres’ was adopted; a detection of respirable fibres would indicate an exceedance of the assessment criteria.

7.2.3. Management Limits

In accordance with Section 2.9 of Schedule B1 of the ASC NEPM, consideration of Management Limits for petroleum hydrocarbons was also considered where appropriate. The Management Limits consider the potential for accumulation of explosive vapours, the potential risk to buried infrastructure, or the formation of phase separated hydrocarbons (PSH).

7.2.4. Ecological Criteria

To assess the impact on site vegetation and animals from contamination within the upper 2 m of the subsurface, ASC NEPM Schedule B1 presents ecological investigation levels (EILs) and ecological screening levels (ESLs) for different settings (e.g., areas of ecological significance, urban residential / public open space and commercial).

Section 3.5.1 of Schedule 5a of NEPM states that the aim of the EILs is that varying levels of protection will be provided to the following ecological receptors at all sites:

- ‘Biota supporting ecological processed including microorganisms and soil invertebrates
- Native flora and fauna

- Introduced flora and fauna
- Transitory or permanent wildlife.

Consideration was given to the commercial / industrial ecological investigation levels (EIL) and Ecological Screening Levels (ESL) where appropriate.

Generic EILs were adopted for lead, arsenic, DDT and naphthalene while site specific EILs for copper, chromium, nickel and zinc were calculated using an average of relevant soil parameters. The derivation of the specific EIL is resented in Appendix 7.

TTMP conducted a review of the background documents used to derive the ecological screening levels (ESLs) for benzo(a)pyrene as prescribed in Schedule B1 of the ASC NEPM 2013. The review identified that the ESLs were heavily based on the 1999 Canadian Soil Quality Guideline (SQG) values (Warne, 2010). Due to the availability of a significant amount of new toxicity data, the Canadian values were revised in 2010 (CCME, 2010), however these revisions were not considered in the ASC NEPM 2013.

As such, TTMP considers that the low reliability ESLs prescribed in Schedule B1 of the ASC NEPM 2013 are now outdated and as such the Canadian Soil Quality Guidelines for Environmental Health (SQGE) have been adopted (CCME, 2010) for this assessment. The Canadian SQGEs for B(a)P (72 mg/kg) for commercial / industrial land use) has been derived based on a similar methodology to that prescribed in Schedule B5b of the ASC NEPM 2013 (i.e., based on the species sensitivity distribution approach).

7.2.5. Aesthetic Considerations

The following characteristics are considered indicative of soil materials that would have the potential to present unacceptable aesthetic impacts:

- Surface soil materials that exhibit heavy staining or emit hydrocarbon odours that are perceptible within 2 m of the soil investigation area;
- Anthropogenic wastes in near-surface soil material onsite; and
- Visible hydrocarbon sheens on groundwater.

7.2.6. Waste Classification

7.2.6.1. NSW EPA Waste Classification Criteria

Concentrations of chemical analytes tested were compared against contaminant threshold (CT) values, specific contaminant concentration (SCC) values and TCLP test values presented in *Waste Classification Guidelines Part 1: Classifying Waste* (NSW EPA, 2014) and *Addendum to the Waste Classification Guidelines (2014) – Part 1: Classifying Waste* (NSW EPA, 2016).

These criteria are considered relevant for waste spoil which is disposed of at landfill in NSW.

Asbestos is pre-classified as Special (Asbestos) Waste under the NSW EPA Waste Classification Guidelines.

7.2.6.2. Virgin Excavated Natural Material (VENM)

The Protection of the Environment Operations Act 1997 defines VENM as:

'natural material (such as clay, gravel, sand, soil or rock fines):

(a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and

(b) that does not contain any sulfidic ores or soils or any other waste.

and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.'

To facilitate assessment of natural soil as VENM, concentrations of metals for natural soil samples were compared with the following ambient background concentrations (ABC), adopted from Schedule B5b of the amended ASC NEPM 2013[7]:

- Zinc: 60 mg/kg
- Arsenic: 18 mg/kg
- Copper: 40 mg/kg
- Lead: 30 mg/kg
- Nickel: 55 mg/kg
- Chromium: 160 mg/kg.

Concentrations of organic compounds and asbestos should be less than the standard limit of reporting (LOR) for natural spoil to be considered VENM.

7.3. Re-Use within Larger Airport Site and Import Material

Material for potential re-use within the larger Western Sydney Airport Site (FS01) and import material were assessed against the criteria specified in AEPR and those for a future commercial / industrial land use, as shown in the result table in Appendix 5

7.4. Groundwater

The groundwater data is likely to be compared to appropriate guidelines including, not limited to:

- ANZG (2018) Freshwater Ecosystems guideline for 95% species protection level default guidelines values;
- ANZECC/ ARMCANZ (2000) guideline values for for 95% species protection level default guidelines values;

[7] National Environment Protection Council (2013); *National Environment Protection (Assessment of Site Contamination) Measure, 1999* (the 'ASC NEPM').

- HEPA (2020) PFAS National Environmental Management Plan, Version 2.0; and
- NHMRC (2022) Australian Drinking Water Guidelines 6 2011, Version 3.7.

In addition, the client indicated that Planning Condition E129 also applies as below:

E129: Unless an EPL (Environmental Protection License) *is in force in respect to the critical state significant infrastructure (CSSI) and that licence specifies alternative criteria, discharges from construction wastewater treatment plants to surface waters must not exceed:*

(a) The Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG 2018) default values for toxicants at 95 per cent species protection level;
(b) For physical and chemical stressors, the guideline values set out in Tables 3.3.2 and 3.3.3 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC/ARMANZ); and
(c) For bio accumulative and persistent toxicants, the ANZG (2018) guideline values at a minimum of 99 per cent species protection level.

Overall, this confirms that the 99% protection level would apply for all bio accumulative compounds (including PFAS compounds), as would the guidelines detailed above.

8. Sampling Methodology

8.1. Overview

The sampling locations (i.e., test pits, boreholes and groundwater monitoring wells) at the site are shown in **Figures 1 and 2**, **Appendix 1**.

The sampling strategy for the site was established with consideration of the guidance provided in the ASC NEPM (NEPC, 2013) and the NSW *Contaminated Sites: Sampling Design Guidelines* (NSW EPA, 1995) (NSW Sampling Guidelines) and in consideration of existing information (Section 5) and data gaps / uncertainties identified (Section 6).

This DSI was undertaken with input from three main work packages which included:

- Geotechnical/Hydrogeological intrusive investigation locations being undertaken by TTC for CPG (Geotechnical Program); and
- Contaminated land intrusive locations being undertaken by TTMP for CPG (Contaminated Land Program).

This section summarises the sampling undertaken by TTMP to support the preparation of this DSI. Further detail is presented within the SAQP (TTC, 2022b)

8.2. Soil

The site construction footprint (not including potential temporary stockpile areas) is shown in **Figures 1 and 2**, **Appendix 1** and has an area of approximately 2 hectares. For a 2 hectare site the NSW Sampling Guidelines recommend 30 sampling points for the detection of circular hotspot of 30.5 m with 95% confidence based on adopting a systematic sampling grid.

The soil sampling locations are shown in **Figures 1 and 2**, **Appendix 1** and are summarised Table 10.

It should be noted that all test locations are labelled SBT-BH-xx, however, most were test pits rather than boreholes, as outlined within Table 9.

The logs presented in Appendix 4 are currently in draft format and subject to change.

Table 9: Test Locations

Test Pit / Borehole	ID	Depth (m bgs)	Surface Level Elevation (mAHD)
Test Pit	SBT-BH-4200	2.0	72.819
Test Pit	SBT-BH-4201	2.0	73.588
Test Pit	SBT-BH-4202	2.0	73.850
Test Pit	SBT-BH-4203	2.0	73.246
Test Pit	SBT-BH-4204	2.0	70.824
Test Pit	SBT-BH-4205	1.8	71.296
Test Pit	SBT-BH-4208	1.0	73.775
Test Pit	SBT-BH-4209	1.0	72.133
Test Pit	SBT-BH-4210	1.0	72.645
Test Pit	SBT-BH-4211	1.0	73.617
Test Pit	SBT-BH4212	1.0	74.317
Test Pit	SBT-BH-4213	1.0	74.318
Test Pit	SBT-BH-4214	1.0	73.993
Test Pit	SBT-BH-4215	1.0	73.641
Test Pit	SBT-BH-4216	1.0	72.534
Test Pit	SBT-BH-4217	1.0	72.539
Test Pit	SBT-BH-4218	1.0	72.179
Test Pit	SBT-BH-4219	1.0	71.175
Test Pit	SBT-BH-4220	1.0	71.710
Test Pit	SBT-BH-4221	1.0	70.662
Test Pit	SBT-BH-4222	1.0	70.539
Test Pit	SBT-BH-4223	1.0	71.133
Test Pit	SBT-BH-4224	1.0	72.067
Test Pit	SBT-BH-4225	1.0	71.772

Test Pit / Borehole	ID	Depth (m bgs)	Surface Level Elevation (mAHD)
Test Pit	SBT-BH-4226	1.0	73.851
Test Pit	SBT-BH-4227	1.0	72.997
Test Pit	SBT-BH-4228	1.0	74.503
Test Pit	SBT-BH-4229	1.0	70.389
Test Pit	SBT-BH-4230	1.0	71.311
Test Pit	SBT-BH-4231	1.0	70.154
Test Pit	SBT-BH-4232	1.0	70.015
Test Pit	SBT-BH-4233	1.0	71.782
Test Pit	SBT-BH-4234	1.0	71.868
Total Test Pits	**33**		
Borehole & Well	SBT-GW-4002	14.07	*To be confirmed* (+1.14 m stick up)
Borehole & Well	SBT-GW-4003	17.29	70.969 (+ 1.11 m stick up)
Borehole	SBT-BH-4004	50.24	72.747
Borehole & Well	SBT-BH-4005	21.00	73.768
Borehole	SBT-BH-4206	25.17	*To be confirmed*
Borehole	SBT-BH-4207	25.00	*To be confirmed*
Borehole & Well	SBT-GW-4020	17.24	71.198
Borehole & Well	SBT-GW-4022	17.90	74.437
Total Boreholes	**8**		
Total Test Locations (Test Pits and Boreholes)	**41**		

Overall, 41 test locations were completed over the site (property boundary) including 36 within the construction footprint (2 ha) and five outside of the construction footprint. All were positioned on a grid basis. The sampling density within the construction footprint consistent with that proposed in the SAQP (TTC, 2022b) and as recommended in the NSW Sampling Design Guidelines (NSW EPA, 1995).

8.3. Sampling Methodology

8.3.1. Soil

The sampling methodology undertaken is presented in Table 10

Table 10: Sampling Methodology

Activity	Detail / Comments
Below Ground Service Clearance and ground penetrating radar (GPR)	Dial-Before-You-Dig (DBYD) service plans and information provided by CPG for the site and surrounding area was reviewed prior to commencement of intrusive investigation works. Investigation locations were scanned by a suitably qualified and experienced underground services clearance sub-contractor using an electromagnetic detector and ground penetrating radar to check for buried services.
Excavation / Drilling method	**Intrusive Locations to Target Depth of 1 m and 2 m bgs** Intrusive locations to a target depth of 1 or 2 m bgs were carried out using an excavator. **Intrusive Locations Completed in Geotechnical Works Program** The boreholes completed as part of the Geotechnical Work Program were drilled using geotechnical drill rig and soil samples were collected either from the solid flight auger.
Sampling Frequency	Soil samples were collected directly collected from the auger. Samples were collected from near surface 0-0.2m bgs, and then 0.5 m intervals in fill material, and natural materials at the natural material interface directly underlying fill materials, and then 1 m intervals in natural to the target depth in the Contaminated Land Works program. Soil samples were collected at approximately 1 m intervals in the Geotechnical Works Program unless there was a requirement for geotechnical testing. Discrete soil samples were also collected where there were visual or olfactory signs of potential contamination.
Soil Sampling Containers	Soil samples were placed in clean acid washed glass jars supplied by the laboratory and sealed with a Teflon-lined lid. The laboratory provided 500 ml sample bags for soil samples for asbestos analysis in fill materials. Soil samples for PFAS analysis were placed in PFAS specific sample containers provided by the laboratory.
Sample collection	Each soil sample was collected with new nitrile gloves to reduce the potential for cross contamination.
Soil Logging	Soil samples were logged by a suitably qualified and experienced TTC scientist in accordance with TTC's relevant Standard Operating Practice (SOP), Field Description of Soils, in Schedule B2 of the ASC NEPM 1999, 20130. Where applicable, signs of potential contamination or anthropogenic material recorded on the soil logs.
Soil Screening	Soil samples were screened in the field for the presence of ionisable volatile organic compounds (VOCs) using a Photoionization Detector (PID) fitted with a 10.6eV lamp. The PID underwent a fresh air calibration at the beginning of each day of sampling. . Calibration certificates provided by the equipment supplier are provided in Appendix 6 . Headspace screening results were recorded on the logs. *It is noted that the draft logs provided in Appendix 4 are missing some of the PID data. These results will be included in the final logs.*

Activity	Detail / Comments
Sample Handling and Transportation	Sample collection, storage and transport was conducted in general accordance with TTC's SOP. Soil samples were placed into laboratory prepared and supplied glass jars, fitted with Teflon lined seals to limit possible volatile loss. Sample jars were filled to minimise headspace. Separate samples for asbestos analysis were collected and placed in double zip lock bags. The samples were placed into ice chilled coolers and dispatched to NATA accredited laboratories for analysis under chain of custody (COC) control. PFAS sample jars were stored in a separate esky from the glass jars and ziplock bags. Furthermore, the PFAS sample jars and bottles (for rinsate blanks) were separated from ice bricks in the esky with a sampling bag to minimise the risk of teflon contamination for PFAS.
QA/QC Samples	To measure the accuracy and precision of the data generated by the field and laboratory procedures for this assessment, TTC collected and analysed quality assurance / quality control (QA/QC) samples in accordance with the DQI's set forth in Appendix 7.

Samples were analysed by laboratories holding accreditation to ISO 17025 General requirements for the competence of testing and calibration laboratories and using National Association of Testing Authorities (NATA) accredited methods (Eurofins and Australian Laboratory Services).

Soil samples were analysed for a range of potential COPC as summarised in the Table 11 and at the rates presented in the following section.

Table 11: Soil Laboratory Analysis

Analyte	Fill	Natural
Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)	Representative samples	Representative samples
Total Recoverable Hydrocarbons (TRH), and benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN)	Representative samples or where visual/olfactory signs of hydrocarbon are present	Representative samples or where visual/olfactory signs of hydrocarbon are present
Polycyclic Aromatic Hydrocarbons (PAH)	Representative samples or where visual/olfactory signs of hydrocarbon are present, or materials containing combustion by-products (e.g., ash, coke, slag) are observed	Where visual/olfactory signs of hydrocarbon are present
Phenolic Compounds	Representative samples or where visual/olfactory signs of hydrocarbon are present	Where visual/olfactory signs of hydrocarbon are present
Organochlorine Pesticides (OCPs) and Organophosphate Pesticides (OPPs)	Representative samples	Natural materials at interface of fill/natural materials
Volatile organic compounds (VOC) and Semi-Volatile Compounds (SVOC)	Where visual/olfactory signs of hydrocarbon are present	Where visual/olfactory signs of hydrocarbon are present
PFAS Extended Suite	Representative samples	Representative samples
Polychlorinated Byphenyls (PCBs)	Representative samples	Where visual/olfactory signs of hydrocarbon are present

Analyte	Fill	Natural
Asbestos	Representative samples or where ACM or demolition materials (e.g., building rubble) is observed	-
pH	-	Representative samples
Other	Other analyte as required based on site observations.	Other analyte as required based on site observations.

Representative soil samples were also analysed for particle size, pH, and cation exchange capacity (CEC) (mainly natural materials) to enable calculation of NEPM ecological investigation levels (EILs) for commercial / industrial land.

Toxicity Characteristic Leaching Procedure (TCLP) leachability tests were undertaken on selected soil samples for waste classification purposes.

Australian Standard Leaching Procedure (ASLP) tests with a pH neutral buffer were also undertaken on selected soil samples to consider the risk of potential contaminants leaching from rainwater, if retained on-site for reuse.

Selected samples were tested for TCLP or ASLP for PFAS and metals with the aim being to provide leachability data for representative samples.

Representative samples were also tested for Total Organic Carbon (TOC) to facilitate risk assessment.

The asbestos sampling outlined in the SAQP (2022b) was not completed. The SAQP stated that bulk 10 L samples would be collected for subsequent screening and analysis where visible ACM was observed. Samples were collected and analysed for asbestos identification instead. Bulk samples were not collected for the following reasons:

- The fragments of ACM which had previously been observed as a result of demolition activities had been removed, and the single fragment which was observed was large, angular, non-friable and considered low risk;
- Fill materials and fragments of ACM were not observed in the soil at the test locations; and
- The buildings present on the site had only been recently demolished.

8.3.2. Groundwater

Groundwater samples were collected from the five monitoring wells installed by TTMP during this investigation. Groundwater samples were not collected from the wells installed during previous investigations.

The SAQP (TTC, 2022b) included the installation of SBT-GW-4002 and SBT-GW-4003 in the commercial / industrial property located north of the site to assess groundwater quality at this property. Predicted construction related groundwater drawdown indicates that groundwater from the commercial / industrial property has the potential to be drawn into the site.

The owner of the commercial / industrial property did not permit the installation of groundwater monitoring wells on this property. As access was not available to assess current groundwater quality, SBT-GW-4002 and SBT-GW-4003 were instead installed along the northern boundary of the site with the commercial / industrial property. In combination with SBT-GW-4020, these monitoring wells will act as sentinel monitoring wells during construction to identify changes in groundwater quality which may require management during construction.

Post-construction, the tunnel and shaft at the site are to be un-drained (tanked) structures, and accordingly groundwater levels and flow direction are expected to return to pre-construction conditions. Risk from groundwater being drawn into the tunnel and shaft post-construction is therefore considered to be negligible as the structures will be undrained.

The groundwater sampling locations are shown in **Figures 1 and 2, Appendix 1** and are summarised in Table 12. The sampling methodology is summarised in Table 13, and laboratory analysis in Table 14.

Table 12: Groundwater Sampling Locations

Location ID	Rationale	Well Installation (screen interval)
SBT-GW-4005	New groundwater monitoring wells to provide baseline data for water quality likely to flow into the excavation.	10m to 20m
SBT-GW-4022		4m to 16m
SBT-GW-4002	New groundwater monitoring wells to act as sentinel monitoring wells during construction to identify changes in groundwater quality which may require management during construction.	4m to 13.07m
SBT-GW-4003		4.24m to 16.25m
SBT-GW-4020		4m to 16m

Table 13: Groundwater Installation and Sampling Procedure

Activity	Detail / Comments
Well Installation	The installation of the monitoring wells was completed in general accordance with Coffey's SOPs and with relevant parts of Section 8 and 9 of Schedule B2 in the ASC NEPM (2013). The wells were installed as follows: Established in a 125 mm diameter boring by a mechanical drill. • 50 mm diameter Class PN18 uPVC casing with a slotted screen interval upward from the base of the well. The depth and length of the screened interval was confirmed in the field based on ground conditions and water ingress observed. • 2 mm poorly-graded sand backfill around and 0.5 m above the screened interval. • 500 mm thick layer of hydrated bentonite above the top of the sand backfill / well screen. • Backfilled with bore cuttings or concrete from the top of the bentonite to finish flush with the ground surface. • A gripper / cap was installed on top of the well string to minimise the potential for infiltration of water and other foreign matter into the well. • The monitoring well was finished with a monument. • Wells were developed using a dedicated disposable bailer (or pump) to remove excess sediment introduced during drilling and improve connection with the surrounding water bearing zone. Well development ceased when water was visibly clear and/or physio-chemical parameters had stabilised. • The relative elevation of monitoring wells was recorded using a Real-time Kinetic GPS equipment with a vertical accuracy of +/-10 mm. • Representative samples of materials used in well construction (bentonite, sand, concrete) and uPVC casing (as a rinsate sample) were collected for laboratory analysis for the COPC. The results of this testing are currently being collated and reviewed and will be reported in a separate Technical Memorandum.

Activity	Detail / Comments
Sampling Methods	Where groundwater was present in the monitoring well, a groundwater sample was collected using a dedicated passive Hydrasleeve samplers made from HDPE which is suitable for collecting samples for PFAS analysis. At least one week following deployment, the hydrasleeve was retrieved for sampling. Field parameters (pH, electrical conductivity (EC), redox potential (Eh), dissolved oxygen (DO) and temperature) were recorded for each intake depth. Prior to retrieval of the hydrasleeve, the wells were also dipped with a dual-phase interface probe (IP) to assess the standing water level (SWL) and presence / absence of Non-aqueous phase liquids (NAPL). Groundwater samples collected also included QA/QC samples as detailed in Section 8.7 and Appendix 9. Sampling field records include the following: • Unique sample location identifier; • Weather conditions; • Water colour, turbidity, odour, present of surface layer; and • Other observations as considered relevant for the location. Field measurements included: • Time and date; • Gauged depth prior to sampling; • Water Quality parameters: pH, ORP, EC, DO and temperature; and • Depth of water sample. Samples were placed in laboratory supplied bottles containing appropriate preservatives and were filled to minimise headspace. Samples collected for heavy metals were filtered using disposable 0.45µm filter packs. Sample containers were immediately capped and placed into an insulated, ice chilled container. Samples collected for PFAS analysis were stored in separate containers to minimise the risk of cross contamination. The samples were dispatched to the nominated laboratory under chain of custody control.

Table 14: Groundwater Laboratory Analysis

Analyte	Groundwater Samples
Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)	All samples
Total Recoverable Hydrocarbons (TRH), and benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN)	All samples
Polycyclic Aromatic Hydrocarbons (PAH)	All samples
Phenolic Compounds	All samples
Organochlorine Pesticides (OCPs) and Organophosphate Pesticides (OPPs)	All samples
Volatile organic compounds (VOC) and Semi-Volatile Compounds (SVOC)	All samples

Analyte	Groundwater Samples
PFAS Extended Suite	All samples
Polychlorinated Byphenyls (PCBs)	All samples
Cation and anions	All samples
Nutrients	All samples

8.4. Decontamination procedures

The excavator and drill rigs were inspected to confirm that the equipment had been cleaned prior to the commencement of drilling. A rinsate sample was collected from the auger immediately prior to the commencement of drilling.

Where applicable, the following procedures were applied for the decontamination of sampling equipment.

- Re-useable equipment (e.g., auger) was decontaminated prior to the first use each day at each site, and between each sampling location or at an increased frequency to provide a satisfactory level of decontamination suitable to meet the project requirements/site conditions.
- Disposable (single use) equipment such as nitrile gloves were disposed of appropriately following each use. This equipment was not re-used and therefore did not require decontamination.
- Care was taken at all times to handle the cleaned equipment and samples only with clean disposable nitrile gloves. Equipment was stored after decontamination and prior to use, in clean polypropylene bags, to ensure the cleaned equipment did not come into contact with anything that may introduce contamination to the equipment.
- Care was taken to ensure that the decontamination process did not contribute to the spread of contamination of the site, stormwater or off site locations.

The procedure noted below was followed as a minimum when decontaminating reusable equipment used to sample soil/sediment at the site.

- For equipment used to sample solids, all adhered materials (such as soil, vegetation) were removed from the sampling equipment by gloved hand, paper towel or scrubbing brush.
- The equipment was washed in a bucket of potable water with Liquinox detergent.
- The equipment was rinsed thoroughly in a second bucket containing deionised water.
- The equipment was spray rinsed with potable water.
- The decontaminated equipment was dried with disposable paper towels or air dried on a surface that would not result in re-contamination of the equipment.
- Where equipment was being temporarily stored between sample locations (i.e., where another round of decontamination washing is not being undertaken) the equipment was stored in clean polypropylene bags, to prevent re-contamination prior to its next use.

8.5. Management of excavated materials

Excavated soil from boreholes less than 6 m and test pits were backfilled in order of excavation, where practicable. Excavated soil from boreholes greater than 6 m was retained on-site and drums for off-site disposal and/or on-site reuse pending the results from analytical testing.

Liquid materials captured during non-destructive drilling, drilling, and groundwater well development and sampling was retained on-site in bulk containers for off-site disposal and/or on-site reuse pending the results from analytical testing.

8.6. Drilling Additives

Drilling additives (e.g., muds and lubricants) proposed to be used by drillers were reviewed to confirm that the additives used were unlikely to result in false positives. Representative samples of drilling additives used was undertaken and analysed for the potential contaminants tested in this DSI. The results of this testing will be included in a separate QA/QC report to be prepared for the Project Site.

8.7. Data Quality Assessment

A standalone data quality assessment is presented in Appendix 7. This assessment concluded that the field and laboratory data collected from this investigation is of suitable quality to assess potential contamination risks from this site.

9. Investigation Results

9.1. Ground Conditions

The ground conditions encountered generally comprised between 0.1 m and 0.4 m of clay, gravelly clay and sandy clay topsoil / fill with roots then natural residual clay to depths of between 2.2 m and 3.8 m, overlying siltstone, sandstone, interlaminated siltstone and sandstone and Bringelly Shale.

Soil materials with visual / olfactory signs of suspected contamination and asbestos containing materials (ACM) were not observed in any of the test pits or boreholes, or site observations made during the intrusive investigation works.

Soil headspace readings were typically below 20 ppm which was considered indicative that there is a low likelihood that significant concentrations of volatile organic compounds were present in the soil.

Groundwater was not encountered in any of the test pits or boreholes during excavation / drilling.

The ACM observed on the surface during previous investigations (refer to Section 5) was not observed during the intrusive investigations and is understood to have been removed from the site during the demolition works.

One material fragment of potential ACM was collected at HA-01 which was observed following the completion of test pitting.

9.2. Groundwater

Groundwater sampling field sheets are presented in Appendix 4. Groundwater sampling was completed on 25 July 2022.

Groundwater levels ranged between 3.168 m below top of casing (mBTOC) at SBT-GW-4020 and 6.622 mBTOC at SBT-GW-4022.

Table 15 presents the groundwater level data measured during sampling.

Table 15: Groundwater Level Data

Well Location	Top of Well Casing Elevation (m AHD)	Standing Water Level (SWL) (mBTOC)	Corrected SWL (mAHD)
SBT-GW-4002	*To be confirmed*	4.737	*To be confirmed*
SBT-GW-4003	72.079	4.074	68.005
SBT-GW-4005	73.768	5.784	67.984
SBT-GW-4020	71.198	3.168	68.030
SBT-GW-4022	74.437	6.622	67.815

Based on available data, groundwater elevation across the site is relatively level with elevations recorded in monitoring wells along the northern boundary are approximately 200mm higher than elevations recorded in monitoring wells along the southern site boundary. Whilst this suggests a slight south-westerly groundwater trend, it is noted that the monitoring well installations are installed across different formations and at slightly different screen intervals. In addition, it is evident that field parameters recorded in SBT-GW-4005 were markedly different from those recorded in other wells. It is assessed that these factors may influence the groundwater flow direction across the site.

To supplement this assessment, TTMP drew upon the interpretation of groundwater elevations recorded in monitoring wells installed within and surrounding the site from the Hydrogeological Interpretative Report (TTMP, Aug 2022). The regional groundwater flow direction reported a north-northwesterly direction towards Badgery's Creek.

Groundwater field parameters were recorded as follows:

- Dissolved oxygen (DO) ranged between 1.38 mg/L and 4.57 mg/L, which is considered indicative of low to moderate levels of dissolved oxygen for the reported temperature range.
- Electrical conductivity ranged between 1,319 μS/cm (SBT-GW-4005) and 20,528 μS/cm (SBT-GW-4020) which is indicative of fresh to brackish conditions;
- pH generally ranged between 7.17 pH units and 7.35 pH units. Groundwater at SBT-GW-4005 was recorded at 11.67 pH units;
- Redox potential ranged between -86.3mV and 104.7mV (Ag/AgCL 3.5M) which equates to a redox potential range of 118.7mV to 309.1mV which is indicative of oxidising conditions; and
- Temperature ranged between 17.2°C and 18.1°C.

All samples were slightly cloudy and either pale brown or pale grey in colour. No odours were recorded. Other indications of potential contamination such as NAPL were not observed.

9.3. Discussion of Analytical Results

9.3.1. General

The following tables provided in Appendix 5 present a comparison of the analytical results and the adopted assessment criteria

- Soil:
  - Table 5.1 – Comparison against health investigation levels;
  - Table 5.2 – Comparison against Airport Regulations;
  - Table 5.3 – Comparison against ecological investigation and screening levels;
  - Table 5.4 – Comparison against waste classification criteria;
- Groundwater:
  - Table 5.5 – Groundwater Results

The laboratory analytical certificates and associated chain of custody records are presented in Appendix 8.

The following sections present a discussion of analytical results and their relevance to the investigation objectives.

9.3.2. Soil

9.3.2.1. Human Health

Analysis of soil samples collected from this investigation did not report concentrations of COPC above the adopted health assessment criteria.

The analysis of soil samples collected from this investigation did not identify asbestos. However, during the investigation, a single fragment of fibre cement sheeting was identified on the ground surface at HA-01. This fragment measured 110 mm x 40 mm x 5 mm(thick), was angular in shape, did not exhibit excessive signs of weathering and was of relatively high strength (i.e., did not readily crumble with moderate hand pressure). Analysis of this fragment confirmed the presence of asbestos.

This material was considered to be consistent with the definition of Bonded ACM. Given the location of this find the likely source of this fragment was the former residential dwelling on site. Its occurrence is consistent with observations made by TTMP during the initial walkover of the site and is considered an indicator that other undetected fragments of ACM existing in fill within the footprint of former structures on site.

9.3.2.2. Ecological Receptors

Analysis of soil samples collected from this investigation did not report concentrations of COPC above the adopted ecological assessment criteria.

9.3.2.3. Management Limits

Analysis of soil samples collected from this investigation did not report concentrations of TRH above the adopted Management Limits, ecological assessment criteria. As such, it is considered that TRH reported in soil presents a low risk to buried services and is highly unlikely to result in the formation of observable NAPL or pose fire/explosive hazards.

9.3.2.4. Aesthetic Issues

The investigation did not encounter soil conditions that are considered to pose aesthetic issues in the context of the proposed use of the site for commercial / industrial purposes.

9.3.2.5. Preliminary Waste Classification & Beneficial Reuse

Asbestos finds suggest fill excavated in the footprint of the former structures should be managed as Special Waste (Asbestos Waste).

The results suggest the fill soils would be preliminary classified as General Solid Waste (non-putrescible).

The investigation indicates that natural soil would provisionally classify as General Solid Waste (non-putrescible). It is noted that the investigation has identified trace concentrations of organic and metal COPC in samples of natural soils at varying depths which would preclude the classification of such materials as VENM.

The investigation results suggest the fill and natural soils sampled would be suitable for reuse at the FS01 site, although further, more detailed checks would need to be undertaken to confirm such material does not contain asbestos. All results were within the AEPR and those for a future commercial / industrial land use, as shown in Tables 5.1 and 5.2 in Appendix 5.

It is noted that the above comments are preliminary and require confirmation as detailed in Section 11.

9.3.3. Groundwater

The laboratory results indicate that the results were within the investigation levels (IL) with the exception of the following:

Minor metal exceedances:

- SBT-BH-4005: Copper concentration of 6 µg/L exceeded the ANZECC guideline level for 95% species protection of 1.4 µg/L;
- SBT-BH-4003:
    - Nickel concentration of 0.020 mg/L exceeded the ANZECC guideline level of 0.011 mg/L;
    - Zinc concentration of 13 µg/L exceeded the ANZECC guideline level of 8 µg/L
- SBT-BH-4020:
    - Nickel concentration of 0.018 mg/L exceeded the ANZECC guideline level of 0.011 mg/L;
    - Zinc concentration of 17 µg/L exceeded the ANZECC guideline level of 8 µg/L; and
- SBT-BH-4022: Copper concentration of 2 µg/L exceeded the ANZECC guideline level of 1.4 µg/L.

Nutrients:

Detectable concentrations of nutrients including Ammonia, Nitrate and Phosphorous were reported in all groundwater samples, with concentrations of Ammonia and Nitrate exceeding the ecological IL in samples SBT-GW-4003 and SBT-BH-4005, respectively.

Concentrations of nitrogen, ammonia and oxides of nitrogen exceeded the ANZECC/ ARMCANZ (2000) guideline values for slightly disturbed freshwater systems.

PFAS exceedances:

- SBT-BH-4005: PFOS concentration of 0.0058 µg/L exceeded the HEPA (2020) PFAS NEMP 99% protection level IL of 0.00023 µg/L; and
- SBT-BH-4002: PFOS concentration of 0.0006 µg/L exceeded the HEPA (2020) IL of 0.00023 µg/L.

It is noted that other PFAS compounds were detected at levels within the assessment criteria in all samples tested.

Discussion:

On review of available data, no discrete potential source of heavy metals has been identified within the site. Given there is no consistent trend showing that these COPC increase along the inferred groundwater flow direction, suggests that these COPC derive from diffuse sources within the surrounding environment.

Whilst the landscaping business to the north of the site was identified as a potential source of nutrients in groundwater, given the inferred north-north-westerly groundwater flow direction it is considered questionable that this operation is the source of the elevated Ammonia at the northern boundary. Notwithstanding this, given there is approximately 400 m between the site and Badgery's Creek (i.e., the nearest surface water receptor along the inferred groundwater flow path), it is assessed that Ammonia in groundwater would attenuate sufficiently to levels that would not pose unacceptable risks to aquatic receptors in this watercourse. Similarly, Nitrate appears to attenuate across the site with concentrations reported at the northern (down hydraulic gradient) boundary to concentrations at, or close to the Limit of Reporting.

Indicator PFAS compounds including PFAS and PFOA were reported at higher concentrations in monitoring well SBT-GW-4005 installed along the southern boundary of the site, relative to concentrations reported in monitoring wells along the northern site boundary. There was no perceptible source of PFAS in land immediately up hydraulic gradient (south) of the site. The available dataset shows the PFAS compounds appear to attenuate as groundwater passes through the site, indicating these compounds are unlikely to pose unacceptable risks to aquatic receptors in Badgery's Creek.

Dewatering of tunnel shaft excavations will temporarily alter the groundwater gradient, drawing in groundwater into this excavation that contains these dissolved COPC. It is assessed that the COPC at the concentrations reported in groundwater will not pose unacceptable risks to human health in a generic commercial / industrial setting. Nevertheless, monitoring groundwater quality during construction will be required to reassess such risks, and future management of water within the shaft.

10. Conceptual Site Model

10.1. Contamination Sources

The investigations completed within the site has not identified significant or widespread contamination across the site. However, the following contamination sources were identified during the investigation that required further consideration within the CSM:

- Bonded ACM: fibre cement sheeting fragment containing asbestos on surface soils at location HA-01.
- Residual contaminants bound within topsoil/fill matrix, including PFAS, TRH, BTEX, heavy metals, PAH and OCP.
- Groundwater containing PFAS and Nutrients.

10.2. Receptors

The following sources were considered relevant to the sources of contamination identified:

- Construction workers.
- General public who could be subject to contaminated media generated during development and maintenance of rail infrastructure.
- Persons involved with future maintenance of the rail infrastructure.
- Surface water receptors (i.e., existing dam on site, of off-site)
- Groundwater.

10.3. Exposure Scenario & Risk Evaluation Discussion

10.3.1. Asbestos Source Zone Characteristics & Potential Risks

Fibre cement debris, suspected of containing ACM, were observed in multiple locations within the site within the footprint and surrounds of the former dwelling and southern site shed. During the subsequent investigation works, this debris was not observed on ground surface or within topsoil/fill exposed in test pits, suggesting these materials were removed during works to demolish the dwelling and shed. TTMP holds no information regarding the nature and extent of ACM removed from these structures and the ground surface.

The fragment of fibre cement sheeting containing asbestos identified during the investigation works at HA-01 is considered to derive from the former dwelling on site, and indicative of the ACM removed from site during recent demolition works. This fragment was assessed to be Bonded ACM and in good condition. As noted in Section 4.6 of Schedule B1, ASC NEPM (NEPC, 2013), 'bonded ACM in sound condition presents a low human health risk'. However, its occurrence is consistent with observations made by TTMP during the initial walkover of the site and is therefore considered an indicator that other undetected fragments of ACM may exist in topsoil/fill within the footprint of former structures on site. The extent of the potential asbestos source zone is presented in Figure 1 in Appendix 1

Bonded ACM has the potential to weather (i.e., deteriorate) by way of chemical weathering and mechanical weathering, which may result in a greater likelihood for fibres being released. Chemical weathering of cement used to bond asbestos fibres within a solid matrix can occur in acidic soils or where other chemical oxidants are present. The pH of the shallow natural soil within the site was recorded to range between 4.6 and 5.8. Further, based on the review of historic residential and agricultural uses of the site, the presence of other chemical oxidants is not anticipated. These mildly acidic conditions are unlikely to result in the accelerated chemical weathering and/or rapid deterioration of cement that bonds the asbestos fibres within a solid matrix.

Mechanical weathering is associated with the breaking down of cement bonding asbestos fibres by physical forces, and could include the movement of vehicles and plant, excavation etc. These activities have the potential to degrade/deteriorate the bonding cement and increase the potential for asbestos fibres to be released. Mechanical weathering of bonded ACM through inadvertent vehicle movements during site redevelopment works has the potential to pose an increased health risk to construction workers, users of surrounding land and potentially, ground workers conducting future subsurface maintenance activities. Furthermore, such works have the potential to spread ACM over a wider area.

Bonded ACM in good condition is less susceptible to being spread through surface water runoff.

10.4. Residual Contamination in Topsoil/Fill

Analysis of samples of topsoil/fill material on site did not record concentrations of COPC above criteria that pose potentially unacceptable risks to human health or terrestrial ecology. Notwithstanding this, this analysis detected COPC including PFAS, TRH, BTEX, heavy metals, PAH and OCP. Surface water has the potential to erode topsoil/fill material and transport sediment-laden runoff.

It is assessed that the lower permeability of the clay residual soil will limit infiltration and subsequent mobilisation of soil bound COPC to significantly impact groundwater at depth.

Based on a review of available topographic records, it is assessed that the dam on site and immediately offsite to the site sit at a higher elevation to the construction site, indicating that runoff from the construction site is unlikely to enter this dam. Where site levels are altered during construction, or significant rainfall events occur, runoff has the potential to enter the dam or neighbouring land.

It is assessed that this potential pollutant linkage could be effectively mitigated through effective site set up and sediment/erosion controls to prevent sediment-laden runoff entering these dams or neighbouring land.

10.5. Nutrients in Groundwater

The concentrations of Ammonia and Nitrate exceeded the ecological criteria in samples SBT-GW-4003 and SBT-BH-4005. Results suggest concentrations of ammonia are higher along the northern site boundary and concentrations of nitrate, are higher at the south-eastern end of the site. These results suggest the landscaping business located to the north is not likely to be the source of nutrients detected in groundwater.

Overall, the nutrients in groundwater are not considered to pose an unacceptable risk to human health in a commercia / industrial setting. Similarly, given the distance to Badgery's Creek (i.e., nearest surface water receptors down hydraulic gradient), it is assessed the nutrients detected in groundwater will sufficiently attenuate to levels that would not pose unacceptable risks to aquatic ecology in this watercourse.

10.6. PFAS Impacted Groundwater

PFAS impacted groundwater was found in all groundwater monitoring locations. The PFOS concentration in SBT-BH-4002 and SBT-BH-4005 exceeded the HEPA (2020) PFAS NEMP 99% protection level IL of 0.00023 µg/L. The available dataset shows PFOS concentrations decrease along the inferred groundwater gradient across the site, implying it would sufficiently attenuate prior to entering Badgery's Creek, located approximately 400m north of the site. For this reason, it is assessed that PFOS detected in groundwater is unlikely to pose unacceptable risks to aquatic receptors in Badgery's Creek.

Dewatering of the tunnel shaft has the potential to intercept and draw in groundwater containing PFAS. The reported concentrations of PFAS compounds do not pose unacceptable risks to workers that enter the tunnel shaft, particularly given that ingestion of groundwater within this construction setting (i.e., primary mode of exposure) would be accidental.

Given that the tunnel and shaft will be undrained, risk from groundwater being drawn into the tunnel and shaft post-construction is therefore considered to be negligible. Six-monthly groundwater monitoring is proposed during construction. If any changes in groundwater conditions are detected, then further assessment will be undertaken.

Given the PFAS concentrations in groundwater and the conditions for discharge to surface waters, the groundwater would not be permitted to be discharged to surface waters.

10.7. Conceptual Site Model - Summary

Table 16 presents a summary of the CSM, which has been revised to account for the findings of the investigations completed by TTMP.

Table 16: Conceptual Site Model - Summary

Potential Contamination Source	Contaminants of Potential Concern and Affected Media	Plausible Exposure Pathways & Transport Mechanisms	Receptors
Demolition materials form Previous Buildings and Structures	Bonded asbestos in topsoil/fill in vicinity of former structures	Mechanical weathering of cement binding asbestos fibres within a solid matrix during construction. Wind-blown soil/dust containing asbestos fibres Inhalation of airborne fibres	Construction workers; General public including persons who could be subject to contaminated media generated during redevelopment/ maintenance Persons involved with future maintenance of the rail infrastructure
Topsoil/Fill Material	Residual contaminants bound within topsoil/fill matrix (e.g., PFAS, heavy metals, TRH, PAH and OCP).	Erosion and surface water flow	Surface water quality (dams on and off site)

Potential Contamination Source	Contaminants of Potential Concern and Affected Media	Plausible Exposure Pathways & Transport Mechanisms	Receptors
Previous Agriculture Land Use & Commercial landscaping business located on an adjacent property north of the site	Nutrients and PFAS in groundwater	Lateral Groundwater Migration	Aquatic receptors in Badgery's Creek

11. Conclusions and Recommendations

Based on review of the field observations, logs, and soil analytical results, TTMP considers that the soil within the site poses a low risk of contamination to the project given that no gross[8] contamination was identified within the site.

Given the results of this DSI, the site is considered suitable for the proposed development (shaft and maintenance facility / industrial land use) based on the following:

- Soil materials from the asbestos source zone will be excavated and removed to facilitate construction of the BSF site;
- The BSF site will be covered in hard landscaping with minimal soft landscaping, and the site not accessible to general public; and
- The shaft and tunnel are undrained (tanked) structures.

The investigation has identified one fragment of Bonded ACM in topsoil/fill material within the footprint of a former dwelling that was recently demolished. This find is considered to be an indicator that other undetected fragments of ACM may exist in topsoil/fill within the footprint of former structures on site. The extent of the potential asbestos source zone is presented in Figure 1 in Appendix 1.

It is understood that topsoil/fill material within the asbestos source zone requires removal from the site to implement the proposed development. The removal of topsoil/fill material from the asbestos source zone will effectively mitigate health risks to construction workers and users of surrounding land, provided these works are undertaken in a manner that minimizes the potential for excessive weathering of ACM. Topsoil/fill materials will be disposed off site as a waste following determination of the waste classification of these materials.

Topsoil/fill material contain low concentrations of COPC including PFAS, TRH, BTEX, heavy metals, PAH and OCP. Whilst the reported concentrations do not pose potential risks to human health in a commercial/industrial land use setting, or terrestrial ecology, it is assessed that sediment-laden runoff has the potential to result in impacts to the water quality of dams within/surrounding the site or neighbouring land. This potential pollutant linkage could be effectively mitigated through effective site set up and sediment/erosion controls to prevent sediment-laden runoff entering these dams or neighbouring land.

[8] Gross contamination is considered to be an area of wide-spread contamination which exceeds relevant commercial/industrial health guidelines triggers a requirement for remediation to mitigate contamination impacts that are over and above the standard construction practices to make the site suitable for commercial / industrial use.

PFAS impacted groundwater was found in all groundwater monitoring locations. Overall, the PFAS exceedances are considered minor and would not pose an unacceptable risk with respect to the proposed development. Given that the tunnel and shaft will be undrained, risk from groundwater being drawn into the tunnel and shaft post-construction is therefore considered to be negligible. Six-monthly groundwater monitoring is proposed during construction. If any changes in groundwater conditions are detected, then further assessment will need to be undertaken.

Given the PFAS concentrations in groundwater and the conditions for discharge to surface waters, the groundwater would not be permitted to be discharged to surface water.

Unexpected contamination, if identified during future works, can be managed through implementation of an Unexpected Contaminated Finds Protocol included in the Project construction environmental management plan (CEMP).

Asbestos finds suggest fill excavated in the footprint of the former structures should be managed as Special Waste (Asbestos Waste).

The results suggest the fill soils would be preliminary classified as General Solid Waste (non-putrescible).

The investigation indicates that natural soil would provisionally classify as General Solid Waste (non-putrescible). It is noted that the investigation has identified trace concentrations of organic and metal COPC in samples of natural soils at varying depths which would preclude the classification of such materials as VENM.

Results suggest the soils sampled would be suitable for reuse at the FS01 site. All results were within the AEPR and those for a future commercial / industrial land use.

The following is also recommended:

- CPG engage a competent person during disturbance of topsoil/fill materials (observed to a depth of approximately 0.2 m) to visually monitor for signs of potential contamination and potential ACM. If evidence of potential ACM or other indications of potential contamination are noted (e.g., stained or odorous soils, buried wastes, etc) work should cease pending further investigation of this material by TTMP. The competent person must be experienced in the undertaking excavation/remediation works and have the necessary experience to identify soil materials containing ACM and unforeseen contamination.
- Topsoil (fill) materials (observed to a depth of approximately 0.2 m) are stockpiled separately to natural soils, and stockpiles are managed in accordance with the requirements of the CEMP.
- No soil materials shall be removed from the site without a Waste Classification Report and / or a Material Classification Report.
- A surface water and sediment sample be collected from the dam to provide baseline conditions prior to the commencement of construction.
- Six-monthly construction groundwater monitoring be carried out to detect any changes in groundwater quality. This monitoring would also confirm the inferred groundwater flow direction.
- Adequate documentation is required to be collected to confirm the chemical suitability of imported materials (if any). The documentation will need to be included in a validation report demonstrating the suitability of the site post-construction (along with other data generated).

12. References

ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018*

Cardno (2021); Contamination Assessment Report – Phase D/E, Sydney Metro Western Sydney Airport (Ref: 80021888; RevB, dated 22nd November 2021)

Cardno (2021); Contamination Assessment Report, Sydney Metro Western Sydney Airport (Ref: 80021888; dated 5th May 2021)

CRC Care (2011) *Technical Report No. 10, Health screening levels for petroleum hydrocarbons in soil and groundwater*

GHD (2019) *Western Sydney Airport, Remediation Action Plan* (Ref: WSA00-WSA-0040-EN-PLN-00001, dated June 2019)

Golder & Douglas Partners (Feb 2021); *Factual Contamination Report – Preliminary Site Investigation* (Ref: 19122621-003-R-Rev3; Rev3; dated 19th February 2021)

NEPC (2013); National Environmental Protection (Assessment of Site Contamination) Measure 1999 (the 'ASC NEPM')

NSW EPA (1995); Sampling Design Guidelines

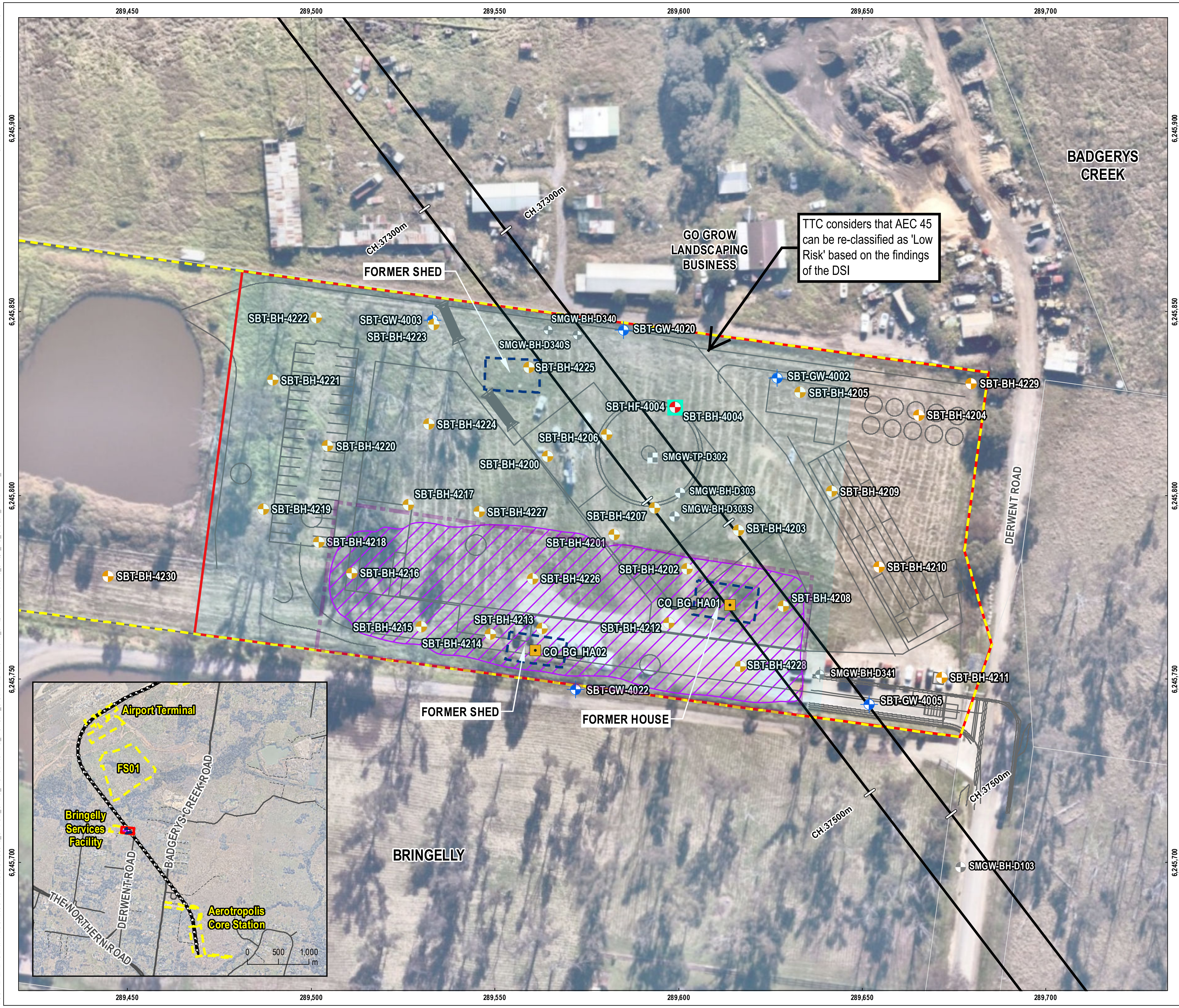
HEPA (2020) *PFAS National Environmental Management Plan (PFAS NEMP) 2.0, 2020*.

M2A (2020) *Sydney Metro - Western Sydney Airport Technical Paper 8 Contamination*

TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Hydrogeological Interpretative Report*.

TTC (2022b) *Western Sydney Airport Station Boxes and Tunnels Tender, Bringelly Sampling and Analysis Quality Plan*.

Appendix 1 Figures 1 and 2, Proposed Layout Plan, Proposed Airport Plan



CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

Additional Contaminated Land Location
- Borehole
- Hand Sample

Additional Geotechnical/Hydrogeological Location
- Borehole
- Monitoring Well
- Hydrofracture In-situ Stress Test

Existing Investigation Location
- Borehole
- Groundwater Borehole
- Test Pit
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Bringelly Services Facility Site Layout
- ACM Fragments
- Former Structure
- Cadastral Boundary
- BSF Site Boundary
- Construction Footprint
- ACM Soil Removal Area
- Low Risk AEC

SOURCE
Contaminated land locations, additional investigations, site boundary, construction footprint boundary, former structures, and ACM fragments from Tetra Tech Coffey.
Existing investigations and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 15-06-2022).

0 20 40 m
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PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 1

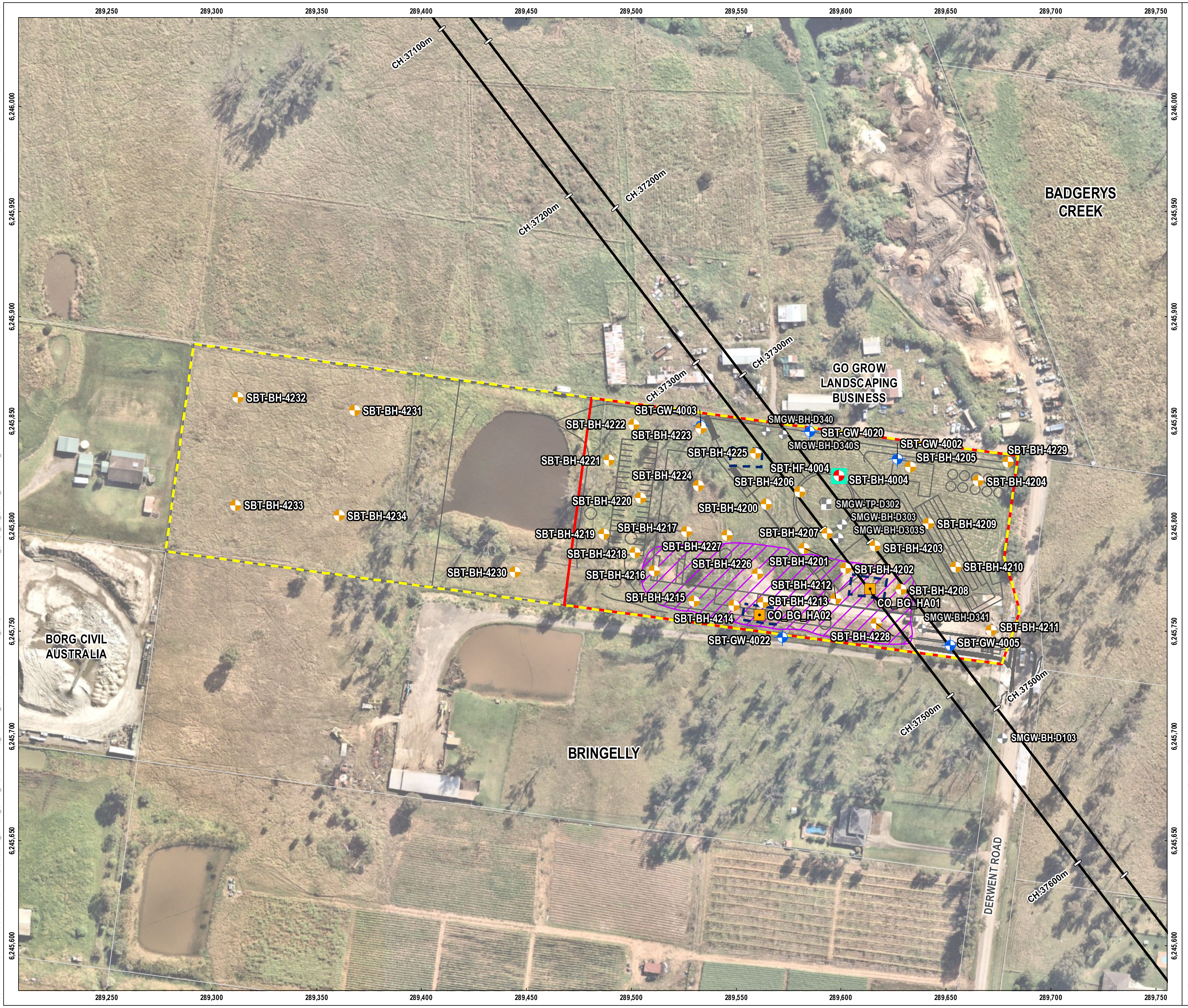
Bringelly Services Facility - Investigations within Construction Boundary

TETRA TECH COFFEY

DATE: 29.07.22 PROJECT: 754-SYDGE292575 FILE: 292575_SAQP_BS_F001_GIS

SAVED BY: EAMMON.MARHA 29.07.22 4:12:43 PM

DOC REFERENCE: \\TT.LOCAL\COFS\72\SIGIS\286919_SYDGE_CPBG_WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_SAQP\REV4\292575_SAQP_BS_GIS001_REVB.MXD_4



LEGEND

Additional Contaminated Land Location
- Borehole
- Hand Sample

Additional Geotechnical/Hydrogeological Location
- Borehole
- Monitoring Well
- Hydrofracture In-situ Stress Test

Existing Investigation Location
- Borehole
- Groundwater Borehole
- Test Pit
- Tunnel Alignment - Chainage
- Tunnel Alignment
- Bringelly Services Facility Site Layout
- ACM Fragments
- Former Structure
- Cadastral Boundary
- BSF Site Boundary
- Construction Footprint

SOURCE
Contaminated land locations, additional investigations, site boundary, construction footprint boundary, former structures, and ACM fragments from Tetra Tech Coffey.
Existing investigations and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 18-02-2022).

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PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 2

Bringelly Services Facility - Investigations within Site Boundary

TETRA TECH COFFEY

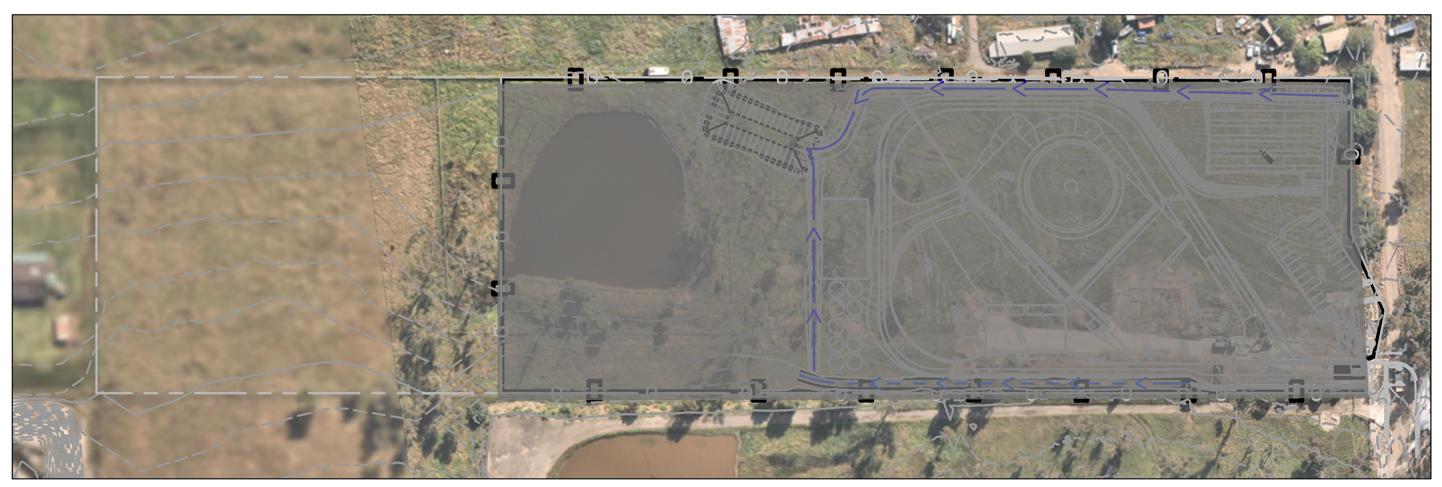
DATE: 07.07.22 PROJECT: 754-SYDGE292575 FILE: 292575_SAQP_BS_F002_GIS

NOTE

SANDBAGS TO BE PROVIDED AROUND EXITING PITS DURING THE CONSTRUCTE PHASE

LEGEND

3.00	EXISTING CONTOURS MAJOR
3.50	EXISTING CONTOURS MINOR
	PROPOSED SITE BOUNDARY
	PROPOSED CHAIN LINK FENCE
	FUTURE BUILDING
E	PROPOSED ELECTRICITY
	PROPOSED CATCH DRAIN
	PROPOSED CUT-OFF DRAIN
	PROPOSED SEDIMENT FENCE
	PROPOSED SHAKER GRID



KEY PLAN

OFFICIAL

FOR CONSTRUCTION

REV.	AMENDED DESCRIPTION	Design by	Verified by	Approved by	Date
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
00	APPROVED FOR CONSTRUCTION	CH	CH	IMc	07.07.22

SCALES: NOT TO SCALE

0 5 10 15 20 25 30m
SCALE 1:500 AT A1 SIZE

CLIENT

NSW GOVERNMENT — Sydney METRO

Engineering Design Solutions

SYDNEY METRO

The information shown on this drawing is for the purposes of the Sydney Metro Project only. No warranty is given or implied as to its suitability for any other purpose. The Service Providers accept no liability arising from the use of this drawing and the information shown thereon for any purpose other than the Sydney Metro Project.

ROBERT BIRD GROUP

SITE ESTABLISHMENT

DRAWN	S.MANANDHAR	07.07.22
DESIGNED	C.HUANG	07.07.22
DRG CHECK	C.HUANG	07.07.22
DESIGN CHECK	C.HUANG	07.07.22
APPROVED	I.MCCUBBIN	07.07.22

SYDNEY METRO - WESTERN SYDNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS
BRINGELLY SERVICES FACILITY
MOBILISATION & SITE ESTABLISHMENT
-
EROSION AND SEDIMENT CONTROL PLAN

FILE No: - SHEET: 1 OF 1 ©
STATUS: APPROVED FOR CONSTRUCTION EDMS No: *EDMS NO*
DRG No. SMWSASBT-CPG-AEC-SF400-MB-DRG-051003 REV 00 VER 1.1

A1 Original | Co-ordinate System: GDA2020/MGAZone56 | 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.

Cad File: P:\2022 JOBS\22028 SBT CSA\5_Working\Drgs & BIM Models\CV\Civil 3D\04_SHEETS\SMWSASBT-CPG-AEC-SF400-MB-DRG-051003.dwg
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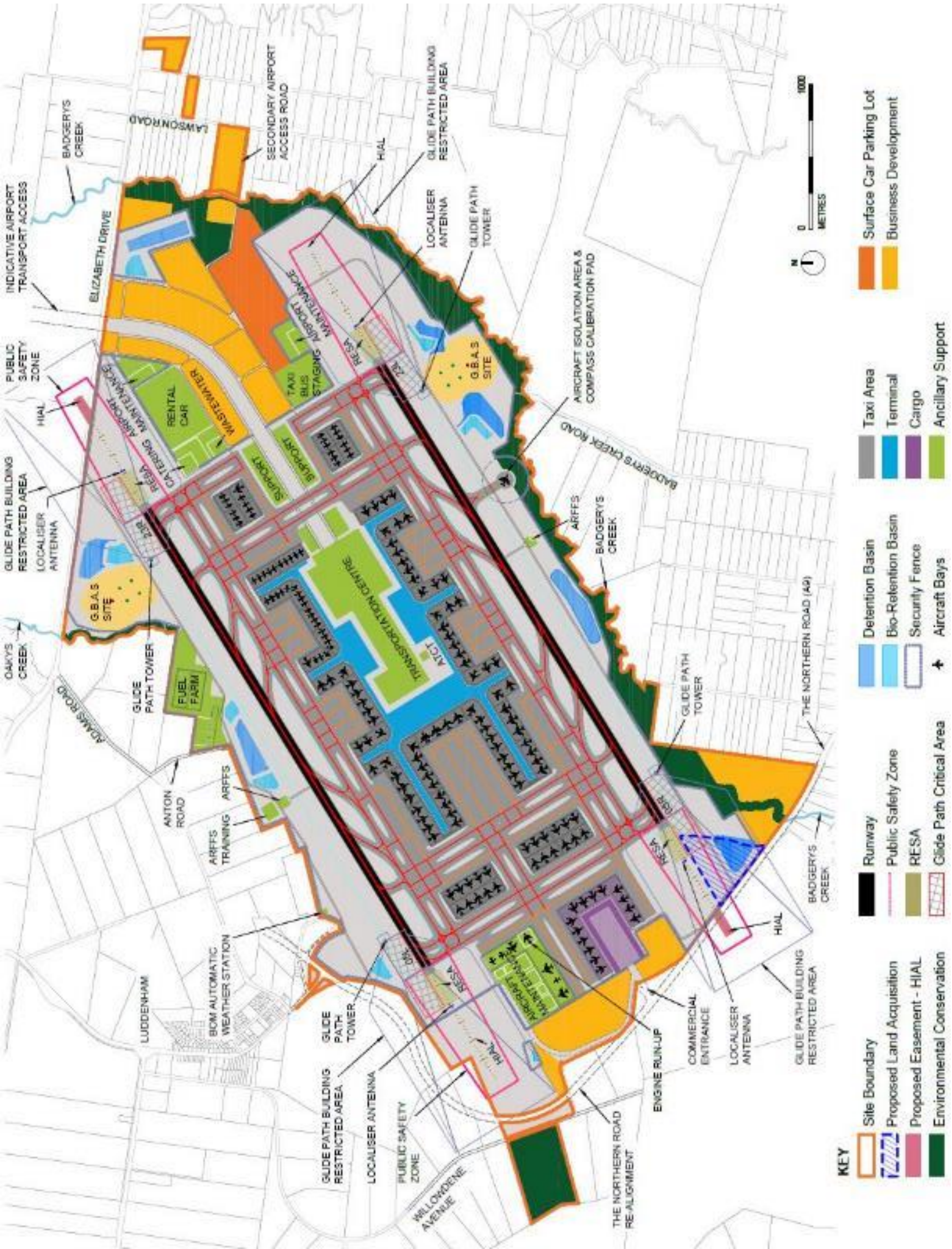
Figure 4: Indicative Airport layout (Long Term)



4.5m WIDE GRASSED SWALE
ONE-WAY SHAFT ACCESS ROAD
450mm x 300mm BOX CULVERT CROSSINGS
2m WIDE GRASSED SWALE
INDICATIVE ELECTRICAL LINE
SEDIMENT BASIN 450m³
WATER TREATMENT PLANT
DERWENT STREET
CARPARK (40 SPACES) 948m²
LAYDOWN YARD 3374m²
SOG HARDSTAND
SHAFT
CRANE PAD
SPOIL BIN
OFFICE 703m²
SUBSTATION 54m²
SPOIL BIN WORKING ZONE
WORKSHOP 375m²
5.5
P1
P2
P3
3m WIDE GRASSED SWALE
TRUCK PARKING LANE
COR GATEHOUSE
INDICATIVE LOCATION OF EXISTING GO GRO ORGANICS GATE
ACCESS GATE FOR ALL TRAFFIC
WORK INTERFACE TO EARLYWORKS PACKAGE TO BE VERIFIED IN DETAILED DESIGN
TWO-WAY GENERAL AND SHAFT ACCESS ROAD
INDICATIVE LOCATION OF EXISTING OVERHEAD POWER POLE, TO BE RELOCATED UNDER EARLYWORKS PACKAGE

Appendix 2 Analytical Data from Previous Investigations