Prepared for
John Holland CPB Ghella Joint Venture
Prepared by
Ramboll Australia Pty Ltd
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SITE AUDIT REPORT
WATERLOO STATION BOX EXCAVATION AND VALIDATION, 49-67 BOTANY ROAD, WATERLOO NSW

RAMBOLL

2 June 2020

John Holland CPB Ghella Joint Venture
Attn.: Krissy Vajda
Level 9, 50 Bridge Street
Sydney NSW 2000

By email: krissy.vajda@sydneymetro2.com.au

Dear Krissy

SITE AUDIT REPORT - WATERLOO STATION BOX EXCAVATION AND VALIDATION, 49-67 BOTANY ROAD, WATERLOO NSW

I have pleasure in submitting the Site Audit Report for the subject site. The Site Audit Statement, produced in accordance with the NSW *Contaminated Land Management Act 1997*, is included as Appendix B of the Site Audit Report. The Audit was commissioned by John Holland CPB Ghella Joint Venture to assess what management remains necessary before the land is suitable for any specified use or range of uses.

The Audit was initiated to comply with requirements of *Condition E67 of Infrastructure Approval, application SSI 15_7400*, approved by the Minister for Planning on 9 January 2017, and is therefore a statutory audit.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8100 if you have any questions.

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Ref 318000323-006

Yours faithfully,
Ramboll Australia Pty Ltd

Tom Onus
EPA Accredited Site Auditor 1505

cc: NSW EPA – Statement only
City of Sydney Council

Ramboll Australia Pty Ltd
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LIST OF ABBREVIATIONS

Measures

%	per cent
µg/L	Micrograms per Litre
µg/m^3	Micrograms per Cubic Metre
ha	Hectare
km	Kilometres
m	Metre
mAHD	Metres Australian Height Datum
mbgl	Metres below ground level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mg/m^3	Milligrams per Cubic Metre
mm	Millimetre
ppm	Parts Per Million

General

ACM	Asbestos Containing Material
ADWG	Australian Drinking Water Guidelines
AF	Asbestos Fines
AHD	Australian Height Datum
ALS	Australian Laboratory Services
ANZG	Australian & New Zealand Guidelines
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
ANZECC	Australian and New Zealand Environment and Conservation Council
BaP	Benzo(a)pyrene
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes & Naphthalene
CLM Act	NSW Contaminated Land Management Act 1997
COC	Chain of Custody
CSM	Conceptual Site Model
DA	Development Application
DGV	Default Guideline Value
DNAPL	Dense Non-Aqueous Phase Liquids
DP	Douglas Partners Pty Ltd
DQI	Data Quality Indicator
DQO	Data Quality Objective
DSI	Detailed Site Investigation
EDC	1,2-Dichloroethane
EI	Environmental Investigations Australia Pty Ltd
EMP	Environmental Management Plan
ENM	Excavated Natural Material
Envirolab	Envirolab Services Pty Ltd
EPA	Environment Protection Authority (NSW)
EPL	Environment Protection Licence
FA	Fibrous Asbestos
GME	Groundwater Monitoring Event
GSW	General Solid Waste
HIL	Health Investigation Level
HSL	Health Screening Level
IAA	Interim Audit Advice
IPA	Iso-propyl alcohol
JHCPBG JV	John Holland CPB Ghella Joint Venture
LCS	Laboratory Control Sample
LEP	Local Environment Plan
LOR	Limit of Reporting
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
ML	Management Limits
MS	Matrix Spike
NATA	National Association of Testing Authorities
NC	Not Calculated

ND	Not Detected
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Non-Limiting
n	Number of Samples
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OH&S	Occupational Health & Safety
OPPs	Organophosphorus Pesticides
OSCI	Onsite Supplementary Contamination Investigation
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PFAS	Per- and Poly-fluoroalkyl substances
pH	A measure of acidity, hydrogen ion activity
PID	Photoionisation Detector
POEO Act	Protection of the Environment Operations Act 1997
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbon
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance/Quality Control
Ramboll	Ramboll Australia Pty Ltd – previously Ramboll Environ Australia Pty Ltd and ENVIRON Australia Pty Ltd
RAP	Remediation Action Plan
RPD	Relative Percent Difference
RRE	Resource Recovery Exemption
RRO	Resource Recovery Order
RSL	Regional Screening Level
SAR	Site Audit Report
SAS	Site Audit Statement
SPR	Source-pathway-receptor
SSI	State Significant Infrastructure
SVME	Soil Vapour Monitoring Event
SVOCs	Semi Volatile Organic Compounds
SWL	Standing Water Level
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalence Quotient
TPHs	Total Petroleum Hydrocarbons
TRHs	Total Recoverable Hydrocarbons
TV	Trigger Value
UPSS	Underground Petroleum Storage System
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VCH	Volatile Chlorinated hydrocarbons
VENM	Virgin Excavated Natural Material
VOCs	Volatile Organic Compounds
WHO	World Health Organisation
1,1,1-TCA	1,1,1-Trichloroethane
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

1.1 Audit Details

A site contamination audit is being conducted in relation to the Waterloo Station site of the Sydney Metro City and South West, which is located at 49-67 Botany Road, Waterloo.

The Audit was conducted to provide an independent review by an EPA Accredited Auditor of what management remains necessary before the land is suitable for any specified use or range of uses i.e. a "Site Audit" as defined in Section 4 (1) (b) (iv) of the NSW *Contaminated Land Management Act 1997* (the CLM Act).

A State Significant Infrastructure (SSI) development application (SSI 15_7400) was approved by the NSW Minister for Planning on 9 January 2017 for the construction and operation of a metro rail line, approximately 16.5 km long (of which approximately 15.5 km is located in underground rail tunnels) between Chatswood and Sydenham, including the construction of a tunnel under Sydney Harbour, links with the existing rail network, seven metro stations, and associated ancillary infrastructure. Condition E67 of the SSI development approval relates to contamination and requires a site audit as follows:

> *"If a Site Contamination Report prepared under Condition E66 finds such land contains contamination, a site audit is required to determine the suitability of a site for a specified use. If a site audit is required, a Site Audit Statement and Site Audit Report must be prepared by a NSW EPA Accredited Site Auditor. Contaminated land must not be used for the purpose approved under the terms of this approval until a Site Audit Statement is obtained that declares the land is suitable for that purpose and any conditions on the Site Audit Statement have been complied with."*

The Audit was initiated to comply with condition E67 of the SSI approval and is therefore a statutory audit.

Details of the Audit are:

Requested by:	Caitlin Richards on behalf of John Holland CPB Ghella Joint Venture (JHCPBG JV)
Request/Commencement Date:	5 October 2017
Auditor:	Tom Onus
Accreditation No.:	1505

1.2 Project Background

As part of the Sydney Metro City and South West (Sydney Metro) Tunnel and Station Excavation (TSE) Works Package, a Remediation Action Plan (RAP) was developed to detail the work required to remediate the site during construction of the station box. The RAP was reviewed by the Auditor (see Section 1.3 for details) prior to remediation commencing.

The site comprises the 'excavation footprint' shown in blue on Attachment 1 (Appendix A). The surrounding 'Worksite Area' is not part of the site. Remediation was undertaken by excavation and off-site disposal of all fill material and natural soil/bedrock to a depth of approximately 28 metres below ground level (mbgl) within the site. A secant pile wall was constructed along the site boundaries to facilitate the excavation.

An off-site source of volatile organic compounds (VOCs) (chlorinated hydrocarbons) was identified immediately adjacent to the site in the Worksite Area. The primary source of contamination (dry cleaner) has been removed, however secondary impact by chlorinated hydrocarbons is expected to remain in soil and groundwater (this has not been not confirmed by investigations).

Onsite investigation locations undertaken prior to remediation identified chlorinated hydrocarbons in soil, groundwater and soil vapour. Onsite impact was removed during station box excavation,

however the off-site secondary source remains. The risk from future onsite migration of contamination is expected to be limited by the secant pile wall, the proposed tanking of the station, and the station ventilation system (once constructed). Further investigation of the site will be required to demonstrate this.

1.3 Interim Audit Advice

Interim Audit Advice (IAA) was prepared by the Auditor in 2018 which provided an initial review of the suitability and appropriateness of a RAP, as well as a review of the previous investigations undertaken at the site. The IAA is provided in Appendix C. The reports reviewed for the IAA are listed in Section 1.4 below.

The IAA concluded that the proposed process for remediation of fill material was practical and that the site could be made suitable for the proposed land use if remediated in accordance with the RAP. The IAA noted that *"Further investigation to determine the extent and magnitude of VOC concentrations in soil vapour and groundwater is proposed. The scope and results of the investigation should be provided to the Auditor for review. Should the results of the investigation indicate a need for additional remediation to address groundwater and soil vapour contamination, an addendum to the RAP should be prepared and provided to the Auditor for review."*

At this stage, investigation of VOC concentrations in soil vapour and groundwater have not demonstrated that the site is suitable for the proposed use. Further investigation and potentially management will be undertaken during development of the station to demonstrate that the site is suitable for the proposed use.

The IAA is attached in Appendix C and is referenced throughout this Site Audit Report (SAR) as appropriate, however, full details of the IAA are not repeated.

1.4 Scope of the Audit

The scope of work undertaken for the IAA the included:

- Review of the following reports:
  - 'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo', report reference: Revision 0, dated 8 March 2018, prepared by Douglas Partners (DP) (*the PSI*).
  - 'Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo', report reference: Revision 1, dated 13 March 2018, prepared by DP (*the DSI*).
  - 'Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo', report reference: Revision 0, dated 13 April 2018, prepared by DP (*the RAP*).
- A site visit by the Auditor on 6 March 2018.
- Discussions with JHCPBG JV, and with DP who undertook the investigations and prepared the RAP.

The scope of work undertaken in completing the SAR included:

- Review of the following reports
  - 'Acid Sulphate Soil Management Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo', report reference: Revision 1, dated 18 June 2018, prepared by DP (*the ASSMP*).
  - 'Factual Report on On-site Supplementary Contamination Investigations, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo

Station, Botany Road and Cope Street, Waterloo', report reference: Revision 0, dated 19 September 2018, prepared by DP (*the OSCI*).

- 'Report on Validation of Remediation, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Sydney Metro City and South West - Waterloo Station, Botany Road, Waterloo, NSW', report reference: Revision 0, dated 14 May 2020, prepared by DP (*the Validation Report*).

- Review of approximately 60 waste classification reports prepared by DP for material disposed from the site.
- Discussions with JHCPBG JV, and with DP who undertook the remediation and validation works.

2. SITE DETAILS

2.1 Location

The site is identified as the '*excavation footprint'* (the site) for the station, shown in blue on Attachment 1 (Appendix A). The '*Worksite Area*' shown on Attachment 1 surrounding the '*excavation footprint'* has been excluded from the DP investigations and is not part of the site audit area. The site details are as follows:

Street address:	49-67 Botany Road, Waterloo, NSW 2017
Identifier:	Part of Lots 4 and 5 DP 215751 Part of Lot 1 DP 814205 Part of Lots 1 and 2 DP 228641 Part of Lot 12 DP 399757 Part of Lots A, B, C, D and E DP 108312 Part of Lot 1 DP 433969 Part of Lot 1 DP 738891 Part of Lots 31 and 32 DP 805384 Part of Lot A DP 408116 Part of Lot 2 DP 205942
Local Government:	City of Sydney
Owner:	Transport for NSW
Site Area:	Approximately 0.5 ha

The northern, eastern and southern boundaries of the site are well defined by Cope Street (East) and Buckland Street (South). The western and northern boundaries are not well defined as these areas of the site have been used for a Worksite Area. The Worksite Area is bound by Botany Road to the west and Raglan Street to the north.

A survey plan of the site has been provided in Attachment 2 (Appendix A) and identifies the Site Audit boundary.

2.2 Zoning

The current zoning of the site is B4 Mixed Use under Sydney Local Environment Plan (LEP) 2012.

2.3 Adjacent Uses

The site is located within an area of mixed landuse including commercial and high density residential. The surrounding site use includes:

North: the Worksite Area, then Raglan Street and high rise mixed-use building beyond.

East: Cope Street and multi-level residential buildings beyond.

South: Wellington Street, commercial and residential buildings located further to the south.

West: the Worksite Area, then Botany Road and commercial buildings located further west.

The site is in a relatively flat area of Waterloo which slopes to the west. DP identified the closest sensitive ecological receptor for groundwater as Sheas Creek located approximately 530 m to the southwest which drains into Alexandra Canal and Cooks River. Cooks River drains into Botany Bay located approximately 6 km further to the south of the site. The site is located in the Botany Sand Aquifer Embargo zone where the abstraction of groundwater for domestic use is banned due to historical regional contamination of the aquifer from industry.

The PSI identified a number of commercial/industrial land uses within close proximity (100 m) including former battery manufacturers, metal workers, coppersmith, printers, blacksmiths, steam engineers, service stations, dry cleaners, electrical equipment manufacturing, boiler makers and motor garages. The business directory search identified that the majority of these

facilities were operational in the 1950's to 1970's. A former dry cleaner was located within the Worksite Area to the west of the subject site.

A search of the NSW EPA public records did not have any sites listed as contaminated in the immediate vicinity of the subject site.

2.4 Site Condition

2.4.1 Pre-Remediation

DP inspected the site for the PSI on 22 September 2017 and noted the following:

- The site was occupied by various commercial properties including an automotive centre and smash repairers. A sump and bund were located in the automotive centre used for the collection of fuels and oil. DP noted some staining on the concrete slab.
- Demolition of buildings was underway in some sections. Former basements were observed on Lot 31 DP805384 and SP75492.
- A former laundry/dry cleaner was located on 87 Botany Road (Lot 2 DP27454). At the time of the inspection, the majority of the building had been demolished. An old washers/dryers store and paper works were noted adjacent to the west of the site.

During the Auditor's site visit on 6 March 2018, the site was an active construction site, with the following features noted:

- The majority of the site surface had been cleared of slabs and pavements. Exposed soil was visible over the majority of the site. Localised excavations associated with an ongoing archaeological survey were evident.
- Imported material (densely graded base (DGB) and excavated natural material (ENM)) had been placed on the surface in the south section for the construction of temporary piling platforms. Some of the material had been stockpiled in the south section. A relatively long trench pit was being excavated along the southeast boundary for piling preparation works.
- A church was located off-site in the Worksite Area (Attachment 1, Appendix A). Sewer line diversions were being undertaken along the church boundary.
- Temporary/demountable sheds were located off-site in the Worksite Area. The area surrounding the sheds had been filled with recycled aggregate (crushed concrete, terracotta and brick).
- A building associated with the former site use remained in the Worksite Area to the southwest of the site. The building was being used as an office during redevelopment of the site.
- A former sump was exposed at the location of the former dry cleaner, located to the west of the site within the Worksite Area (Attachment 1, Appendix A). The sump contained wastewater, with inlets and outlets at the eastern and western sides of the sump.
- A large stockpile of fill soil was located in the north section awaiting disposal.

2.4.2 Post-Remediation

DP noted in the Validation Report that the site had been excavated into sandstone bedrock with a partial concrete slab observed to assist tunnel boring machines.

2.5 Proposed Development

The proposed development comprises a new below ground station building, access road, substation and upgrades to pedestrian access. The depth of excavation is approximately 28 mbgl with localised deeper excavation for a stormwater sump. The base of the structure will comprise an approximately 125 mm thick concrete slab. The walls will comprise secant pile walls with shotcrete (200 mm) between the piles to a depth of approximately 17 mbgl. The RAP reports that the proposed station will be tanked to minimise groundwater inflow.

For the purposes of this audit, the 'commercial/industrial' land use scenario will be assumed.

3. SITE HISTORY

The IAA provided a summary of the site history. The IAA noted that the PSI provided a summary of the site history based on a review of historical business listings, historical title deeds, aerial photographs, NSW EPA records, Section 149 (2&5) certificates (now known as Section 10.7 certificates) and NSW Safe Work records. The site history from the IAA is summarised as follows.

Aerial photographs indicated that the site was developed and mainly used for residential purposes with some commercial land uses until the 1950s. From 1950 the majority of the site was occupied by commercial buildings. Commercial uses included: manufacturing of batteries, forging, chemical, mirrors, glass, hospital equipment, plastic, tiles and electrical equipment; metal workers and merchants; motor electricians; motor painters; panel beaters; welders; coppersmith; printers; blacksmiths; steam engineers; and boilermakers. Demolition of site structures commenced in 2017.

A review of the SafeWork NSW information did not identify any records for the storage of dangerous goods including hazardous chemicals at the site.

DP noted that previous assessments by another consultant (Environmental Investigations Australia Pty Ltd (EI)) in 2015 identified residual contamination on 59-63 Botany Road (Lot 5 DP215751) and recommended site remediation. A RAP was understood to have been prepared by EI in 2015 and it is not known if remediation was undertaken, however is considered unlikely.

A laundry/dry cleaner was located to the west of the site within the Worksite Area (Lot 2 DP 27454).

A review of the NSW EPA public records did not find any notices for the site. Two sites in the immediate vicinity were listed as regulated by the EPA. They include the former Gas-N-Go service station at 10-20 Botany Road located approximately 141 m northwest and Lawrence Dry Cleaners at 887-893 Bourke Street located approximately 780 m to the east. The former service station has the potential to impact the site, however, the dry cleaners is considered to be across gradient of the site and unlikely to be a potential source of impact.

Based on the site location and history, potential contamination could have impacted the site from on-site and/or off-site sources.

3.1 Auditor's Opinion

In the Auditor's opinion, the site history indicates past activities have a high potential for significant contamination to have occurred. Sources of contamination appear to be associated with commercial/ industrial land use (including an automotive centre and smash repairer), fill and surface soil imported to achieve site levels, hazardous building materials from demolition of former buildings, and off-site land use including dry cleaners, motor garages and service stations.

The Auditor considers that the site history is broadly understood and adequate for identification of contaminants of concern (Section 4) and remediation of the site (Section 12).

4. CONTAMINANTS OF CONCERN

As outlined in the IAA, the DP PSI and DSI provided a list of contaminants of concern and potentially contaminating activities. These have been tabulated in Table 4.1.

Table 4.1: Contaminants of Concern

Area	Activity	Potential Contaminants
Entire Site	Fill and surface soil imported from unknown sources. Demolition of former buildings containing hazardous materials. Spills and leakage of chemicals associated with historical commercial/ industrial land use.	Metals, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes & naphthalene (BTEXN), volatile organic compounds (VOCs), volatile chlorinated hydrocarbons (VCH), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCBs), phenols, lead (from paint) and asbestos.
Off-Site Sources	Migration of potential contaminants from off-site sources including the former laundry/dry cleaner (within the Worksite Area), motor garage and service station.	Dry cleaner: VCHs Motor garage: Metals, petroleum hydrocarbons (BTEXN, TPH), PAHs, VCH and phenols.

The RAP stated that based on the DSI results, the main contaminants of concern for remediation include asbestos, VOC, lead and OCP. OCP was detected in groundwater and DP concluded that the potential source was unknown.

4.1 Auditor's Opinion

The Auditor considers that the analyte list used by DP adequately reflects the site history and condition.

5. STRATIGRAPHY AND HYDROGEOLOGY

5.1 Stratigraphy

DP reviewed geological maps and reported that the site is located within the Aeolian soil landscape underlain by Quaternary age transgressive dunes comprising of marine sand with podsols.

The sub-surface profile of the site encountered during the DP DSI prior to remediation is summarised by the Auditor in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0.0 – 0.35 (maximum)	Concrete pavements/slab.
0.15 – 1.0	Fill material comprising sand, gravel and clay with inclusions of demolition rubble, brick, glass, tile, ash, fly ash, charcoal, coal, wood, concrete and metal. Ash/coal was detected in 3 sampling locations. Potential asbestos containing material (ACM) was detected in test pit TP10 between 0.2 mbgl and 0.3 mbgl.
1 – 5.5	Natural sand, clayey sand and silty sand.
5.5 to 7.5	Natural clay (possible residual).

mbgl – metres below ground level

The subsurface profile comprised relatively shallow fill underlain by natural sand and clay soil.

DP report that Hibbs & Associates identified ACM in the north section of the site during demolition works. Hibbs concluded that ACM could have impacted the fill over the entire site.

The DP DSI indicated that there is a low to moderate risk of encountering acid sulfate soils (ASS) at the site. Acidic soils were identified in the ASSMP however DP did not consider these to be ASS. DP indicated that potential alluvial/estuarine/marine sediments may be encountered during earthworks which may need to be managed in accordance with the ASSMP. The Validation Report indicates that ASS was identified in a relatively small quantity and was treated onsite following successful neutralisation.

Following remediation of the site (discussed in Section 12), fill material and natural soil/rock were removed from the entire site area to a depth of approximately 28 mbgl.

5.2 Hydrogeology

The PSI included a search of the groundwater information database maintained by the NSW Government and identified eight registered groundwater bores within a 0.5 km radius of the site. The majority of the bores were registered for monitoring or recreational use. One bore (GW106192) located approximately 150 m southwest of the site is registered for domestic use. The depth of standing water in the bores ranged from 3.49 m to 11.6 mbgl.

The PSI concluded that based on the topography, groundwater is anticipated to flow to the southwest. DP identified the closest sensitive ecological receptor for groundwater to be Sheas Creek located approximately 530 m to the southwest. The creek drains into Alexandra Canal then to Cooks River and Botany Bay located approximately 6 km to the south of the site. Excess surface water run-off is anticipated to flow into the local stormwater network.

The site is located in the Botany Sand Aquifer Embargo zone where the abstraction of groundwater for domestic use is banned due to historical regional contamination of the aquifer.

As part of the DSI, four groundwater monitoring wells were installed on the site. Groundwater observations and sampling was undertaken as part of the DSI on 19 December 2017. Depth to groundwater in the monitoring wells was recorded between 3.3 m to 3.7 mbgl. DP did not assess the groundwater flow direction based on measured groundwater elevation. DP assumed that regional groundwater flow was to the southwest based on the topography and closest surface water receptor.

The DSI included field records of groundwater parameters recorded during sampling. They indicated that the pH was 6.51 to 6.68, dissolved oxygen was 0.48 to 1.08 mg/L, redox was 94 to 108 mV, and electrical conductivity was 337 to 438 µS/cm.

The RAP includes a summary of a Hydrogeological Interpretive Report by PSM (2018) which modelled the groundwater seepage rates expected during and post construction. DP summarised the findings as follows:

- Drawdown will occur in the immediate vicinity of the excavation due to vertical leakage through the residual soil of the Botany Sands Aquifer. Considering the high transmissivity of the sand aquifer, drawdown will be relatively flat with a large zone of influence;
- Contaminants are likely to be transmitted rapidly through the Botany Sands Aquifer. Considering that the structure will be tanked (constructed to limit groundwater inflow), the potential for inflow will be minimised;
- Maximum modelled seepage rate during construction (with inflows from faults) was 185 kL/day;
- Modelled steady state seepage rate prior to tanking the station structure was 147 kL/day;
- Water table in the Botany Sands Aquifer was at depths of 3 to 5 m;
- The modelled zone of capture for the first 10 years would extend to approximately 670 m from the site. The actual capture zone will depend on the time lapse between construction and tanking of the final structure; and
- Historical land use (existing and former commercial/ industrial premises in the vicinity, former Gas-N-Go service station, dry cleaners) may have an impact on groundwater quality and potential for contamination migration (TRH, BTEXN, heavy metals and VOCs).

The Auditor has not reviewed the PSM (2018) Hydrogeological Interpretive Report, however, considers that the primary long term source of seepage/ inflows is likely to be sandy soil and seepage from Botany Sands Aquifer. This is based on the stratigraphy and hydrogeology encountered during the DSI.

5.3 Auditor's Opinion

The Auditor considers that the site stratigraphy and hydrogeology are sufficiently well known for the purpose of the Audit.

6. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

An evaluation of the overall quality of the data obtained in previous investigations (PSI and DSI) at the site was presented in the IAA (Appendix C). The IAA concluded that the data was likely to be representative of site conditions, the data was largely complete, the data was likely to be comparable for each sampling and analytical event, the laboratories provided sufficient information to conclude that data was of sufficient precision and the data was considered to be accurate.

Subsequent to the PSI and DSI and preparation of the IAA, additional investigations were undertaken for the On-site Supplementary Contamination Investigations (OSCI), as outlined in Table 6.1. Soil samples or other data were not obtained for validation purposes.

Table 6.1: Summary of Additional Investigations

Stage of Works	Field Data	Analytical Data
OSCI (DP, 2018) *Fieldwork date: February to July 2018* Attachment 3 (Appendix A)	Nine boreholes (MW101 to MW106, MW102A, MW104A and MW106A) for combined groundwater/soil vapour well installation and collecting soil samples for ASS testing. Three wells were completed as pairs (MW102/MW102A, MW104/MW104A and MW106/MW106A). Ten boreholes (BH201 to BH210) and twelve test pits (TP211 to TP216, BH01-TPC, BH01-TPN, BH01-TPE1, BH01-TPE2, BH01-TPS and BH01-TPW) for waste classification of the upper 4 m of soil profile. Eleven boreholes (BH301 to BH310A) for waste classification of material below 4 m depth. Groundwater and soil vapour sampling over three groundwater monitoring events (GMEs) (March, May and July 2018). A total of sixteen groundwater samples and fifteen soil vapour samples over the three monitoring events.	*Soil:* Metals, TRH/BTEX, PAHs, phenols, OCPs, OPPs, PCBs, VOCs, pH_F, pH_{FOX}, chromium reducible sulfur (full suite) and asbestos (presence/absence) *Groundwater:* Metals, TRH/BTEX, PAHs, phenols, OCPs, OPPs, PCBs and VOCs *Soil Vapour:* VOCs (TO15 USEPA) and general gases (including methane, oxygen and carbon monoxide)

The Auditor's assessment of data quality for the OSCI follows in Tables 6.2 and 6.3.

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Data Quality Objectives (DQO) DP defined specific DQOs in accordance with the seven-step process outlined in Schedule B2 of NEPM (2013). The following decisions/objectives were identified by DP for the OSCI: • Assess the potential for contamination from the former off-site dry cleaner in soil, groundwater and soil vapour at the site • Assess acid sulfate soil (ASS) presence and distribution across the site • Classify soils for off-site disposal.	The identified DQOs were considered appropriate for the additional investigations conducted.
Sampling pattern and locations *Soil:* OSCI locations were generally located systematically to gain coverage of the majority of the site for ASS and waste classification (considering DSI locations). Select locations targeted the area adjacent to the former off-site dry cleaner and areas where VOC concentrations were detected in the DSI above waste criteria. The various fill and natural materials at the site were targeted for sampling. *Groundwater:* Monitoring wells were spaced to gain site coverage and were targeted to specific strata of concern (sand/clay interface and the clay/bedrock interface). Wells	In the Auditor's opinion the investigation locations were adequate to address the objectives of the investigation.

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
were located in the western portion of the site targeted towards the off-site VOC source, in assumed down-gradient positions, with the exception of two wells located in the south third of the site which were located centrally. *Soil vapour:* The soil vapour wells were combined into the groundwater monitoring wells.	
Sampling density *Soil:* The additional sampling density of 42 locations from the OSCI supplementing 12 obtained for the DSI (reviewed in the IAA) over approximately 0.5 ha exceeds the minimum recommended by EPA (1995) *Sampling Design Guidelines*. The coverage provides a 95% confidence of detecting a residual hot spot of approximately 11 m diameter. Samples analysed for asbestos were not collected at twice the minimum density in EPA (1995) *Sampling Design Guidelines*. *Groundwater*: A total of nine groundwater wells were installed at the site. It is noted that not all wells were available for sampling for every GME, with various wells being lost/ destroyed due to construction works during the monitoring period. All wells able to be located at the time of a specific GME were sampled. *Soil vapour:* Soil vapour samples were collected from nine groundwater monitoring wells installed at the site. As with the GMEs, it is noted that not all wells were available for sampling for every soil vapour monitoring event (SVME), with various wells being lost/destroyed due to construction works during the monitoring period. All wells able to be located at the time of a specific SVME were sampled.	In the Auditor's opinion the sampling density was appropriate.
Sample depths Soil samples were collected and analysed from a range of depths targeting fill, natural sand, clay and bedrock. The depths of sample intervals varied, with samples collected from 0.1 m to 17.9 mbgl. DP indicated that groundwater was sampled from towards the centre of the water column within the well. Six wells were installed to the top of bedrock and three were drilled adjacent and installed shallower to the top of clay. Screen inlets were located at the bottom 1 m of the wells which were installed to depths of 4.1-10.5 mbgl.	In the Auditor's opinion the sampling strategy was appropriate and adequate to meet the objectives of the investigation.
Well construction *Groundwater/soil vapour:* The monitoring wells were typically constructed with screen intervals of 1 m. A gravel filter pack was generally extended above the screen by approximately 0.5 m. Wells were constructed of 50 mm uPVC. A bentonite seal of 0.5-7 m thickness was placed above the screen/gravel and the well backfilled with soil cuttings or cement grout to the ground surface. Three shallow wells were installed to depths between 4.1 and 6 mbgl and six deep wells were installed to depths ranging from 8.9 to 10.5 mbgl. The shallow wells were located adjacent to deep wells as pairs. The screen interval in all wells was below the SWL.	In the Auditor's opinion the well construction was acceptable for assessment of groundwater conditions. Positioning of the screen interval below the SWL would not allow for identification of light phase separated hydrocarbons (PSH) however the dissolved phase concentrations (refer Section 9) do not indicate PSH are likely to be present. Use of groundwater wells for assessment of soil vapour is not considered appropriate particularly given the screen interval is below the SWL. Soil vapour results are not considered to be representative of site conditions.
Sample collection method *Soil*: Sample collection was via a SPT split spoon and/or from the auger flights, with external material removed prior to collecting the sample. 50 g samples were collected for laboratory analysis for asbestos. Laboratory reports indicate that asbestos analysis on some samples was undertaken on sub-samples from soil jars. Samples analysed for asbestos were not collected according to the asbestos quantification methodology outlined in NEPM (2013) (Schedule B1).	Soil sample collection from the auger flights is not ideal as it can result in loss of volatiles and sample cross contamination, although cross contamination was minimised by removing external material. Given the key contaminants at the site are volatile organics, the soil concentrations reported must be considered as indicative only and may underestimate the actual concentrations present.

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Groundwater: Wells were installed by solid flight augers, developed with a pump and samples were collected by low flow micro-purge pump with dedicated sample tubing. *Soil Vapour:* Samples were collected directly into evacuated Summa canisters provided by the laboratory (TO-15). Leak testing was undertaken using iso-propyl alcohol (IPA) within a shroud placed over the well and sampling equipment. Detections of IPA were reported in all samples during the March and May 2018 sampling rounds. DP considered that the IPA results were acceptable based on the concentrations reported being significantly less than 10% of the recorded shroud IPA concentrations.	Assessment of asbestos concentrations using 50 g samples is not in accordance with NEPM (2013), however it is noted that all fill material was removed from site during remediation and is therefore acceptable for the purposes of the investigation. Groundwater and soil vapour sampling methods were acceptable (although the soil vapour data is not considered representative based on the well construction).
Decontamination procedures *Soil:* Sampling equipment was cleaned with detergent, tap water and then de-ionised water prior to sampling and between sampling events to prevent cross contamination. New gloves were reportedly used for each new sample. Decontamination of augers between locations was not explicitly reported. *Groundwater*: Dedicated sampling equipment was used for each well. New gloves were reportedly used for each new sample. *Soil Vapour:* No specific detail has been provided regarding decontamination, however discussion has been provided regarding dedicated sorbent tubes and storage containers and that the sorbent tubes have been analysed and certified as clean prior to sampling.	Acceptable
Sample handling and containers Samples were placed into prepared and preserved sampling containers provided by the laboratory and chilled during storage and subsequent transport to the labs. Samples for asbestos analysis were placed in plastic zip-lock bags (50 g samples). DP did not indicate whether groundwater samples analysed for heavy metals were field filtered. Soil vapour samples were collected in Summa canisters or carbon tubes provided by the analytical laboratory. Canister pressures received on return to the laboratory were within acceptable limits.	Acceptable
Chain of Custody (COC) Completed COC forms were provided in the report.	Acceptable
Detailed description of field screening protocols *Soil:* Field screening for volatiles was undertaken using a PID. Soil sub-samples were placed in ziplock plastic bags and the headspace measured for VOCs after allowing time for equilibration. Kitagawa Tubes were also used to assess for the likely presence of tetrachloroethene (PCE). *Groundwater:* Field parameters were measured during well sampling and development. The groundwater level and presence of PSH were measured using an interface meter. *Soil vapour:* No field screening protocols were reported by DP however the field documentation provides PID reading results prior to applying IPA.	Acceptable
Calibration of field equipment The reports indicated that calibration had been undertaken prior to use and checks were performed during use. Calibration certificates from the equipment supplier were not provided for all equipment however a calibration certificate for the water quality meter was provided by DP.	Acceptable
Sampling logs Soil logs are provided within the report, indicating sample depth, PID readings and lithology. The logs report indications of contamination were found (e.g. hydrocarbon odours).	Acceptable

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Groundwater field sampling records were provided, indicating SWL, field parameters, methodology and observations. Soil vapour field sampling records were provided, including canister pressure, purge time, purge volume, PID readings, weather, pre-start QA and leak testing results.	

Table 6.3: QA/QC – Field and Lab Quality Assurance and Quality Control

Field and Lab QA/QC	Auditor's Opinion
Field quality control samples Soil and groundwater field quality control (QC) samples including trip blanks, trip spikes, rinsate blanks, field intra-laboratory and inter-laboratory duplicates were undertaken. Rinsate blanks were not undertaken during groundwater sampling however were not required since dedicated sampling equipment was used for each location. DP noted that the frequency of total and inter-laboratory replicate soil samples tested is less than the recommended 10% and 5% of the number of primary samples, respectively. However, DP considered that the total number of replicate samples (8% of primary samples) is only slightly below the recommended frequency, and the actual number of samples collected is considered reasonable to assess the consistency of the data. Soil vapour QC included an IPA shroud during the vapour sampling for leak testing and analysis of field duplicates. Only intra-laboratory replicate samples were collected for soil vapour. The use of inter-laboratory replicate samples is not stipulated by *ASTM D7663-12 Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations* which was the referenced methodology adopted for the soil vapour sampling by DP.	Acceptable
Field quality control results The results of field quality control samples were generally within appropriate limits. However, exceedances for relative percent difference calculations (RPDs) were noted for approximately 60% of the intra and inter-laboratory duplicate soil samples, all groundwater duplicate samples and one soil vapour duplicate. RPD exceedances were generally for individual metals and PAHs however one inter-laboratory groundwater duplicate exceeded RPDs for TRH (F1 and F3).	Overall, in the context of the dataset reported, the elevated RPD results are not considered significant and the field quality control results are acceptable.
NATA registered laboratory and NATA endorsed methods Laboratories used included: ALS, Envirolab, and Eurofins | mgt. Laboratory certificates were NATA stamped.	Acceptable
Analytical methods Analytical methods were included in the laboratory test certificates. All laboratories provided brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods (excluding asbestos) for extraction and analysis in accordance with NEPM (2013). Asbestos identification was conducted using polarised light microscopy with dispersion staining by method AS4964-2004 *Method for the Qualitative Identification of Asbestos Bulk Samples*.	The analytical methods are considered acceptable for the purposes of the site audit, noting that the AS4964-2004 is currently the only available method in Australia for analysing asbestos. DOH (2009) and enHealth (2005) state that *"until an alternative analytical technique is developed and validated the AS4964-2004 is recommended for use"*.
Holding times Review of the COCs and laboratory certificates indicate that the holding times had been met. DP also reported that holding times were met.	Acceptable
Practical Quantitation Limits (PQLs) *Soil:* PQLs (except asbestos) were less than the threshold criteria for the contaminants of concern.	*Soil (except asbestos) and Groundwater:* Overall the PQLs are acceptable.

Field and Lab QA/QC	Auditor's Opinion
Asbestos: The NATA approved limit of detection for asbestos in soil was 0.01% w/w. *Groundwater:* PQLs were less than the threshold criteria for the contaminants of concern. *Soil vapour:* PQLs were generally less than the threshold criteria however the PQL of many of the analytes was raised. The PQL for trichloroethene (TCE) was raised above the interim HIL for one sample during the March 2018 sample round. An elevated concentration of PCE was detected in the same sample. Remaining raised PQLs were below threshold criteria.	*Asbestos:* The method adopted was in accordance with NATA, however, was not in accordance with NEPM (2013). *Soil Vapour*: The elevated PQLs were only marginally elevated above the trigger values. In the context of the results reported and stage of the audit (further works are required with respect to soil vapour), these discrepancies are not considered significant.
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory.	Acceptable
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: • Poor spike recovery was obtained for heavy metals in one sample. The sample was re-digested and re-spiked and the poor recovery was confirmed. This was due to the inhomogeneous nature of the element/s in the sample/s and the matrix interferences. However, an acceptable recovery was obtained for the LCS. • The laboratory RPD acceptance criteria was exceeded for individual heavy metals in two samples. Triplicate results were issued under a different laboratory sample number. The RPDs for the duplicate result was accepted (by the laboratory) due to the non-homogenous nature of the sample. • The quality control frequency for mercury was not within specification for ALS.	The slightly poor spike recoveries are not considered to affect the usability of the data as metals were not detected above guidelines in any of the samples analysed. In the context of the dataset reported, the elevated RPDs are not considered significant and the laboratory quality control results are acceptable.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) Predetermined data quality indicators (DQIs) were set for laboratory analyses including blanks, replicates, duplicates, laboratory control samples, matrix spikes, surrogate spikes and internal standards. These were discussed with regard to the five category areas. DP conclude that "*…the QC data is considered to be of sufficient quality to be acceptable for the assessment".*	An assessment of the data quality with respect to the five category areas has been undertaken by the Auditor and is summarised below.

6.1 Auditor's Opinion

In considering the data as a whole the Auditor concludes that:

- The data from the investigations are likely to be representative of the overall soil and groundwater conditions. Soil vapour data collected from groundwater monitoring wells is unlikely to be representative of site conditions.
- The data is considered to be adequately complete.
- There is a high degree of confidence that data is comparable for each sampling and analytical event.
- The primary laboratory provided sufficient information to conclude that data is of sufficient precision.
- There is a high degree of confidence that the data is accurate.

7. ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed the results against Tier 1 criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013). Other guidance has been adopted where NEPM (2013) is not applicable or criteria are not provided. Based on the proposed development (excavation and construction of a train station), the human health criteria for 'commercial/industrial' and ecological criteria appropriate for 'commercial/industrial' were adopted.

7.1 Soil Assessment Criteria

7.1.1 Human Health Assessment Criteria

The Auditor has adopted human health assessment criteria from the following sources:

- NEPM (2013) Health Investigation Levels (HILs) for 'Commercial/Industrial' (HIL D) land use.
- NEPM (2013) Health Screening Levels (HSLs) for 'Commercial/Industrial' (HSL D) land use. The HSLs assumed a sand soil type. Depth to source adopted was <1 m as an initial screen.
- NEPM (2013) Management Limits (MLs) for petroleum hydrocarbons for 'Commercial/Industrial' land use and assuming coarse soil texture.
- The presence/absence of asbestos.
- Friebel & Nadebaum (2011) HSLs for direct contact for all land use categories, and vapour inhalation/direct contact pathways for intrusive maintenance workers.
- USEPA Regional Screening Levels (RSLs) 'Composite Worker Soil' criteria. Online database of assessment criteria that are current as of November 2019. Soil assessment criteria derived for carcinogenic compounds were multiplied by a factor of 10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000 to be consistent with Australia's recommended target cancer risk level. For most chemicals, where a criterion was derived using both non-cancer and cancer toxicity data, the lower criteria was adopted.

7.1.2 Ecological Assessment Criteria

The Auditor has not adopted ecological soil assessment criteria as soil from the site will be excavated to a maximum depth of 28 mbgl and disposed off-site during development of the site. Ecological soil criteria are applicable to depths of 2 mbgl and are therefore not applicable for the remaining natural soil.

7.1.3 Soil Aesthetic Considerations

The Auditor has considered the need for soil remediation based on 'aesthetic' contamination as outlined in *Section 3.6 Aesthetic Considerations* of NEPM (2013) Schedule B1, which acknowledges that there are no chemical-specific numerical aesthetic guidelines. Instead, site assessment requires a balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity.

7.1.4 Imported Fill

Imported fill has been assessed in relation to attributes expected of virgin excavated natural material (VENM). The NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* defines VENM as "*…natural material (such as clay, gravel, sand, soil or rock fines):*

> *'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*
>
> *'that does not contain sulphidic 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 from time to time by a notice in the NSW Government Gazette."*

On this basis, the Auditor considers that for soil to be classified as VENM, the following criteria generally apply:

- Organic compounds (including petroleum hydrocarbons, PAHs, OCPs, PCBs and phenols) should be less than the PQLs.
- Inorganic compounds should be consistent with background concentrations.
- The material should not contain or comprise actual or potential acid sulfate soil.

Imported material, such as excavated natural material (ENM) or mulch, was assessed against the requirements of the applicable resource recovery order (RRO) and resource recovery exemption (RRE) issued by the EPA under clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014*.

7.2 Groundwater Assessment Criteria

7.2.1 Human Health Assessment Criteria

NEPM (2013) HSLs are not appropriate for assessing risks from groundwater to human health at the site due to the potential for direct contact. The Auditor has adopted human health assessment criteria from the following sources to assess risk from direct contact, inhalation and incidental ingestion:

- NHMRC (2011) *National Water Quality Management Strategy, Australian Drinking-Water Guidelines* (ADWG), Version 3.5 Updated August 2018.
- USEPA RSLs Residential Tap Water Criteria. Online database of assessment criteria that are current as of November 2019. Tap water assessment criteria derived for carcinogenic compounds were multiplied by a factor of 10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000 to be consistent with Australia's recommended target cancer risk level. For some chemicals, where a criteria has been derived using both non-cancer and cancer toxicity data, the lower criteria was adopted.
- WHO (2008) *Petroleum Products in Drinking-water. Background document of WHO Guidelines for Drinking-water Quality* (adopted in absence of health-based criteria in WHO (2017) because the taste and odour of petroleum products will in most cases be detectable at concentrations below those of health concern).

7.2.2 Ecological Assessment Criteria

The Auditor has adopted ecological groundwater assessment criteria from the following source:

- 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 (www.waterquality.gov.au/anz-guidelines). Criteria for freshwater and 95% level of protection were adopted.

7.3 Soil Vapour Assessment Criteria

The Auditor has adopted soil vapour assessment criteria from the following sources:

- NEPM (2013) HSLs for 'Commercial/Industrial' land use (HSL D) were adopted. The HSLs assumed a sand soil type.
- NEPM (2013) interim soil vapour HILs for volatile organic chlorinated compounds. Interim HILs for 'Commercial/Industrial' land use (HIL D) were adopted.
- Friebel & Nadebaum (2011) HSLs for TPH, BTEX and naphthalene for intrusive maintenance workers. The HSLs assumed a sand soil type.

The Auditor obtained ambient or indoor air guidelines from the following sources:

- USEPA RSLs 'Composite Worker Ambient Air'. Online database of assessment criteria that are current as of November 2019. Air assessment criteria derived for carcinogenic compounds were multiplied by x10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000 to be consistent with Australia's recommended target cancer risk level. For the majority of

chemicals, where a criterion was derived using both non-cancer and cancer toxicity data, the lower criteria was adopted.

- NSW EPA Approved methods for the modelling and assessment of air pollutants in New South Wales, January 2017 (NSW EPA, 2017).

7.4 Auditor's Opinion

The environmental quality criteria referenced by the Auditor are consistent with those adopted by DP with the exception of the following:

- Safe Work Australia's Workplace Exposure Standards for Airborne Contaminants apply to exposure in the workplace and were considered by DP for reference purposes for assessing the potential for impacts on construction workers. The Exposure Standards are understood to be sourced from the SafeWork Australia, Hazardous Chemical Information System (HCIS)(2018), and comprise:
  - 8-hour time-weighted average (TWA). This provides the time weighted average airborne concentration of a particular substance permitted over an eight-hour working day and a 5-day working week.
  - Short term exposure limit (STEL). This provides a time-weighted maximum average airborne concentration of a particular substance permitted over a 15 minute period.

Given the results obtained, the Auditor considers that these discrepancies do not affect the overall conclusions reached by DP and the Auditor.

8. EVALUATION OF SOIL RESULTS

The IAA reviewed the soil analytical results of investigations undertaken prior to preparation of the RAP. Following the issue of the IAA, DP undertook the OSCI in September 2018 which included the drilling of 30 boreholes, excavation of 12 test pits and installation of nine monitoring wells (combined groundwater and soil vapour). The OSCI locations are shown as Attachment 3, Appendix A. The following sections outline the soil field and analytical results reviewed as part of the IAA and the new data obtained from the OSCI.

8.1 Field Results

Variable filling was encountered to depths of between 0.15 m and 3 mbgl with inclusions of building rubble (concrete, bricks, tile and metal), glass, slag, ash and wood. ACM has also previously been identified in filling that contained building rubble.

Staining and odours were not noted in the PSI and DSI however hydrocarbon odours were observed in filling in one borehole (BH305) drilled for the OSCI between the ground surface and a depth of 2.5 m.

PID results in the OSCI were generally less than 10 ppm, although readings of up to 15 ppm were recorded in the test pits around the former Borehole BH01, and results of 190 ppm to 220 ppm were recorded in samples BH308/0.9-1 m, BH310A/4-4.45 m and BH310A/5.5-5.95 m.

8.2 Analytical Results

Soil samples were analysed for a variety of contaminants as detailed in Tables 8.1 (fill) and 8.2 (natural) and assessed against the environmental quality criteria summarised in Section 7. Soil sampling locations are shown on Attachment 3, Appendix A.

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria (mg/kg)
Asbestos in soil	34	0	<PQL	0 above 0.1 g/kg
Benzene	37	0	<PQL	0 above HSL D (sand 0-1 m) 3
Toluene	37	0	<PQL	0 above HSL D (sand 0-1 m) NL
Ethylbenzene	37	0	<PQL	0 above HSL D (sand 0-1 m) NL
Total Xylenes	37	0	<PQL	0 above HSL D (sand 0-1 m) 230
F1 (TRH C_6–C_{10} minus BTEX)	37	1	39	0 above HSL D (sand 0-1 m) 260 0 above ML 700
F2 (TRH >C_{10}–C_{16} minus naphthalene)	37	0	<PQL	0 above HSL D (sand 0-1 m) NL 0 above ML 1,000
TRH >C_{16}-C_{34}	37	0	<PQL	0 above ML 3,500
TRH >C_{34}-C_{40}	37	0	<PQL	0 above ML 10,000
Naphthalene	38	1	0.1	0 above HSL D (sand 0-1 m) NL
Benzo(a)pyrene	36	30	1.4	-
Benzo(a)pyrene TEQ	36	14	2.1	0 above HIL D 40
Total PAHs	36	33	22	0 above HIL D 4,000
Tetrachloroethene (PCE)	37	1	32[a]	0 above RSL 1,000[b]
Other VOCs	37	0	<PQL	-
Total Phenols	32	0	<PQL	0 above HIL D 240,000
Arsenic	36	8	11	0 above HIL D 3,000
Cadmium	36	7	1	0 above HIL D 900

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria (mg/kg)
Chromium	36	34	12	0 above HIL D 3,600
Copper	36	36	460	0 above HIL D 240,000
Lead	36	36	1,200	0 above HIL D 1,500
Manganese	11	11	170	0 above HIL D 60,000
Mercury	36	27	1.3	0 above HIL D 730
Nickel	36	29	23	0 above HIL D 6,000
Zinc	36	36	710	0 above HIL D 400,000
PCB	33	0	<PQL	0 above HIL D 7
OCP	33	1	1.9*	0 above HIL D
OPP	33	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non-limiting
<PQL Less than the practical quantitation limit
a PCE was detected in fill sample BH01 (0.5-0.95). PCE is a VOC compound historically used in dry-cleaning and as a metal degreasing solvent (NEPM, 2013).
b USEPA Carcinogenic Screening Level (SL) has been adjusted by a factor of 10 to address cancer risk acceptance rates (1:100,000) in Australia.
* OCP detections of Heptachlor and Chlordane in BH01-E1 (1.1-1.2 m).

Table 8.2: Evaluation of Natural Soil Analytical Results – Summary Table

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria (mg/kg)
Asbestos in soil	1	0	<PQL	0 above 0.1 g/kg
Benzene	51	0	<PQL	0 above HSL D (sand 0-1 m) 3
Toluene	51	0	<PQL	0 above HSL D (sand 0-1 m) NL
Ethylbenzene	51	0	<PQL	0 above HSL D (sand 0-1 m) NL
Total Xylenes	51	0	<PQL	0 above HSL D (sand 0-1 m) 230
F1 (TRH C_6–C_{10} minus BTEX)	51	0	<PQL	0 above HSL D (sand 0-1 m) 260 0 above ML 700
F2 (TRH >C_{10}–C_{16} minus naphthalene)	51	0	<PQL	0 above HSL D (sand 0-1 m) NL 0 above ML 1,000
TRH >C_{16}-C_{34}	51	0	<PQL	0 above ML 3,500
TRH >C_{34}-C_{40}	51	0	<PQL	0 above ML 10,000
Naphthalene	64	1	0.2	0 above HSL D (sand 0-1 m) NL
Benzo(a)pyrene	63	2	1.8	-
Benzo(a)pyrene TEQ	63	1	2.6	0 above HIL D 40
Total PAHs	63	2	19	0 above HIL D 4,000
Tetrachloroethene (PCE)	139	1	19[a]	0 above RSL 1,000[b]
Other VOCs	139	0	<PQL	-
Total Phenols	33	0	<PQL	0 above HIL D 240,000

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria (mg/kg)
Arsenic	63	9	15	0 above HIL D 3,000
Cadmium	63	1	0.6	0 above HIL D 900
Chromium	63	44	31	0 above HIL D 3,600
Copper	63	29	47	0 above HIL D 240,000
Lead	63	48	330	0 above HIL D 1,500
Manganese	9	8	190	0 above HIL D 60,000
Mercury	63	1	0.7	0 above HIL D 730
Nickel	63	20	14	0 above HIL D 6,000
Zinc	63	53	350	0 above HIL D 400,000
PCB	38	0	<PQL	0 above HIL D 7
OCP	52	1	0.1*	0 above HIL D
OPP	33	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non-limiting
<PQL Less than the practical quantitation limit
a PCE was detected in fill sample BH01 (1.0-1.45). PCE is a VOC compound historically used in dry-cleaning and as a metal degreasing solvent (NEPM, 2013).
b USEPA Carcinogenic Screening Level (SL) has been adjusted by a factor of 10 to address cancer risk acceptance rates (1:100,000) in Australia.
* OCP detection of Heptachlor in BH203 (0.7-0.8 m).

In reviewing the analytical results, the Auditor notes the following:

- Metals, light fraction TRH, individual PAHs, PCE and OCPs were detected in the fill samples at concentrations below the screening criteria. The fill appears to have been impacted by the historical activities undertaken at the site (Section 4). PCE was also detected in the underlying natural soil at BH01. The source of PCE is likely to be the former laundry/dry cleaner at 87 Botany Road (Lot 2 DP 27454), which is located immediately to the west of the site within the Worksite Area.
- Elevated lead concentrations were detected in fill with a maximum concentration of 1,200 mg/kg. Previous investigation by EI detected elevated lead concentrations up to 2,100 mg/kg. The source of lead could be attributed to inclusions of ash, fly ash, charcoal and coal detected in the fill.
- Asbestos was not detected in the soil samples analysed by DP. However, DP noted the presence of fragments potentially containing asbestos in the fill at TP10.
- Marginal detections of metals, PAHs, PCE and Heptachlor below the screening criteria were detected in some natural soil samples. The source of these contaminants can be attributed to the following:
  - Detections of PAHs in the natural soil in BH01 could be attributed to cross contamination from the overlying fill soil as the sample was obtained directly beneath the fill.
  - Detections of PCE in the natural soil in BH01 could be attributed to the former laundry/dry cleaner at 87 Botany Road. PCE was also detected in the overlying fill at this location, and groundwater in a nearby well.
  - The majority of the metal results are consistent with background concentrations except for lead in BH01 which was above typical background levels (10-40 mg/kg). The source of lead could be attributed to cross contamination from the overlying fill soil as the sample was obtained directly beneath the fill.

8.2.1 Acid Sulfate Soil

A combined 100 fill and natural soil samples obtained during the DSI and OSCI were initially screened (pH_F and pH_{FOX}) at the laboratory prior to thirty seven samples being selected for Chromium Reducible Sulfur Suite analysis. Samples were collected from a range of depths, from both above and below the water table. Nineteen samples obtained from below the water table and from depths of between 4.0 and 8.6 mbgl returned positive results for ASS.

8.3 Auditor's Opinion

In the Auditor's opinion, the soil analytical results are consistent with the site history and field observations. The results indicate the fill to be locally impacted by lead, PCE and ACM, however more widespread contamination from ACM is possible and considered likely. Low level contamination of fill and underlying natural soil was identified, however this was at concentrations less than the assessment criteria.

Remediation of fill material was undertaken and is discussed further in Section 12.

9. EVALUATION OF GROUNDWATER RESULTS

The IAA reviewed the groundwater analytical results for investigations undertaken prior to preparation of the RAP. Following the issue of the IAA, DP undertook the OSCI in September 2018 which included the installation of nine monitoring wells (combined groundwater and soil vapour). The DP OSCI locations are shown on Attachment 3, Appendix A. The following sections outline the groundwater field and analytical results reviewed as part of the IAA and the new data obtained from the OSCI.

9.1 Field Results

DP undertook one GME as part of the DSI and three GMEs during the OSCI. Each GME comprised collection of groundwater samples from all available wells.

No PSH was recorded in any of the groundwater wells.

9.2 Analytical Results

Groundwater samples were collected by DP over four rounds during the DSI and OSCI and analysed for a variety of contaminants as detailed in Table 9.1. The results have been assessed against the environmental quality criteria outlined in Section 7 and are summarised below.

Table 9.1: Summary of Maximum Groundwater Investigation Analytical Results (µg/L)

Analyte	n	Detections	Maximum	n > ANZG (2018) Fresh	n > ADWG/RSL
TRH C_6-C_{10} less BTEX (F1)	19	4	210	-	0 above criteria of 15,000[a]
TRH >C_{10}-C_{16} less naphthalene (F2)	19	0	<PQL	-	-
TRH >C_{16}-C_{34}	19	0	<PQL	-	-
TRH >C_{34}-C_{40}	19	0	<PQL	-	-
Benzene	19	0	<PQL	0 above criteria of 950	0 above criteria of 1
Toluene	19	0	<PQL	0 above criteria of 180	0 above criteria of 800
Ethylbenzene	19	0	<PQL	0 above criteria of 80	0 above criteria of 300
Xylenes	19	0	<PQL	0 above criteria of 75	0 above criteria of 600
Naphthalene	19	0	<PQL	0 above criteria of 16	-
Benzo(a)pyrene	12	0	<PQL	0 above criteria of 0.1	0 above criteria of 0.01
Anthracene	12	0	<PQL	0 above criteria of 0.01	-
Fluoranthene	12	0	<PQL	0 above criteria of 1	-
Phenanthrene	12	1	0.04	0 above criteria of 0.6	-
Total PAHs	12	1	0.04	-	-
Arsenic	12	4	5	0 above criteria of 24	0 above criteria of 10
Cadmium	12	2	0.2	0 above criteria of 0.2	0 above criteria of 2
Chromium	12	3	2	0 above criteria of 3.3	0 above criteria of 50

Analyte	n	Detections	Maximum	n > ANZG (2018) Fresh	n > ADWG/RSL
Copper	12	11	**10**	**10 above criteria of 1.4**	0 above criteria of 2,000
Lead	12	4	**5**	**1 above criteria of 3.4**	0 above criteria of 10
Manganese	3	3	130	0 above criteria of 1,900	0 above criteria of 500
Mercury	12	0	<PQL	0 above criteria of 0.06	0 above criteria of 1
Nickel	12	3	3	0 above criteria of 8	0 above criteria of 20
Zinc	12	12	**310**	**10 above criteria of 8**	-
Chlorodibromomethane	19	1	3	-	0 above criteria of 8.7
Chloroform (Trichloromethane)	19	10	**31**	0 above criteria of 370	**5 above criteria of 3**
PCE	19	1	**150**	**1 above criteria of 70**	**1 above criteria of 50**
1,2,4-trimethylbenzene	19	2	2	0 above criteria of 85	0 above criteria of 56
Other VCHs	19	0	<PQL	0 above criteria	0 above criteria
Aldrin+Dieldrin	19	5	0.058	-	0 above criteria of 0.3
Chlordane	19	2	0.02	0 above criteria of 0.03	0 above criteria of 2
Dieldrin	19	4	**0.058**	**1 above criteria of 0.01[b]**	-
Heptachlor epoxide	19	1	0.012	-	0 above criteria of 0.3
Total OPPs	12	0	<PQL	-	-
Total PCBs	12	0	<PQL	-	-
Total Phenols	12	0	<PQL	0 above criteria of 320	-

n number of samples
- No criteria available/used
<PQL Less than the practical quantitation limit
NL non limiting
Bold Values exceed criteria
a WHO (2008) assessment criteria for TPH aliphatic fraction adjusted by x10 in accordance with NHMRC (2008) recommendations for incidental ingestion of groundwater.
b In the absence of high reliability guidelines, the moderate or low reliability guideline concentration has been adopted.

In assessing the analytical results, the Auditor makes the following observations:

- The groundwater analytical results for the majority of the analytes were below the health and ecological screening criteria.
- Elevated dissolved metals concentrations were detected in the groundwater samples. The DSI concluded that the heavy metals can be attributed to diffuse urban-sourced background levels and are not from a site-specific source. The concentrations of copper, lead and zinc were slightly above the adopted criteria. The OSCI concluded that these results were not considered to be consistent with these metals in groundwater being a persistent issue of concern.

- Low concentrations of OCPs were detected in groundwater samples, generally below criteria, however dieldrin exceeded the low reliability criteria in one sample (MW106A). Although OCPs were detected at low concentrations in two soil samples DP stated that no sources of pesticides were identified and the results are likely to be consistent with groundwater quality in the area.
- An elevated concentration of PCE was detected in groundwater sample MW05 located close to the western site boundary, near the former laundry/dry cleaner at 87 Botany Road. PCE was also detected in the fill and natural soil in the vicinity of this monitoring well. Groundwater from this well also contained a chloroform concentration above the ADWG screening criteria.
- Concentrations of PCE breakdown products (TCE, cis-1,2-dichloroethene, trans-1,2-dichloroethene and vinyl chloride) were less than the detection limit.
- The DSI concluded that the source of VOCs was from the former use of 87 Botany Road as a laundry/dry cleaner. VOCs in soil and groundwater may pose a risk to site receptors and will require further assessment.
- Concentrations of 1,2,4-trimethylbenzene were recorded in two samples however results were well below drinking water human health criteria.
- Chloroform and dibromochloromethane concentrations were detected in several groundwater samples. Both are trihalomethanes and when combined the results were less than the ADWG criteria. DP indicated that the recorded concentrations of trihalomethanes are not considered to be an issue of concern, and the lower recorded concentrations are likely to be generally consistent with groundwater quality in the area of the site.
- Concentrations of TRH C_6-C_{10} less BTEX (F1) were recorded in four samples or their duplicates/replicates, with three of the results consistent with concentrations of VOCs also detected in the samples. DP considered that these results did not warrant independent assessment.
- A concentration of Phenanthrene, a PAH, was recorded in one sample below the adopted criteria. This result was recorded in the duplicate/replicate sample and no PAHs were reported in the primary sample. DP concluded that the result did not appear to be repeatable or characteristic of the site.
- The DSI concluded that the potential on-site sources will be removed during site works and that groundwater treatment requirements should be considered for groundwater disposal.

9.3 Auditor's Opinion

In the Auditor's opinion, the groundwater analytical results indicate that groundwater at the site has been impacted from the historical on-site and off-site land use. The station will require a tanked excavation which is likely to limit ingress of contaminants onto the site. Further assessment will be required to demonstrate that contamination associated with the offsite source is not migrating onto the site and posing an unacceptable risk to the site receptors.

10. EVALUATION OF SOIL VAPOUR RESULTS

Following the issue of the IAA, DP undertook the OSCI in September 2018 which included the installation of nine monitoring wells (combined groundwater and soil vapour). The DP OSCI locations are shown on Attachment 3, Appendix A. The following sections outline the soil vapour field and analytical results.

10.1 Field Results

The nine DP monitoring wells were installed to varying depths and included six deep monitoring wells installed to the top of the underlying bedrock and three shallow wells installed to the top of the underlying natural clay.

Soil vapour sampling was undertaken over three rounds by DP between March and July 2018. No odours were noted during the sampling events. Kitagawa Tube screening results for PCE were all less than the detection limit in the samples screened. DP indicated that the detection range for PCE using the Kitagawa tubes can vary (2.1 to 300 ppm) depending on the tube type used and the number of pump strokes of air pulled through the tube.

DP noted that some damage to the at/above ground portion of the wells was observed during the May and July 2018 monitoring rounds, and it is possible that some damage had been sustained to the below ground portion of the well, including the bentonite seal which could have impacted the results. DP indicated that all IPA results from the July 2018 SVME were below the PQL, and IPA results from all sampling events were significantly less than 10% (maximum result was 0.1%) of the recorded shroud IPA concentrations, indicating the well integrity was acceptable for all samples collected.

10.2 Analytical Results

The soil vapour samples collected by DP were analysed for a variety of contaminants as detailed in Table 10.1. The results have been assessed against the environmental quality criteria outlined in Section 7 and are summarised below.

Table 10.1: Maximum Soil Vapour Results

Chemical of Concern in Soil Vapour	Soil Vapour Screening criteria (mg/m^3)	Maximum Soil Vapour Concentration (mg/m^3)	Exceedances Above Screening Criteria
Benzene	4 (0-<1 m)-130 (8 m+)	0.12 (MW104, 12 July 2018, 8 m)	0 above NEPM (2013) HSL D
Toluene	4,800 (0-<1 m)-84,000 (4-<8 m)	1.1 (MW102A, 12 July 2018, 5 m)	0 above NEPM (2013) HSL D
Ethylbenzene	1,300 (0-<1 m)-53,000 (8 m+)	0.065 (MW102A, 12 July 2018, 5 m)	0 above NEPM (2013) HSL D
Xylene	840 (0-<1 m)-37,000 (8 m+)	0.222 (MW104, 12 July 2018, 8 m)	0 above NEPM (2013) HSL D
Naphthalene	3 (0-<1 m)-150 (8 m+)	<PQL	0 above NEPM (2013) HSL D
Heptane	0.417	0.25 (MW104, 12 July 2018, 8 m)	Residential ambient air criteria from USEPA RSL
Hexane	3.2	1.1 (MW102A, 12 July 2018, 5 m)	n-hexane criteria NSW EPA air pollutants criteria
Chloroform	0.0053	**0.32 (MW106A, 23 May 2018, 5 m)**	**7 above USEPA RSL for worker ambient air. 3 raised PQLs (0.012) above USEPA RSL for worker ambient air**

Chemical of Concern in Soil Vapour	Soil Vapour Screening criteria (mg/m^3)	Maximum Soil Vapour Concentration (mg/m^3)	Exceedances Above Screening Criteria
Trichlorofluoromethane	103	0.86 (MW103, 22 March 2018, 10 m)	NSW EPA air pollutants criteria
Tetrachloroethene (PCE)	8	**30 (MW103, 22 March 2018, 10 m)**	**1 above NEPM (2013) HIL D**
Trichloroethene (TCE)	0.08	0.029 (MW102A, 23 May 2018, 5 m).	0 above NEPM (2013) HIL D. 1 result the PQL was raised above the NEPM (2013) HIL D.
1,1,1-Trichloroethane (1,1,1-TCA)	230	0.059 (MW105, 22 March 2018, 4 m)	0 above NEPM (2013) HIL D. PQL raised for 1 sample however below NEPM (2013) HIL D. 0 above USEPA RSL for worker ambient air.
1,2-Dichloroethane (EDC)	0.0047	0.002 (MW102A, 23 May 2018, 5 m). PQL raised 0.1 for 1 sample (MW103, 22 March 2018, 10 m), 0.017 (2 samples 23 May 2018) and 0.01 (3 samples 12 July 2018).	0 detections above USEPA RSL for worker ambient air. 6 raised PQLs above USEPA RSL for worker ambient air.
Cis-1,2-dichloroethene	0.3	<PQL (0.1)	0 above NEPM (2013) HIL D.
Vinyl chloride	0.1	<PQL (0.06)	0 above NEPM (2013) HIL D.

In assessing the analytical results, the Auditor makes the following observations:

- The majority of the soil vapour concentrations were below the adopted guideline levels.
- A concentration of PCE was detected above the interim HIL criteria at one location (MW103) during the March 2018 sampling event however the well was destroyed prior to being resampled. The PQL for TCE was raised above the interim HIL in the same sample obtained during the March 2018 sampling event.
- Concentrations of PCE, TCE, 1,1,1-TCA and EDC, which are generally associated with dry cleaning, were recorded above the PQLs. PCE was recorded above the PQL in ten of fifteen samples (1 above criteria), TCE in three of fifteen samples (1 sample above criteria), 1,1,1-TCA (1 above criteria) and EDC (6 above criteria) recorded in two of fifteen samples. Generally the detections of VOCs in the deeper wells targeting the clay/shale interface were greater than from the adjacent shallower wells (sand/clay interface).
- Concentrations of Chloroform were detected above the ambient air criteria in six samples with a further three samples having the PQL raised above the criterion.

DP concluded that *"…results indicate that, without remediation, there was a potential risk to human health from VOC contamination under the proposed development. The results were consistent with the source of the contamination being the off-site former dry cleaner. The extent of the contamination within the site at concentrations presenting a risk to human health was considered to be limited. The excavation and dewatering required for the construction of the station box is considered appropriate to remove contamination which has already migrated onto the site."*

10.3 Auditor's Opinion

In the Auditor's opinion, the soil vapour analytical results indicate that the site has been impacted from the historical on-site and off-site land uses. Soil vapour samples were collected from groundwater monitoring wells rather than soil vapour specific wells. The analytical results are therefore unlikely to be representative of site conditions.

The Auditor agrees that the tanked excavation required for the construction of the station box is appropriate to remove contamination which has migrated onto the site. However, further assessment will be required to demonstrate that contamination associated with the offsite source is not migrating onto the site and posing an unacceptable risk to the site receptors.

11. EVALUATION OF CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representation of the source, pathway and receptor linkages at a site. DP developed a CSM and used it iteratively throughout the site assessment to inform decisions around investigation and remediation requirements. The CSM was initially developed following the preliminary investigations and included in the RAP and was reviewed by the Auditor in the IAA. Following completion of the OSCI, the CSM was updated by DP. Table 11.1 provides the Auditor's review of the updated CSM presented by DP prior to remediation.

Table 11.1: Review of the Conceptual Site Model

Element of CSM	Consultant	Auditor Opinion
Contaminant source and mechanism	Soil contamination from former industrial land use and imported fill material containing lead, VOC and asbestos. Off-site impacts from previous industries near to the site including the former laundry/dry cleaner, VOC has been detected in groundwater. OCP (heptachlor epoxide) in groundwater recorded above the ANZG.	Source and mechanism for soil considered appropriate, however the source of VOCs is considered to be the former off-site dry cleaner. The source of OCPs in groundwater has not been identified, however is likely to be related to historical use of the site and the wider Worksite Area.
Affected media	Fill material, vapour and groundwater.	Affected media have been identified, however it is noted that natural soil was also impacted by VHCs, PAHs and OCPs.
Receptor identification	Future site users (rail corridor), construction workers (for station box construction), adjacent land users, surface water and groundwater.	The receptors have been appropriately identified. The closest surface water receptor is Sheas Creek located 530 m to the southwest and is therefore unlikely to be impacted by site contamination. Terrestrial ecology at the site has not been listed as a potential receptor given that the entire site has been excavated to approximately 28 mbgl for the station box.
Exposure pathways	Inhalation of dust and vapours, leaching of contaminants and vertical migration to groundwater, lateral migration of groundwater, surface water run-off, ingestion and direct contact with soil, groundwater extraction for dewatering and disposal.	The exposure pathways identified are acceptable, however additional exposure pathways include lateral migration of soil vapour from off-site sources, and ingestion and direct contact with groundwater.
Presence of preferential pathways for contaminant movement	DP noted that the location and distribution of contamination may have been influenced by trenches for buried services, as these trenches may have acted as migratory pathways in the past.	Preferential pathways for groundwater and vapour migration may be present on the site, including current and planned subsurface services. The sump and associated pipes identified in the Worksite Area are likely to be a source and preferential pathway for VOC contamination. Excavation of the site may create preferential pathways for groundwater flow towards the site. The locations of preferential pathways have not been identified.
Potentially complete source-pathway-receptor (SPR) linkages requiring remediation or management	The pre-remediation CSM did not clearly specify potentially complete SPR linkages.	Potentially complete SPR linkages were to be largely addressed during excavation of the station box. Migration of VCHs onto the site in soil vapour and groundwater may result in inhalation, ingestion or dermal contact with construction workers and future site users. Further

Element of CSM	Consultant	Auditor Opinion
		investigation is required regarding the SPR linkage.
Evaluation of data gaps	One off-site source with the potential to impact future site users has been identified, namely VOC contamination associated with a former off-site dry cleaner immediately to the west of the site. Remediation/ management of potential risks from this off-site source to on-site users will be addressed by the Station Box Contractor as part of the station construction works. The specific works required to address this data gap have not been identified. DP have indicated that the potential risk from off-site VOC contamination will be limited by the already constructed secant pile wall, the proposed tanking of the station and the proposed ventilation system (once constructed).	The Auditor agrees with DP that the potential risk from the off-site VOC contamination will be further limited by the already constructed secant pile wall, the proposed tanking of the station, and the station ventilation system (once constructed). Further investigation will be required to demonstrate this.

11.1 Auditor's Opinion

The Auditor is of the opinion that the CSM was a reasonable representation of the contamination at the site prior to remediation during station box excavation.

12. EVALUATION OF REMEDIATION

12.1 Remediation Required

DP determined remedial requirements based on review of investigation results against screening criteria and consideration of aesthetic issues. The RAP considered the horizontal extent of the remediation to be the excavation footprint, and the vertical extent to be the depth of contaminated or potentially contaminated soils, or the base of the excavation (whichever occurs first). DP anticipated that all contaminated or potentially contaminated soils within the excavation footprint will be removed as part of the bulk excavation works required for the development. Excavation and off-site reuse or disposal of the soil was therefore considered in the RAP by DP to be the only practicable remediation strategy.

An evaluation of the RAP was undertaken by the Auditor as part of the IAA (Appendix C), which included a comparison with the checklist included in OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The RAP was found to address the required information, and the Auditor concluded that the remediation approach was adequate to address contaminated fill material during redevelopment of the site through excavation and off-site disposal of contaminated fill material and natural soil and successful validation.

In summary, remediation and validation works included:

- Excavation and off-site disposal of fill materials containing asbestos.
- Assessment of imported materials to be used during construction (and then disposed off-site).
- Excavation and off-site disposal of remaining fill material and underlying natural soils/rock until bulk excavation depths achieved.

12.2 Remedial Works Undertaken

General excavation was carried out by State Roads Construction (SRC) who supplied the operator and equipment. The management of SRC was carried out by JHCPBG JV. Asbestos removal, monitoring and load out of all asbestos impacted material was undertaken by ASP Australia under the Supervision of Leon Johnstone (licence number AD210968). ASP Australia were operating under sub-contract through Delta Group Pty Ltd. Environmental consulting was provided by DP between February 2018 and July 2019.

Following the demolition of site buildings and structures the following sequence of remediation/bulk earthworks were undertaken:

- The fill material which had been previously preliminarily classified as restricted solid waste – special waste (asbestos) and general solid waste – special waste (asbestos) were excavated and disposed off-site.
- The Validation Report indicates that asbestos containing fill materials were moved between different site areas following excavation to make way for archaeological works. DP indicated that it was understood that geofabric was placed on the bare soils on site and the asbestos impacted material was placed on the geofabric before being disposed off-site.
- Materials for construction activities were imported to the site. All of the imported materials were subsequently classified for off-site disposal purposes by DP and others and, following completion of use on site, were disposed of off-site to licensed facilities.
- Remaining fill materials were excavated and disposed off-site in accordance with their assigned waste classification.
- Natural soils containing ASS were excavated and treated/managed prior to off-site disposal.
- VOC impacted natural material was then excavated and disposed off-site.

- Remaining natural soils and bedrock were excavated to the required development excavation depth.

12.3 Validation Activities

12.3.1 Asbestos Clearances

The Validation Report indicates that asbestos clearances were provided (by others) following removal of materials containing asbestos. Documentation provided in the Validation Report included asbestos clearance documentation prepared by WSP and Hibbs which appear to be documenting asbestos clearance for exposed surface soils following removal of concrete slabs, concrete slabs returned to the site from the receiving facility and two areas of excavated soil.

12.3.2 VOC Screening Trench

A trench was excavated along the site boundary in the identified VOC Area of Concern associated with the adjacent off-site former dry cleaner. DP defined the area of concern as:

- Soil to 1 m into clay: 15 m either side of the boundary between the site and the former off-site dry cleaner and 15 m into the site (i.e., approximately 40 m north-south by 15 m east-west)
- Soil to 1 m into clay: to be determined based on observations at shallower depths

The screening was used as part of the finalisation of the VENM assessment of natural soils in the VOC Area of Concern and to identify the presence of any preferential migration pathways between the former off-site dry cleaner and the site. The screening was undertaken in accordance with a DP waste classification of the natural soils and included PID readings on samples collected in a sealed snap lock bag from each screening location/depth. Selected samples, including any samples with elevated PID readings were also screened using a Kitagawa Tube.

Five rounds of trench screening inspections were undertaken by DP between 24 July 2018 and 16 November 2018. No buried pipes or signs of concern, such as other preferential pathways, staining or odours were observed during the inspection of the trenches. PID and Kitigawa tube readings were undertaken during the excavation with all PID results less than 1 ppm and no positive results recorded in the Kitagawa Tubes (limit of detection of 10 ppm).

12.3.3 Material Disposed Off-Site

Waste materials generated on-site were sampled and classified in accordance with the EPA (2014) *Waste Classification Guidelines*. Sampling from stockpiles of excavated soils and in-situ material was undertaken to characterise and classify the waste materials prior to off-site disposal. 361,307 tonnes (t) of waste material was disposed off-site including the following waste types:

- General Solid Waste (non-putrescible) (GSW)
- GSW Special Waste (Asbestos)
- Restricted Solid Waste (non-putrescible) (RSW)
- RSW Special Waste (Asbestos)
- Virgin Excavated Natural Material (VENM)

Waste materials (including VENM) were disposed from the site between December 2017 and May 2019. DP included supporting documentation from the contractors including waste disposal dockets, tipping information and registers for receival sites.

The Auditor has reviewed the documentation provided and is of the opinion that the supplied documentation is consistent with the remedial works described. Further assessment of the waste classifications and disposal quantities is provided in Section 15.5.

12.3.4 Imported Material

The Validation Report indicates that approximately 2,580 m^3 of material was temporarily imported to the site to allow for construction activities that formed part of the excavation works. The materials imported are summarised in Table 12.1.

Table 12.1: Imported Material

Source	Volume imported (m^3)	Material Type	Supporting Documentation
WestConnex Stage 2 Project extending from the King Georges Road interchange on the existing M5 East Motorway at Beverly Hills, to St Peters	900 to 1,100	Grey crushed sandstone with some sandstone cobbles with trace metal fibres	The WestConnex Stage 2 tunnel spoil exemption 2017
WestConnex Stage 1B Project extending from the Homebush Bay Interchange to the Parramatta Road and Wattle Street Interchange	770	Grey crushed sandstone with some sandstone cobbles	The WestConnex Stage 1B tunnel spoil exemption 2016
Boral Recycling	5 to 10	Light grey aggregate gravel with traces of plastic and root fibres	Documentation classifying the material under the *Protection of the Environment Operations Act 1997* (POEO Act) were not provided, supply dockets from Boral for geotechnical testing of the material as 'Unbound Base'.
Boral Recycling	200 to 290	Sandy gravel	Documentation classifying the material under the POEO Act were not provided, supply dockets from Boral for geotechnical testing of the material as 'Unbound Base'

All of the imported materials were subsequently classified for off-site disposal purposes by DP and others and, following completion of use on site, were disposed of off-site to licensed facilities. The off-site disposal of these imported materials is discussed in Section 15.4.

The Auditor notes that the sampling of the sandy gravel material sourced from Boral recycling prior to removal from site identified elevated concentrations of PCB compound arochlor 1254, with a maximum concentration of 2.4 mg/kg. DP indicated that the material was understood to have been placed over imported sandstone for the initial piling pad in the southern portion of the site. Geofabric was placed between the piling pad and the underlying soils. The presence of PCBs would deem the material non-compliant with the NSW EPA Resource Recovery Order (RRO) for recovered aggregates (2014). The source of the PCBs was considered to be the imported material given that PCBs were not identified in fill or natural soil during site investigations, and a source of PCB was not identified on the site. During removal of all materials at the site it is understood that JHCPBG JV implemented an over-excavation policy to reduce the risk of cross contamination.

12.4 Auditor's Opinion

In the Auditors' opinion, the excavation works were appropriate to remediate onsite contamination.

The adjacent off-site VOC contamination source requires further investigation and/or remediation. The Auditor notes that the potential risk from the off-site VOC contamination will be further limited by the already constructed secant pile wall, the proposed tanking of the station, and the station ventilation system (once constructed). However, further assessment will be required to demonstrate that off-site impact is not migrating onto the site.

13. CONTAMINATION MIGRATION POTENTIAL

Based on the remediation/excavation works outlined in the Validation Report it is considered that all on-site sources of contamination have been removed during remediation/excavation works.

One off-site source with the potential to impact future site users has been identified, namely VOC contamination associated with a former off-site dry cleaner within the 'Worksite Area' adjacent to the station box construction (immediately to the west of the site). Previous investigations identified VOC contamination in soil, groundwater and soil vapour at the site. PCE was recorded in one groundwater sample, from Well MW05 adjacent to the off-site dry cleaner, and was at a concentration above the ANZG. PCE and TCE were recorded in soil vapour samples from various locations across the site, with results above the Interim Health-based Investigation Level recorded in Well MW103 located onsite in the area adjacent to the former off-site dry cleaner.

The potential for migration of VOC impacted groundwater and soil vapour will be limited by the secant pile wall and the proposed tanking of the station. Further assessment will be required to demonstrate that off-site impact is not migrating onto the site.

14. ASSESSMENT OF RISK

14.1 Post-Remediation CSM

DP indicated that an area of environmental concern (AEC) remains present to the west of the central portion of the site due to the potential for ongoing VOC impacts associated with the former dry cleaner. This AEC forms part of the Worksite Area and DP indicated that it presents a potential risk to the site as a source of contaminated groundwater and soil vapours which could migrate to the station box.

DP provided the following post-remediation CSM

- *Source:* Off-site VOC contamination (groundwater and soil vapour) (former dry cleaner).
- *Pathway:* Inhalation of vapours.
- *Receptors:* Future site users.

DP indicated that the potential SPR linkage from the off-site source is to be addressed by the Station Box Contractor during station construction.

The Auditors notes that direct contact and incidental ingestion are potential pathways that will also requires assessment.

14.2 Assessment of Risk

Based on assessment of results against relevant guidelines and consideration of the overall investigations and remediation performed, the Auditor considers that contaminant concentrations remaining onsite are not considered to pose a risk to site users or the environment under the proposed land use scenario.

One off-site source has the potential to impact future site users, namely from VOC contamination associated with a former off-site dry cleaner immediately to the west of the site. The Auditor notes that the potential risk from the off-site VOC source will be limited by the secant pile wall, the proposed tanking of the station, and the station ventilation system (once constructed). Further assessment will be required to demonstrate that off-site impact is not migrating onto the site and posing an unacceptable risk to site receptors.

15. COMPLIANCE WITH REGULATORY GUIDELINES AND DIRECTIONS

15.1 General

The Auditor has used guidelines currently made and approved by the EPA under section 105 of the NSW *Contaminated Land Management Act 1997*.

The investigation was generally conducted in accordance with SEPP 55 Planning Guidelines and reported in accordance with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*.

15.2 Development Approvals

A statutory site audit is required for the proposed Waterloo Station development, part of the Sydney Metro rail project between Chatswood and Sydenham, to address the requirements of Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the NSW Minister for Planning on 9 January 2017. Condition E67 relates to contamination and requires a site audit as follows:

> *"If a Site Contamination Report prepared under Condition E66 finds such land contains contamination, a site audit is required to determine the suitability of a site for a specified use. If a site audit is required, a Site Audit Statement and Site Audit Report must be prepared by a NSW EPA Accredited Site Auditor. Contaminated land must not be used for the purpose approved under the terms of this approval until a Site Audit Statement is obtained that declares the land is suitable for that purpose and any conditions on the Site Audit Statement have been complied with.".*

This SAR and accompanying Site Audit Statement (SAS) has been completed in order to partially comply with this condition. Although onsite sources of impact have been removed, an off-site source of contamination has the potential to impact the site and further investigation is required to demonstrate that the risk is low and acceptable.

15.3 Duty to Report

Consideration has been given to the requirements of the EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. Based on the findings of this SAR, the Auditor considers that the site is not required to be notified under the Duty to Report requirements.

15.4 Waste Management

In accordance with Section 4.3.7 of the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme (3rd Edition),* the Auditor has checked the following aspects relating to waste disposal.

15.4.1 Waste Classification

Sixty waste classification letters have been prepared by DP and although they were referenced, were not included within the Validation Report. These were provided separately to the Auditor and were reviewed during the course of the audit. It was reported that wastes were classified in accordance with the NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste*. The adopted waste classification strategy included sampling from stockpiles of excavated soils and in-situ material.

Based on the summary of waste classification reports presented in Table 7 of the Validation Report, the waste classification reports were prepared for the following soils at the site:

- GSW (non - putrescible) for fill material and treated natural soils impacted by ASS.
- GSW (non - putrescible) - Special waste (asbestos waste) for selected fill.
- RSW for natural soils in the vicinity of test pit BH01

- RSW – Special waste (asbestos waste) for stockpiled material excavated from upper 0.2 m in the central portion of the site.

15.4.2 Waste Volumes, Disposal Receipts and Disposal Facilities

The Validation Report provides disposal dockets for the off-site disposal of different wastes which occurred between December 2017 and May 2019. Dockets include materials disposed during demolition and excavation stages of the project. The Validation Report also includes a waste receiving site register and a waste tracking register prepared by JHCPBG JV.

DP report that a total of 361,307 t (including VENM) was removed off-site. JHCPBG JV records indicate that a total of 365,035.77 t was removed off-site. The Auditor has assessed the volumes presented and calculates a similar number to those provided by JHCPBG JV. Based on the volumes presented by DP, it would appear that the construction and demolition wastes included in JHCPBG JV information are not included in the DP calculations. The addition of the construction and demolition waste volumes to the DP calculated total would provide a similar value to the Auditor and JHCPBG JV. This discrepancy is therefore minor and is due to an addition error.

Table 15.1 summarises the waste disposal information for non-VENM materials disposed off-site to several waste management facilities that are licensed to receive the specified waste under their Environmental Protection Licence (EPL).

Table 15.1: Summary of Waste Disposal

Waste Classification	Tonnage (t)	Disposal Facility	EPL No.
GSW (non-putrescible)	93	Bingo Recycling (Banksmeadow)	12857
GSW (non-putrescible)	3,456.38	MET recycling (Silverwater)	20948
GSW (non-putrescible)	31,171.6	Breen Resources Pty Ltd (Kurnell)	4608
GSW (non-putrescible)	45.36	Genesis Dial A Dump (Eastern Creek)	13426
GSW (non-putrescible)	35.58	Boral Recycling Pty Ltd (Wetherill Park)	11815
GSW (non-putrescible)	738.41	Aussie Skips Recycling Pty Ltd (Strathfield South)	20885
GSW (non-putrescible) and Special waste (Asbestos)	4,421.69	Genesis Dial A Dump (Eastern Creek)	13426
GSW (building and demolition waste)	1,064.7	Breen Resources Pty Ltd (Kurnell)	4608
GSW (building and demolition waste)	8.78	MET recycling (Silverwater)	20948
GSW (building and demolition waste)	188.16	Boral Recycling Pty Ltd (Wetherill Park)	11815
GSW (building and demolition waste)	2,362.96	Boral Recycling Pty Ltd (St Peters)	12418
GSW (building and demolition waste)	16	Aussie Skips Recycling Pty Ltd (Strathfield South)	20885
GSW (building and demolition waste)	230.1	Metropolitan Demolitions and Recycling Pty Limited (St Peters)	11483
RSW	1,356.56	Suez (Kemps Creek)	4068

15.4.3 Auditor's Opinion

The Auditor considers that the waste management that was assessed as part of the remedial works was undertaken in accordance with the relevant guidelines and regulations.

15.5 Imported Materials

As detailed in Section 12.3.4, materials other than VENM were imported to the site temporarily to allow for construction activities. The Auditor is of the opinion that the materials imported from the Boral Recycling may not have been compliant with the the NSW EPA RRO for recovered aggregates (2014) which would be required to be met at the source. DP indicated in the Validation Report that these materials were excavated, waste classified and disposed off-site and therefore are no longer present at the site.

15.6 Licenses

Excavation and off-site removal of ACM contaminated soils were required to be conducted by at least a Class B licensed contractor.

DP confirmed that during the initial remediation works all Class B Asbestos removal works was completed by ASP Australia. Copies of the appropriate licences were not provided to the Auditor, however the Auditor undertook a search of the SafeWork NSW asbestos licence database on 24 April 2020 which indicates that ASP Australia are licenced for non-friable asbestos removal works (Licence number: AD210968). This licence information is what was provided on the clearance documentation attached to the Validation Report.

15.7 Conflict of Interest

The Auditor has considered the potential for a conflict of interest in accordance with the requirements of section 3.2.3 of the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*.

The Auditor considers that there are no conflicts of interest, given that:

1. The Auditor is not related to a person by whom any part of the land is owned or occupied.
2. The Auditor does not have a pecuniary interest in any part of the land or any activity carried out on any part of the land.
3. The Auditor has not reviewed any aspect of work carried out by, or a report written by, the site auditor or a person to whom the site auditor is related.

16. CONCLUSIONS AND RECOMMENDATIONS

Based on the results documented in the Validation Report, DP concluded that "*all on-site sources of contamination have been removed. One off-site source with the potential to impact future site users has been identified, namely VOC contamination associated with a former off-site dry cleaner immediately to the west of the site. Remediation/management of potential risks from this off-site source to on-site users will be addressed by the Station Box Contractor as part of the station construction works".* DP also noted that "*the potential risk from the off-site VOC contamination will be further limited by the already constructed secant pile wall, the proposed tanking of the station, and the station ventilation system (once constructed).*"

Based on the information presented in the referenced reports and observations made on site, and following the Decision-making process for assessing urban redevelopment sites in NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, the Auditor concludes that the onsite contamination has been adequately remediated and validated, however an off-site contamination source exists with the potential to impact future site users.

The following management remains necessary before the land is suitable for any specified use or range of uses:

- Development of a plan by a suitably qualified environmental consultant for the assessment of potential soil vapour and groundwater contamination migration onto the site. This may include investigation and remediation of the Worksite Area, sealing of any penetrations through the walls/floor of the tanked basement, assessment of ambient air concentrations within the station box and/or preparation of a human health risk assessment.
- A NSW EPA Accredited Site Auditor be engaged to review the documents prepared and prepare a Section A SAS and SAR assessing the suitability of the site for the intended use.

Groundwater has not been assessed for any beneficial re-use. Any future use of groundwater would require appropriate assessment and regulatory approvals from the NSW Office of Water.

17. OTHER RELEVANT INFORMATION

This Audit was conducted on the behalf of JHCPBG JV to provide an independent review by an EPA Accredited Auditor of what management remains necessary before the land is suitable for any specified use or range of uses i.e. a "Site Audit" as defined in Section 4 (1) (b) (iv) of the CLM Act.

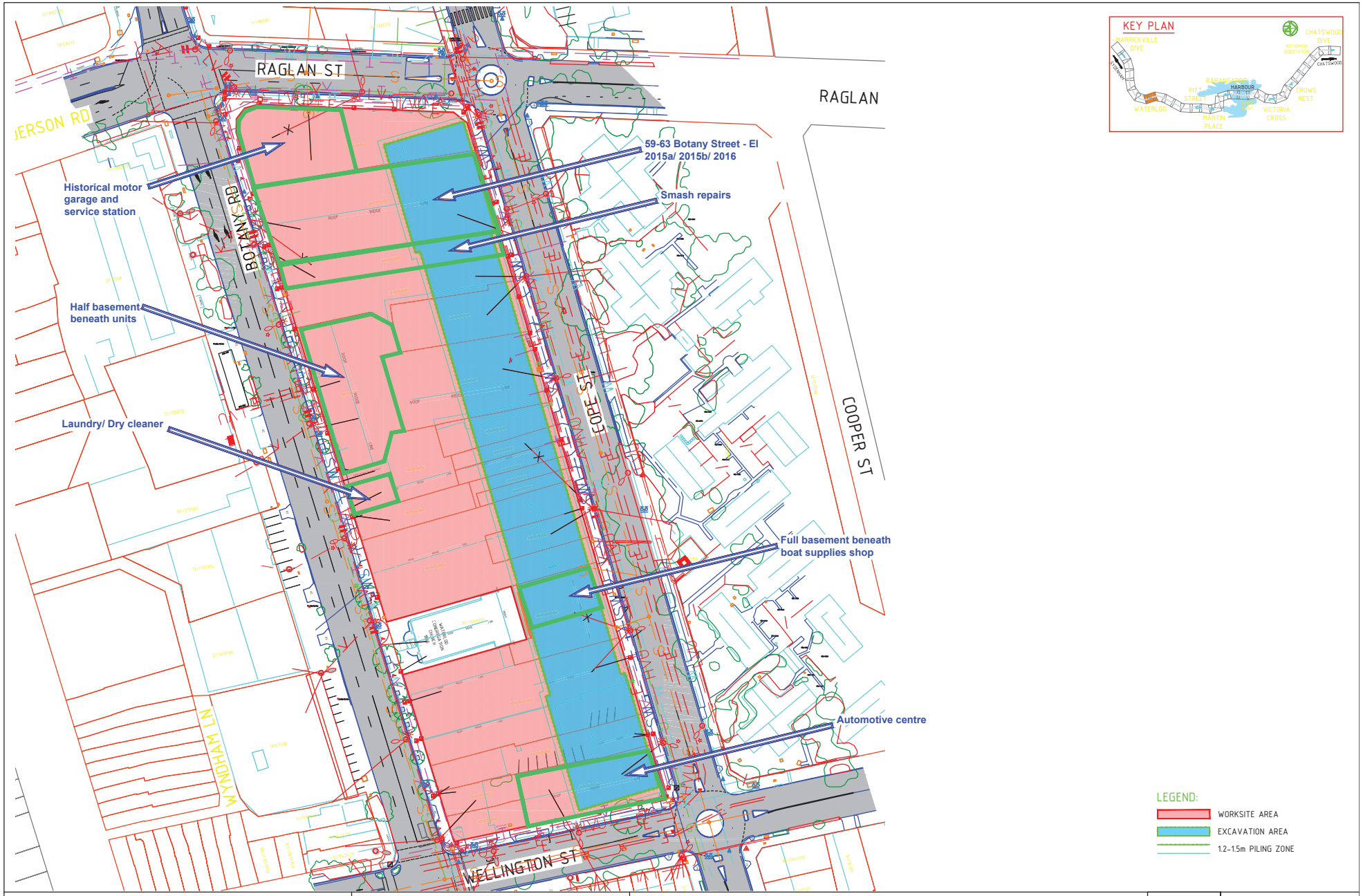
This summary report may not be suitable for other uses. Douglas Partners Pty Ltd included limitations in their reports. The Audit must also be subject to those limitations. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which the Auditor had some control or is reasonably able to check.

The Auditor has relied on the documents referenced in Section 1 of the Site Audit Report in preparing the Auditors' opinion. If the Auditor is unable to rely on any of those documents, the conclusions of the audit could change.

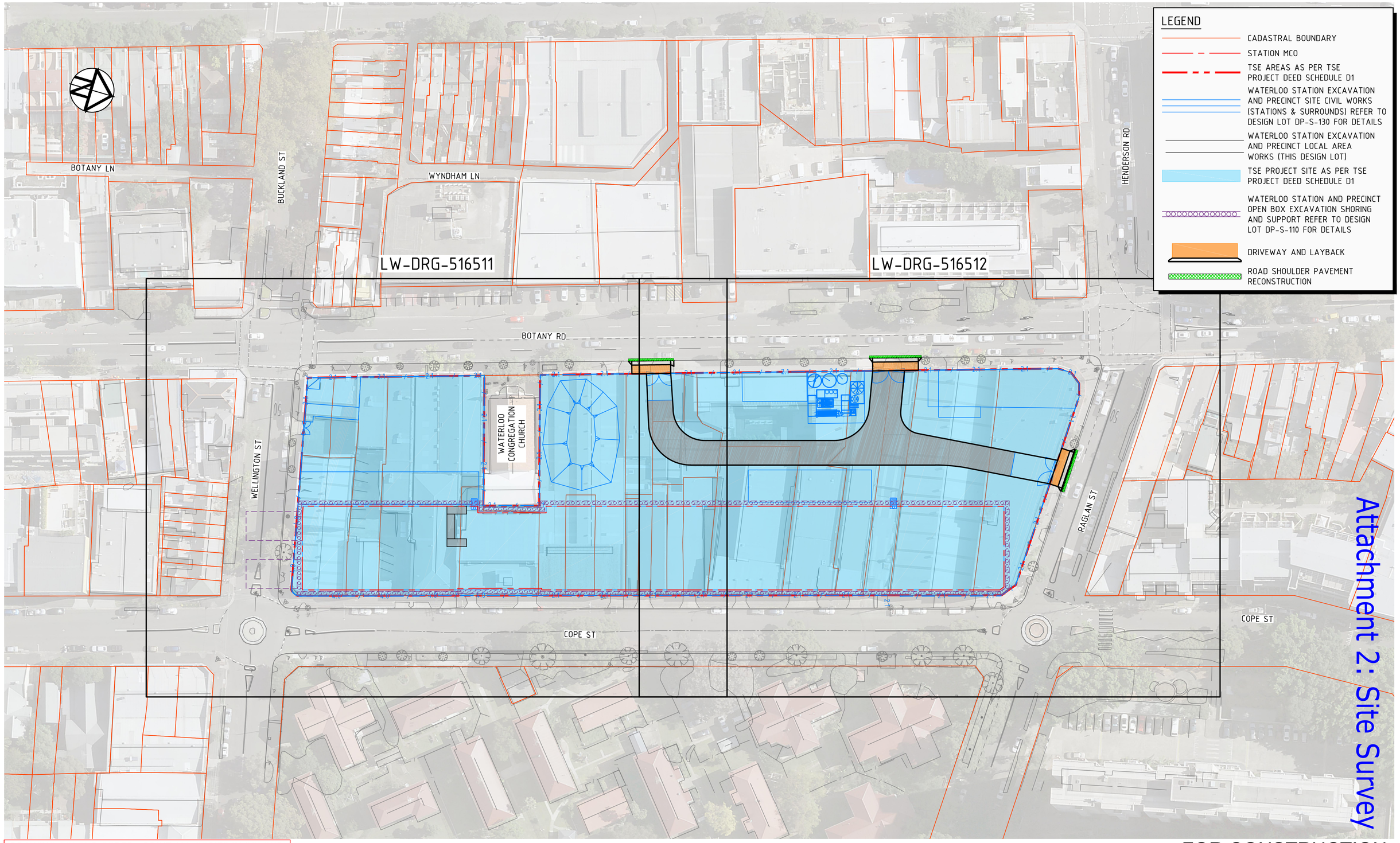
It is not possible in a Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

APPENDIX A
ATTACHMENTS

Attachment 1: Site Location
Attachment 2: Site Survey
Attachment 3: Sampling Locations



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: **Site Locations and Features, Sydney Metro City & South West, Tunnel and Station Works Package, Proposed Waterloo Dive, Botany Rad and Cope Street, WATERLOO**	PROJECT No: 85608.14
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 1
	SCALE: 1:2000 @ A3 / DATE: 10.10.2017		REVISION: 0



Attachment 2: Site Survey

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

FOR CONSTRUCTION

AMD	DESCRIPTION	DESIGNER SIGN./DATE	VERIFIED SIGN./DATE	APPROVED SIGN./DATE
00	ASSURED FOR CONSTRUCTION	CL/07.02.18	DT/07.02.18	DR/07.02.18

CO-ORDINATE SYSTEM: MGA | HEIGHT DATUM: AHD | SCALE: 1:500

SCALES
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SCALE 1:500 AT A1 SIZE

IC CERTIFIED - IC CERTIFICATE SMCSWTSE-IC-CER-B2-024-A

CLIENT
NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: Metro city&southwest, AECOM, CBS, Mott MacDonald, ARCADIS, BG&E, NOVA CONSULTING, HOCHTIEF, PSM, McMULLEN JACOBS ASSOCIATES

DRAWN	F. BATHAN	07.02.18
DESIGNED	C. LEE	07.02.18
DRG CHECK	J. MACADANGDANG	07.02.18
DESIGN CHECK	G. TRIVIC	07.02.18
APPROVED	D. ROBERTSON	07.02.18

SYDNEY METRO CITY & SOUTHWEST
WATERLOO STATION EXCAVATION AND PRECINCT
LOCAL AREA WORKS
OVERVIEW PLAN

FILE No. | SHEET: 6 OF 26 | A1
STATUS: FOR CONSTRUCTION ©
DRG No. SMCSWTSE-JAB-SWL-LW-DRG-516510 | 00 | EDMS No.

DF 801*554

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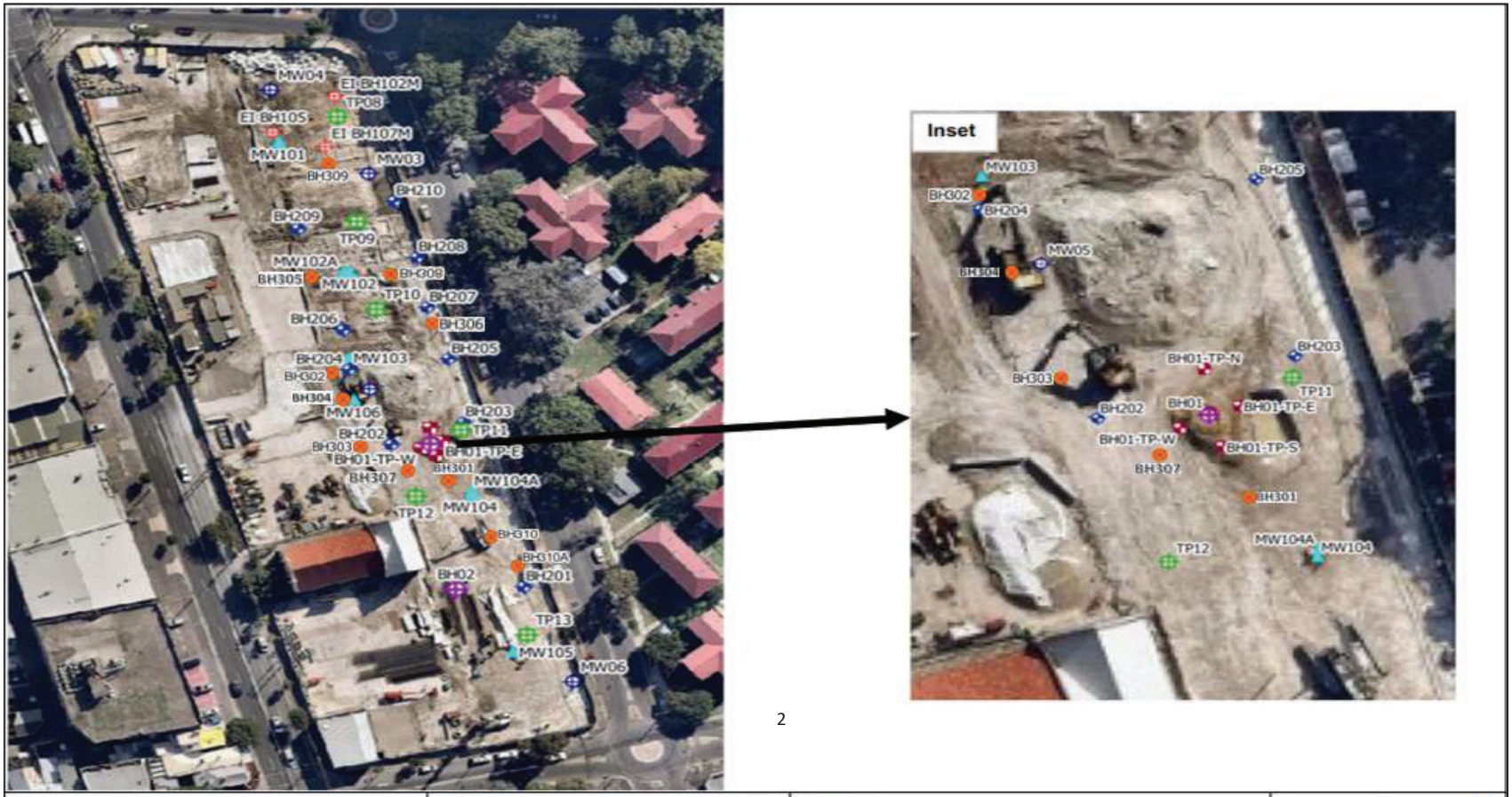
Plotted by DAVID.THOMSON



2

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	Sample Locations	PROJECT No: 85608.14
	OFFICE: Sydney	Sydney Metro City & South West, Tunnel & Station Works Package	DWG No: 3
	DATE: 01.04.20	Botany Rd and Cope St, Waterloo	REVISION: 2

APPENDIX B
SITE AUDIT STATEMENT

NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. TO-024-1

This site audit is a:

☒ statutory audit

☐ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name	Tom Onus
Company	Ramboll Australia Pty Ltd
Address	Level 3, 100 Pacific Highway, North Sydney
	Postcode 2060
Phone	02 9954 8133
Email	tonus@ramboll.com

Site details

Address: 49-67 Botany Road, Waterloo, NSW

Postcode: 2017

Property description

(Attach a separate list if several properties are included in the site audit.)

The site covers an approximate rectangle shape (see figure at end of Part I of this statement). The Lot/Deposited Plan (DP) numbers for the site are as follows:

Part of Lots 4 and 5 DP215751

Part of Lot 1 DP814205

Part of Lots 1 and 2 DP228641

Part of Lot 12 DP399757

Part of Lots A, B, C, D and E DP108312

Part of Lot 1 DP433969

Part of Lot 1 DP738891

Part of Lots 31 and 32 DP805384

Part of Lot A DP408116

Part of Lot 2 DP205942

Local government area: City of Sydney

Area of site (include units, e.g. hectares): Approximately 0.5 ha

Current zoning: B4 Mixed Use

Regulation and notification

To the best of my knowledge:

☐ **the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)

- ☐ Declaration no.
- ☐ Order no.
- ☐ Proposal no.
- ☐ Notice no.

☒ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

☐ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☒ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

Site audit commissioned by

Name: Caitlin Richards

Company: John Holland CPB Ghella Joint Venture

Address: Level 9, 50 Bridge Street, Sydney, NSW

Postcode: 2000

Phone: 0407 176 672

Email: caitlin.richards@sydneymetro2.com.au

Contact details for contact person (if different from above)

Name: Krissy Vajda

Phone: 0439 477 649

Email: krissy.vajda@sydneymetro2.com.au

Nature of statutory requirements (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)

☒ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the Minister for Planning on 9 January 2017

☐ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

☐ Requirements under other legislation (please specify, including date of issue)

Purpose of site audit

☐ **A1** To determine land use suitability

Intended uses of the land:

OR

☐ **A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land:

OR

(Tick all that apply)

☒ **B1** To determine the nature and extent of contamination

☒ **B2** To determine the appropriateness of:

- ☒ an investigation plan
- ☐ a remediation plan
- ☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

- ☐ **voluntary management proposal** or
- ☐ **management order** under the *Contaminated Land Management Act 1997*

☐ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land:

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Douglas Partners Pty Ltd (DP)

Titles of reports reviewed:

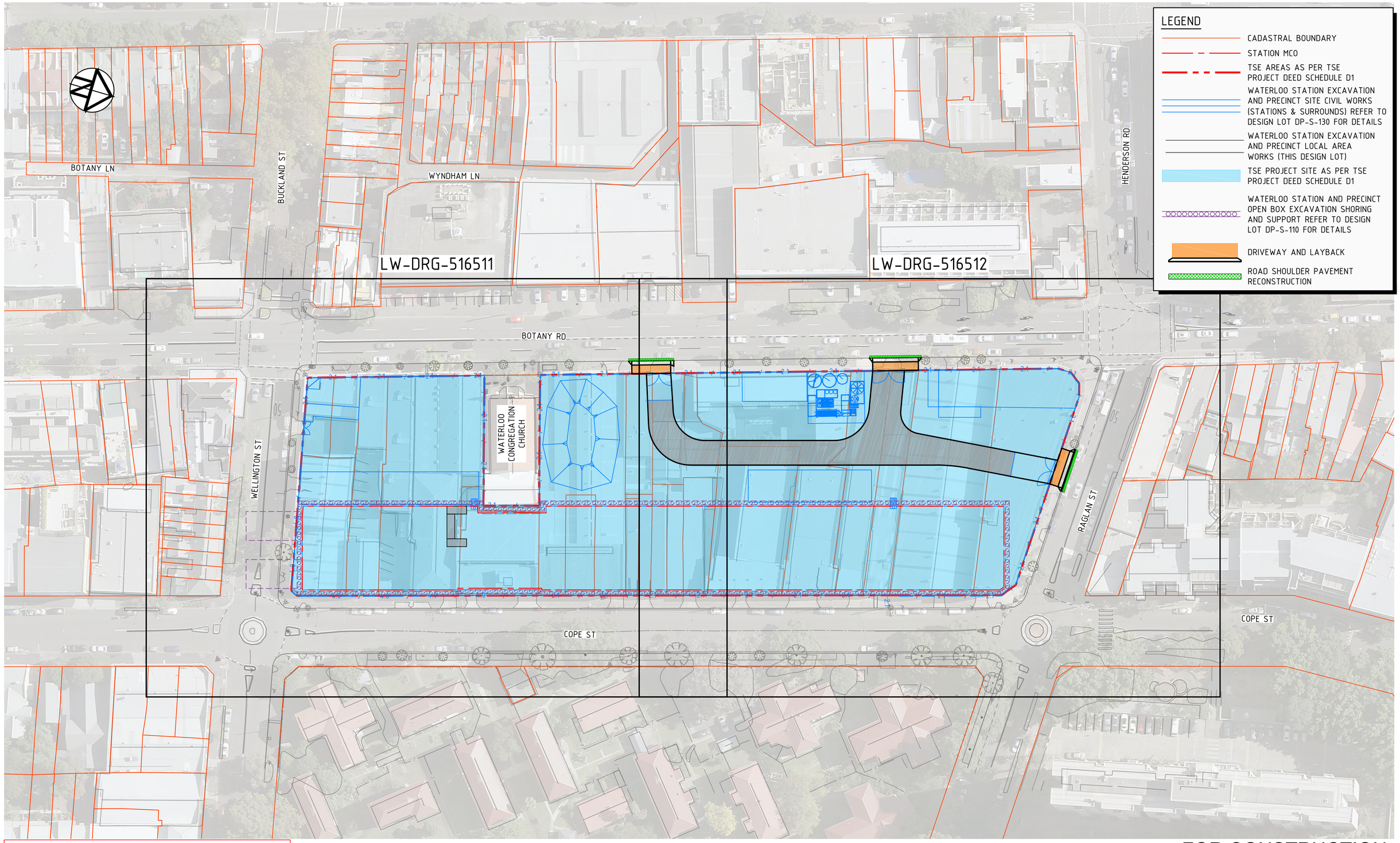
‘Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo’, report reference: Revision 0, dated 8 March 2018, prepared by DP

‘Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo’, report reference: Revision 1, dated 13 March 2018, prepared by DP

‘Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo’, report reference: Revision 0, dated 13 April 2018, prepared by DP
‘Acid Sulphate Soil Management Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo’, report reference: Revision 1, dated 18 June 2018, prepared by DP
‘Factual Report on On-site Supplementary Contamination Investigations, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo’, report reference: Revision 0, dated 19 September 2018, prepared by DP
‘Report on Validation of Remediation, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Sydney Metro City and South West - Waterloo Station, Botany Road, Waterloo, NSW’, report reference: Revision 0, dated 14 May 2020, prepared by DP
Other information reviewed, including previous site audit reports and statements relating to the site:
Approximately 60 waste classification reports prepared by DP for material disposed from the site.

Site audit report details

Title	Site Audit Report – Waterloo Station Box Excavation and Validation, 49-67 Botany Road, Waterloo NSW		
Report no.	TO-024-1 (Ramboll Ref: 318000323-006)	Date	2 June 2020



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FOR CONSTRUCTION

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CO-ORDINATE SYSTEM: MGA | HEIGHT DATUM: AHD | SCALE: 1:500

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

IC CERTIFIED - IC CERTIFICATE SMCSWTSE-IC-CER-B2-024-A

CLIENT
NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: Metro city&southwest, AECOM, CBD, Ghella, ARCADIS, BG&E, NOVA CONSULTING, HOCHTIEF, PSM, McMULLEN JACOBS ASSOCIATES

DRAWN	F. BATHAN	07.02.18
DESIGNED	C. LEE	07.02.18
DRG CHECK	J. MACADANGDANG	07.02.18
DESIGN CHECK	G. TRIVIC	07.02.18
APPROVED	D. ROBERTSON	07.02.18

SYDNEY METRO CITY & SOUTHWEST
WATERLOO STATION EXCAVATION AND PRECINCT
LOCAL AREA WORKS
OVERVIEW PLAN

FILE No. | SHEET: 6 OF 26 | A1
STATUS: FOR CONSTRUCTION ©
DRG No. SMCSWTSE-JAB-SWL-LW-DRG-516510 | 00 | EDMS No.

DF 801*554

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Plot Date & Time 2/7/2018 10:13 AM
Plotted by DAVID.THOMSON

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
    - (B1) the nature and extent of contamination, and/or
    - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
    - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
    - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
    - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

_____

OR

☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

_____

_____

_____

_____

_____

_____

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

EMP details

Title:

Author:

Date: No. of pages:

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

☐ requires operation and/or maintenance of **active** control systems[3]

☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

~~Purpose of the EMP:~~

~~Description of the nature of the residual contamination:~~

~~Summary of the actions required by the EMP:~~

~~How the EMP can reasonably be made to be legally enforceable:~~

~~How there will be appropriate public notification:~~

~~Overall comments:~~

Section B

Purpose of the plan[4] which is the subject of this audit:

Report on validation of remediation to demonstrate that the identified onsite sources of contamination have been remediated to allow construction of the station. Offsite contamination sources will require further assessment and/or remediation in order to make a conclusion on the suitability of the site for the proposed use.

I certify that, in my opinion:

(B1)

☒ The nature and extent of the contamination **has** been appropriately determined

☐ ~~The nature and extent of the contamination **has not** been appropriately determined~~

AND/OR (B2)

☒ The investigation, remediation or management plan **is** appropriate for the purpose stated above

☐ ~~The investigation, remediation or management plan **is not** appropriate for the purpose stated above~~

~~AND/OR (B3)~~

☐ ~~The site testing plan:~~

- ☐ ~~**is** appropriate to determine~~
- ☐ ~~**is not** appropriate to determine~~

~~if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

~~AND/OR (B4)~~

☐ ~~The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):~~

- ☐ ~~**have** been complied with~~
- ☐ ~~**have not** been complied with.~~

~~*voluntary management proposal no.~~

~~**management order no.~~

~~AND/OR (B5)~~

☐ ~~The site **can be made suitable** for the following uses:~~

~~(Tick all appropriate uses and strike out those not applicable.)~~

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

~~☐ Residential, including substantial vegetable garden and poultry~~

~~☐ Residential, including substantial vegetable garden, excluding poultry~~

~~☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~

~~☐ Day care centre, preschool, primary school~~

~~☐ Residential with minimal opportunity for soil access, including units~~

~~☐ Secondary school~~

~~☐ Park, recreational open space, playing field~~

~~☐ Commercial/industrial~~

~~☐ Other (please specify):~~

~~IF the site is remediated/managed* in accordance with the following plan (**attached**):~~

~~*Strike out as appropriate~~

~~Plan title:~~

~~Plan author:~~

~~Plan date: No. of pages:~~

~~SUBJECT to compliance with the following condition(s):~~

Overall comments:

Historical investigations at the site identified lead, volatile organic compounds (VOCs) and asbestos contamination in soils and VOCs in groundwater and soil vapour. The contamination sources are from historic commercial/industrial onsite and offsite land uses including an offsite former dry cleaner. The development (station box) required excavation depths of approximately 28 m. Excavated soils and rock were classified and disposed offsite. The excavation works successfully removed the onsite sources of contamination however contamination associated with the former dry cleaner remains offsite and could present a risk to site users.

The excavation works for the proposed station required the installation of secant pile wall around the perimeter and the construction of a tanked basement. The station construction is also understood to contain a ventilation system. These construction items are likely to limit the potential risk of impacted groundwater and soil vapour migrating onto the site, however further assessment of the onsite ambient air and/or remediation/management of the offsite source will be required in order for the site to be considered suitable for the proposed use.

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. 1505

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed: 

Date: 2 June 2020

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

- the **local council** for the land which is the subject of the audit.

APPENDIX C
INTERIM AUDIT ADVICE

22 May 2018

John Holland CPB Ghella Joint Venture
Attn: Robert Muir
Senior Environment Coordinator
Sydney Metro City & Southwest
Level 3, 140 Sussex Street, Sydney NSW 2000

By email: Robert.Muir@sydneymetro2.com.au

Dear Robert

Ramboll Australia Pty Ltd
Level 3, 100 Pacific Highway
PO Box 560
North Sydney NSW 2060

T +61 2 9954 8100
www.ramboll.com

Ref 318000323-006

RE: INTERIM AUDIT ADVICE LETTER NO. 5 - REMEDIATION ACTION PLAN, WATERLOO STATION, BOTANY ROAD AND COPE STREET, WATERLOO, NSW

1. INTRODUCTION

As a NSW Environment Protection Authority (EPA) accredited Contaminated Sites Auditor, I am conducting an Audit in relation to the subject site. This initial review has been undertaken to provide an independent review of the suitability and appropriateness of a Remediation Action Plan (RAP).

A statutory site audit is required for the proposed Waterloo Station development, part of the Sydney Metro rail project between Chatswood and Sydenham, to address the requirements of *Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the Minister for Planning on 9 January 2017*. This Interim Audit Advice (IAA) letter was also prepared to satisfy conditions of the deed agreed between Transport for NSW and John Holland CPB Ghella Joint Venture (JHCPBG JV).

This IAA letter is based on a review of the documents listed below and observations made on a site visit on 6 March 2018, as well as discussions with JHCPBGJV and Douglas Partners Pty Ltd (DP) who undertook the investigations.

The reports reviewed were:

- *'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo, prepared for John Holland CPB Ghella JV, Project 85608.14, March 2018'*, report reference: Revision 0, dated 8 March 2018, prepared by DP (the PSI).
- *'Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo*

Station, Botany Road and Cope Street, Waterloo, prepared for John Holland CPB Ghella JV, Project 85608.14, March 2018', report reference: Revision 1, dated 13 March 2018, prepared by DP (the DSI).

- *'Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo, prepared for John Holland CPB Ghella JV, Project 85608.14, April 2018'*, report reference: Revision 0, dated 13 April 2018 prepared by DP (the RAP).

Draft versions of the PSI, DSI and RAP reports were issued for audit review. Review comments (issued by the Auditor by email) were incorporated into the final DP reports (listed above). The PSI makes reference to three previous reports by Environmental Investigations Australia Pty Ltd (EI) prepared for 59-63 Botany Road (north part of the site). The reports included a RAP which was reviewed by Mr Mike Nash (NSW EPA Auditor) of DP. The PSI stated that the audit was terminated and remediation was not undertaken. The reports were not provided to the Auditor for review, however a summary of relevant information from these reports was included in the DP reports.

The RAP summarised a hydrogeological interpretive report prepared by Pells Sullivan Meynink Pty Ltd (PSM) (dated 19 March 2018), which was prepared to model the groundwater inflows into the Sydney Metro excavations. This report was not reviewed by the Auditor.

2. SITE DETAILS

2.1 Location

The site is identified as the '*excavation footprint'* (the site) for the station shown on Attachment 1. The '*Worksite Area*' shown on Attachment 1 surrounding the '*excavation footprint'* has been excluded from the DP investigations and is not part of the site audit area.

The site details are as follows:

Street address:	49-57, 59-63, 65, 67, 93-101, and 107-117A Botany Road, Waterloo, NSW 2017 124-128, 130-134, 136-144, 156-160, and 170-174 Cope Street, Waterloo, NSW 2017
Identifier:	Part of Lots 4 and 5 DP215751 Part of Lot 1 DP814205 Part of Lots 1 and 2 DP228641 Part of Lot 12 DP399757 Part of Lots A, C, D and E DP108312 Part of Lot 1 DP433969 Part of Lot 1 DP738891 Part of Lots 31 and 32 DP805384 Part of Lot A DP408116 Part of Lot 2 DP205942
Local Government:	City of Sydney
Owner:	Transport for New South Wales
Site Area:	Approximately 0.5 ha
Zoning:	B4 – Mixed Use

2.2 Site Condition

DP inspected the site for the PSI on 22 September 2017 and noted the following:

- The site was occupied by various commercial properties including an automotive centre and smash repairers. A sump and bund were located in the automotive centre used for the collection of fuels and oil. DP noted some staining on the concrete slab.
- Demolition of buildings was underway in some sections. Former basements were observed on Lot 31 DP805384 and SP75492.
- A former laundry/dry cleaner was located on 87 Botany Road (Lot 2 DP27454). At the time of the inspection, the majority of the building had been demolished. An old washers/dryers store and paper works were noted adjacent to the west of the site.
- The site was surrounded by Raglan Street (north), Wellington Street (south), Cope Street (east) and Botany Road (west). The landuse beyond the site was mainly commercial/high-density residential.

During the Auditors site visit on 6 March 2018, the site was an active construction site, with the following features noted:

- The majority of the site surface had been cleared of slabs and pavements. Exposed soil was visible over the majority of the site. Localised excavations associated with an ongoing archaeological survey were evident.
- Imported material (DGB and ENM) had been placed on the surface in the south section for the construction of temporary piling platforms. Some of the material had been stockpiled in the south section. A relatively long trench pit was being excavated along the southeast boundary for piling preparation works.
- A church was located offsite in the Worksite Area (Attachment 1). Sewer line diversions were being undertaken along the church boundary.
- Temporary/demountable sheds were located offsite in the Worksite Area. The area surrounding the sheds had been filled with recycled aggregate (crushed concrete, terracotta and brick).
- A building associated with the former site use remained in the Worksite Area to the southwest of the site. The building was being used as an office during redevelopment of the site.
- A former sump was exposed at the location of the former dry cleaner, located to the west of the site within the Worksite Area (Attachment 1). The sump contained waste water, with inlets and outlets at the eastern and western sides of the sump.
- A large stockpile of fill soil was located in the north section awaiting disposal.

2.3 Adjacent Uses

The site is located within an area of mixed landuse including commercial and high density residential. The surrounding site use includes:

North: Raglan Street and high rise mixed-use building beyond.

East: Cope Street and multi-level residential buildings beyond.

South: Wellington Street, commercial and residential buildings located further to the south.

West: the Worksite Area, Botany Road and commercial buildings located further to the west.

The site is in a relatively flat area of Waterloo with slopes to the west. DP identified the closest sensitive ecological receptor for groundwater as Sheas Creek located approximately 530 m to the southwest which drains into Alexandra Canal and Cooks River. Cooks River drains into Botany Bay located approximately 6 km further to the south of the site. The site is located in the Botany Sand Aquifer

Embargo zone where the abstraction of groundwater for domestic use is banned due to historical regional contamination of the aquifer from industry.

The PSI identified a number of commercial/industrial landuses within close proximity (100 m) including former battery manufacturers, metal workers, coppersmith, printers, blacksmiths, steam engineers, service stations, dry cleaners, electrical equipment manufacturing, boiler makers, and motor garages. The business directory search identified that the majority of these facilities were operational in the 1950's to 1970's. A former dry cleaner was located within the Worksite Area to the west of the subject site.

A search of the NSW EPA public records did not have any sites listed as contaminated in the immediate vicinity of the subject site.

2.4 Proposed Development

The proposed development comprises a new below ground station building, access road, substation and upgrades to pedestrian access. The depth of excavation is approximately 28 metres below ground level (mbgl) (Attachment 2) with localised deeper excavation for a stormwater sump. The base of the structure will comprise an approximately 125 mm thick concrete slab. The walls will comprise secant pile walls with shotcrete (200 mm) between the piles to a depth of approximately 17 mbgl. The RAP reports that the proposed station will be tanked to minimise groundwater inflow.

For the purposes of this audit, the 'commercial/industrial' land use scenario will be assumed.

3. SITE HISTORY

The PSI site history assessment included a review of historical business listings, historical title deeds, aerial photographs, NSW EPA records, Section 149 (2&5) certificates (now known as Section 10.7 certificates) and NSW Safe Work records. The site history is summarised in Table 3.1.

Table 3.1: Site History

Date	Activity
1900s – 1950	The site was developed and used mainly for residential purposes with some commercial landuse. Cope Street, Raglan Street, Wellington Street and Botany Road were established prior to 1930.
1950s – 2016	The majority of the site was occupied by commercial buildings. The commercial uses included manufacturing of batteries, forging, chemical, mirrors, glass, hospital equipment, plastic, tiles and electrical equipment, metal workers and merchants, motor electricians, motor painters, panel beaters, welders, coppersmith, printers, blacksmiths, steam engineers and boilermakers. DP note that the rooves of many buildings were replaced around 2005.
2016 to date	The site is currently owned and occupied by Transport for NSW. The demolition of previous site structures commenced in 2017.

A review of the SafeWork NSW information did not identify any records for the storage of hazardous chemicals at the site.

DP noted that previous assessments by EI (2015) identified residual contamination on 59-63 Botany Road (Lot 5 DP215751) and recommended site remediation. A RAP was prepared by EI in 2015. It is not known if remediation was undertaken, however is considered unlikely.

A laundry/dry cleaner was located to the west of the site within the Worksite Area.

A review of the NSW EPA public records did not find any notices for the site. Two sites in the immediate vicinity were listed as contaminated to the EPA. They include the former Gas-N-Go service station at 10-20 Botany Road located approximately 141 m northwest and Lawrence Dry Cleaners at 887-893 Bourke Street located approximately 780 m to the east. The former service station has the potential to impact the site, however the dry cleaners is considered to be across gradient of the site and unlikely to be a potential source of impact.

Based on the site location and history, potential contamination could have impacted the site from on-site and/or off-site sources.

3.1 Auditor's Opinion

In the Auditor's opinion, the site history indicates past activities have a high potential for significant contamination. Sources of contamination appear to be associated with commercial/ industrial landuse (including an automotive centre and smash repairer), fill and surface soil imported to achieve site levels, hazardous building materials from demolition of former buildings, and off-site landuse including dry cleaners, motor garages and service stations.

The Auditor considers that the site history is broadly understood and adequate for identification of contaminants of concern (Section 4) and remedial planning (Section 10).

4. CONTAMINANTS OF CONCERN

The PSI and DSI provided a list of the contaminants of concern and potentially contaminating activities. These have been tabulated in Table 4.1.

Table 4.1: Contaminants of Concern

Area (DP Source ID)	Activity	Potential Contaminants
Entire Site	Fill and surface soil imported from unknown sources. Demolition of former buildings containing hazardous materials. Spills and leakage of chemicals associated with historical commercial/ industrial landuse.	Metals, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes & naphthalene (BTEXN), volatile organic compounds (VOCs), volatile chlorinated hydrocarbons (VCH), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCBs), phenols, lead (from paint) and asbestos.
Off-Site Sources	Migration of potential contaminants from off-site sources including the former laundry/dry cleaner (within the Worksite Area), motor garage and service station.	Metals, petroleum hydrocarbons (BTEXN, TPH), PAHs, VCH and phenols.

The RAP stated that based on the DSI results, the main contaminants of concern for remediation include asbestos, VOC, lead and OCP. OCP was detected in groundwater and DP concluded that the potential source was unknown.

4.1 Auditor's Opinion

The Auditor considers that the analyte list used by DP adequately reflects the site history and condition.

5. STRATIGRAPHY AND HYDROGEOLOGY

Following a review of the DP reports, a summary of the site stratigraphy and hydrogeology conditions at the site are compiled below.

5.1 Topography, Geology and Stratigraphy

The PSI states that the site is located in a relatively flat area at approximately 16 m Australian Height Datum (AHD) with slopes to the west and southwest. The site is located within the Aeolian soil landscape underlain by Quaternary age transgressive dunes comprising of marine sand with podsols. DP stated that, considering the depth of excavation for the proposed development, there is a low to moderate risk of encountering acid sulfate soils (ASS) at the site.

The sub-surface profile detailed by DP in the DSI is summarised in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0.0 – 0.35 (maximum)	Concrete pavements/slab.
0.15 – 1.0	Fill material comprising sand, gravel and clay with inclusions of demolition rubble, brick, glass, tile, ash, fly ash, charcoal, coal, wood, concrete and metal. Ash/coal was detected in 3 sampling locations. Potential ACM was detected in test pit WLTP10 between 0.2 mbgl and 0.3 mbgl.
1 – 5.5	Natural sand, clayey sand and silty sand.
5.5 to 7.5	Natural clay (possible residual).

mbgl – metres below ground level

The subsurface profile comprised relatively shallow fill underlain by natural sand and clay soil.

DP report that Hibbs & Associates identified ACM in the north section of the site during demolition works. Hibbs concluded that ACM could have impacted the fill over the entire site.

5.2 Hydrogeology

The PSI undertook a search of the groundwater information database maintained by the NSW Government and identified eight registered groundwater bores within a 0.5 km radius of the site. The majority of the bores were registered for monitoring or recreational use. One bore (GW106192) located approximately 150 m southwest of the site is registered for domestic use. The depth of standing water in the bores ranged from 3.49 m to 11.6 mbgl.

The PSI concluded that based on the topography, groundwater is anticipated to flow to the southwest. DP identified the closest sensitive ecological receptor for groundwater to be Sheas Creek located approximately 530 m to the southwest. The creek drains into Alexandra Canal then to Cooks River and Botany Bay located approximately 6 km to the south of the site. Excess surface water run-off is anticipated to flow into the local stormwater network.

The site is located in the Botany Sand Aquifer Embargo zone where the abstraction of groundwater for domestic use is banned due to historical regional contamination of the aquifer.

As part of the DSI, four groundwater monitoring wells were installed on the site (Attachment 2). Groundwater observations and sampling was undertaken as part of the DSI on 19 December 2017. Depth to groundwater in the monitoring wells was recorded between 3.3 mbgl to 3.7 mbgl. DP did not assess the groundwater flow direction based on measured groundwater elevation. DP assumed that regional groundwater flow was to the southwest based on the topography and closest surface water receptor.

The DSI included field records of groundwater parameters recorded during sampling. They indicated that the pH was 6.51 to 6.68, dissolved oxygen (DO) was 0.48 to 1.08 mg/L, redox was 94 to 108 mV, and electrical conductivity (EC) was 337 to 438 µS/cm.

The RAP includes a summary of the PSM (2018) Hydrogeological Interpretive Report, which modelled the groundwater seepage rates expected during and post construction. Details of the modelling and the results are included in the Hydrogeological Interpretive Report. DP summarised the findings as follows:

- Draw down will occur in the immediate vicinity of the excavation due to vertical leakage through the residual soil of the Botany Sands Aquifer. Considering the high transmissivity of the sand aquifer, drawdown will be relatively flat with a large zone of influence;
- Contaminants are likely to be transmitted rapidly through the Botany Sands Aquifer. Considering that the structure will be tanked (constructed to limit groundwater inflow), the potential for inflow will be minimised.
- Maximum modelled seepage rate during construction (with inflows from faults) was 185 kL/day;
- Modelled steady state seepage rate prior to tanking the station structure was 147 kL/day;
- Water table in the Botany Sands Aquifer was at depths of 3 to 5 m;
- The modelled zone of capture for the first 10 years would extend to approximately 670 m from the site. The actual capture zone will depend on the time lapse between construction and tanking of the final structure; and
- Historical land use (existing and former commercial/ industrial premises in the vicinity, former Gas-N-Go service station, dry cleaners) may have an impact on groundwater quality and potential for contamination migration (TRH, BTEXN, heavy metals and VOCs).

The Auditor has not reviewed the PSM (2018) Hydrogeological Interpretive Report, however considers that the primary long term source of seepage/ inflows is likely to be sandy soil and seepage from Botany Sands Aquifer. This is based on the stratigraphy and hydrogeology encountered during the DSI.

5.3 Auditor's Opinion

The Auditor considers that the site stratigraphy and hydrogeology conditions detailed by DP adequately reflect the site conditions and are sufficient for remediation planning.

6. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

The Auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows in Tables 6.1 and 6.2.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Data Quality Objectives (DQO) The PSI and DSI defined specific DQOs in accordance with the seven step process outlined in Schedule B2 of NEPM (2013).	These were considered appropriate for the investigations conducted.
Sampling pattern and locations *Soil:* The DSI adopted a general grid pattern or systematic sampling plan. Investigation locations were spaced to gain coverage of the majority of the site. The various fill materials at the site were also targeted for sampling. *Groundwater:* Four monitoring wells (WLMW03, WLMW04, WLMW05 and WLMW06) were distributed across the site. WLMW05 was installed along the west excavation boundary close to the former laundry/dry cleaning facility. The DSI stated that WLMW03 was destroyed during demolition works.	In the Auditor's opinion these investigation locations provide adequate site coverage and target the main known areas of concern.
Sampling density *Soil:* The DSI included a sampling density of 12 locations (Attachment 2) over approximately 0.5 ha, which does not meet the minimum density of 13 recommended by EPA (1995) *Sampling Design Guidelines*. The coverage provides a 95% confidence of detecting a residual hot spot of approximately 24 m diameter. Samples analysed for asbestos were not collected in accordance with the density outlined in NEPM (2013). *Groundwater:* Three groundwater samples were obtained from the monitoring wells at the site.	In the Auditor's opinion the sampling density was appropriate to inform the remediation planning process. Considering that the fill from the entire site would be excavated and disposed off-site as part of the development, the sampling adopted by DP is acceptable to give a general indication of the presence/absence of asbestos in soil. The density of groundwater monitoring wells is not adequate to assess the extent and magnitude of groundwater contamination associated with the former dry cleaner. Further investigation is proposed by DP prior to remediation of the site.
Sample depths *Soil:* Samples were collected and analysed from a range of depths targeting the fill and natural sand/clay. The depth intervals ranged from 0.1 m to 7.45 mbgl. *Groundwater*: Groundwater samples were obtained from the standing water level (SWL) depths observed in the monitoring wells during sampling. The depth ranged from approximately 3.3 mbgl to 3.7 mbgl.	In the Auditor's opinion, this sampling strategy was appropriate and adequate to characterise the primary material types present on site. DP RAP recommends additional groundwater testing for VOCs. Groundwater samples should be obtained from depth to assess the potential for dissolved non-aqueous phase liquids (DNAPL) associated with the former dry cleaners.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Well construction The wells were installed from the surface to depths of approximately 6 mbgl to 7 mbgl, and were constructed of 50 mm diameter acid washed, class 18, PVC casing and machine slotted well screen intervals. The top of the screened interval was up to 1.5 mbgl, and therefore the screens of the wells extended above the groundwater table. The wells were completed to assess shallow perched groundwater present in sand.	The Auditor notes that, whilst it is preferable for monitoring wells to be screened over a discrete short vertical interval, the wells are adequate to provide an indication of the shallow groundwater conditions in sand. Deeper groundwater, which is likely to be present in underlying clay, was not assessed. The proposed excavation will extend to a depth of 28 mbgl and is therefore likely to intercept deeper groundwater.
Sample collection method *Soil*: Sample collection was by test pit (6 locations) and solid stem auger drilling (6 locations). Test pit samples were obtained directly from the excavator bucket. Drilling samples were collected from the auger flights, with external material removed prior to collecting the sample or via a SPT split spoon. *Groundwater*: Wells were installed by solid flight augers, developed with a pump and samples were collected by low flow peristaltic pump with dedicated sample tubing.	Sample collection from the auger flights is not ideal as it can result in loss of volatiles and sample cross contamination, although cross contamination was minimised by removing external material. Results for samples collected from solid flight augers may underestimate concentrations of volatile contaminants. Considering that a large portion of samples were from SPT spoon, the overall sample collection method was found to be acceptable. The groundwater sample collection methodology is considered acceptable.
Decontamination procedures *Soil:* Sampling equipment was cleaned with detergent (3% Decon 90 solution), tap water and then de-ionised water prior to sampling and between sampling events to prevent cross contamination. New gloves were reportedly used for each new sample. *Groundwater*: Dedicated sampling equipment was used for each well.	Acceptable.
Sample handling and containers Soil samples were placed into prepared and preserved sampling jars/bottles provided by the laboratory and chilled during storage and subsequent transport to the laboratories. DP report that replicate samples were placed in plastic zip-locked bags for screening for volatile compounds using a PID.	Overall, the field screening protocols were acceptable to assess site contamination in the context of the proposed development.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
The DSI does not mention sampling procedure for asbestos in soil. However, the laboratory reports indicate that asbestos analysis was undertaken on sub-samples from soil jars. Groundwater samples to be analysed for heavy metals were field filtered.	
Chain of Custody (COC) Completed chain of custody forms were provided in the report.	Acceptable.
Detailed description of field screening protocols Field screening for volatiles was undertaken using a calibrated hand held PID unit. The PID screening procedure was provided and involved placing the samples in ziplock plastic bags and measuring VOCs in the headspace after allowing time for equilibration. PID readings are provided on selected borehole logs. PID screening was not undertaken on samples collected by test pit. The DSI reported groundwater quality parameters measured during well sampling in field logs for each well.	Overall, the field screening protocols were acceptable to assess site contamination in the context of the proposed development.
Calibration of field equipment DP report that the PID was calibrated prior to use in the field. Calibration information for the field equipment (PID and groundwater meters) was included in the DSI.	Acceptable.
Sampling logs Soil logs were provided within the DSI, indicating sample depth, PID readings and lithology. The logs reported inclusions in fill (asbestos, ash, fly ash, coal and charcoal) which could pose a contamination risk. Groundwater field sampling records were included in the DSI with well development and sampling details.	Acceptable.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Field quality control samples Field quality control samples including trip blanks (1 per field batch), trip spikes (1 per field batch), rinsate blanks (1 per day), field intra-laboratory and inter-laboratory duplicates (5% of primary samples) were undertaken by DP during the DSI.	Acceptable.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Field quality control results The results of field quality control samples were generally within appropriate limits. The trip blank results were below the laboratory PQL. The trip spike recovery was acceptable. The rinsate blanks reported an elevated TRH C_6-C_{10} concentration (51 µg/L), which DP report was from the demineralised water used. RPDs for the intra-laboratory soil and groundwater duplicate samples for four metals (soil) ranged from 54% to 115% and for two PAHs ranged from 140% to 144%. RPDs for the inter-laboratory soil and groundwater duplicate samples for two metals (soil) ranged from 54% to 57%. The DSI has assessed field duplicate results along with the primary sample results against the site acceptance criteria.	Overall, the field quality control results were found to be acceptable. RPD exceedances were infrequent and minor and do not impact the overall dataset. DP assessed the results for primary samples and field duplicates against the site acceptance criteria which is considered appropriate. The Auditor has adopted the highest concentration from field duplicate and triplicate results. The detections of TRH in the rinsate samples were minor and close to the laboratory detection limits. Evidence that the TRH was from the demineralised water was not provided as not field blanks were analysed. DP assessed the results for primary samples and field duplicates against the site acceptance criteria.
NATA registered laboratory and NATA endorsed methods Laboratories used included: Envirolab Services Pty Ltd (primary) and Eurofins Scientific (secondary). Laboratory certificates were NATA stamped.	Acceptable.
Analytical methods Analytical methods were included in the laboratory test certificates. Both Envirolab and Eurofins provided brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods (excluding asbestos) for extraction and analysis in accordance with the NEPM (2013). Asbestos analysis was based on AS4964-2004.	The analytical methods are considered acceptable for the purposes of the site audit, noting that the AS4964-2004 is currently the only available method in Australia for analysing asbestos. DOH (2009) and enHealth (2005) state that *"until an alternative analytical technique is developed and validated the AS4964-2004 is recommended for use"*.
Holding times Review of the COCs and laboratory certificates indicate that the holding times had been met. DP also reported that holding times have been met.	Acceptable.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Practical Quantitation Limits (PQLs) *Soil:* PQLs for individual PCBs were slightly raised in one soil sample due to interference from analytes other than those being tested. The raised PQLs were below the quality criteria. *Groundwater:* PQLs were within acceptable range.	Overall the PQLs are acceptable. The PQL for asbestos analysis is considered acceptable in the absence of any other validated analytical method.
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory.	Acceptable.
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: • Percentage matrix spike recovery was not possible for individual metals due to high concentrations, the inhomogeneous nature of the compound in the sample and/or interference from analytes. Low recovery was noted for some metals due to matrix interferences. This was considered acceptable as acceptable recovery was reported for the laboratory control samples (LCS). • Some samples sent for asbestos analysis had to be sub-sampled by the laboratory due to the weight of the sample exceeding the recommended 40-50 g (presence/absence) or samples not provided in zip-lock bags. • The laboratory RPD acceptance criteria were exceeded for individual metals. Triplicate result was issued by the laboratory to confirm the metal results exceeding the RPD criteria.	In the context of the dataset reported, the laboratory quality control results are acceptable for remediation planning purposes.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) The DSI assessed the field and laboratory results against predetermined data quality indicators (DQIs) and internal standards. These were discussed with regard to the five category areas. There was limited discussion regarding actions required if data do not meet the expected objectives.	An assessment of the data quality with respect to the five category areas has been undertaken by the Auditor and is summarised below.

In considering the data as a whole the Auditor concludes that:

- The laboratories provided adequate information to conclude that the data are of sufficient precision.
- There is a high degree of confidence that the data are accurate.

- The data are likely to be representative of the overall site conditions, including fill, natural soil and shallow groundwater. Results for volatile organics in soil samples collected by solid stem auger may underestimate actual concentrations. Deep groundwater and soil vapour have not been assessed. Assessment of deep groundwater, and further assessment of shallow groundwater is proposed in the RAP prior to remediation commencing.
- The investigation data are considered to be largely complete. One groundwater monitoring well was destroyed during demolition work, however further groundwater investigation is proposed prior to remediation of the site.
- There is a high degree of confidence that the data are comparable for each sampling and analytical event.

7. ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed **soil** data provided with reference to criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013). Based on the proposed development (excavation and construction of a station), the Tier 1 (screening) criteria for a 'commercial/industrial' setting were referred to.

- Human Health Assessment:
  - Health Based Investigation Levels (HIL D).
  - Soil Health Screening Levels (HSL D) for Vapour Intrusion. The most conservative criteria were adopted i.e. assumed depth to source <1 m and sand.
  - Asbestos presence/absence.
  - USEPA Regional Screening Level (RSL) (November 2017) Composite Worker Soil Criteria for use where HILs are not applicable or where local guidelines are not available for individual VOC contaminants.
- Terrestrial Ecological Assessment (TEA): The soil data has not been assessed against the TEA as soil from the site will be excavated to a maximum depth of 29 mbgl and disposed off-site during development of the site. The TEA is applicable to depths of 2 mbgl and is therefore not applicable for the remaining natural soil.
- Management Limits (ML commercial/industrial) assuming coarse soil.
- Aesthetics
  - The Auditor has considered the need for remediation based on 'aesthetic' contamination as outlined in the NEPM (2013).

The Auditor has assessed the **groundwater** data provided with reference to Tier 1 (screening) criteria for 'commercial/industrial' from the following:

- Human Health Assessment: HSLs are not appropriate for assessing risks from groundwater to human health due to the potential for direct contact. Therefore risk from direct contact, inhalation and incidental ingestion were assessed using:
  - NHMRC and NRMMC (2011) *Australian Drinking Water Guidelines* (ADWG).
  - USEPA RSL (on-line) Residential Tap Water Criteria for use where local guidelines are not available for individual contaminants.

  - WHO (2008) Petroleum Products in Drinking-water guidelines.
  - ADWG (2011) criteria with a factor of 10 for incidental direct contact (for non-volatiles).
- Ecological Assessment:
  - Groundwater Investigation Levels (GILs) listed in NEPM (2013) for protection of aquatic ecosystems referenced in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Trigger values (TVs) provided are concentrations that, if exceeded, indicate a potential environmental problem at the point of use and 'trigger' further investigation. The 95% fresh water level of protection was adopted.

Groundwater monitoring wells were screened across different soil profiles (fill, sand and clay), however are considered to target perched groundwater in sand. The extraction and use of groundwater as a resource at the site is unlikely as the site is within the Botany Sand Aquifer Embargo zone where the abstraction of groundwater for domestic use is banned due to historical regional contamination of the aquifer. The site is in an area which has reticulated water supply from Sydney Water. Therefore assessment of direct contact and consumption of groundwater by nearby residents is not considered to be required.

7.1 Auditor's Opinion

The environmental quality criteria referenced by the Auditor are consistent with those adopted by DP, with the exception of the following:

- The DSI does not mention assessment of 'aesthetic' contamination as outlined in the NEPM (2013). However, the report results discuss potential aesthetic issues detected during sampling.
- The DSI had adopted 'hardness modified trigger values' (HMTV) for the assessment of individual metals in GILs. The hardness conditions of the receiving water body has not been assessed to justify the use of HMTV.

8. EVALUATION OF SOIL ANALYTICAL RESULTS

Soil samples were analysed for a variety of contaminants detailed in Tables 8.1 (fill) and 8.2 (natural). The results have been assessed against the environmental quality criteria and summarised below. Soil sampling locations are presented in Attachment 2.

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table (mg/kg)

Analyte	N	Detections	Maximum	n > Human Health Screening Criteria
Asbestos in soil (presence/absence)	10	0	<PQL	-
Arsenic	11	5	8	0 above HIL D 3,000
Cadmium	11	3	1	0 above HIL D 900
Total Chromium	11	10	12	0 above HIL D 3,600
Copper	11	11	460	0 above HIL D 240,000
Lead	11	11	1,200	0 above HIL D 1,500
Manganese	11	11	170	0 above HIL D 60,000
Mercury (inorganic)	11	9	1	0 above HIL D 730

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table (mg/kg)				
Analyte	**N**	**Detections**	**Maximum**	**n > Human Health Screening Criteria**
Nickel	11	9	23	0 above HIL D 6,000
Zinc	11	11	710	0 above HIL D 400,000
TRH (C_6-C_{10} minus BTEX)	11	1	39	0 above HSL D (sand 0-1 m) 260 0 above ML 700
TRH (>C_{10}-C_{16} minus naphthalene)	11	0	<PQL	0 above HSL D (sand 0-1 m) NL 0 above ML 1,000
TRH (>C_{16}-C_{34})	11	0	<PQL	0 above ML 3,500
TRH (>C_{34}-C_{40})	11	0	<PQL	0 above ML 10,000
Benzene	11	0	<PQL	0 above HSL D (sand 0-1 m) 3
Toluene	11	0	<PQL	0 above HSL D (sand 0-1 m) NL
Ethylbenzene	11	0	<PQL	0 above HSL D (sand 0-1 m) NL
Xylene	11	0	<PQL	0 above HSL D (sand 0-1 m) 230
Tetrachloroethene (PCE)	11	1	32[a]	0 above RSL 1,000[b]
Other VOCs	11	0	<PQL	-
Total PAHs	11	9	22	0 above HIL D 4,000
Carcinogenic PAHs (BaP TEQ)	11	8	2	0 above HIL D 40
Benzo(a)pyrene	11	8	1	-
Naphthalene	11	0	<PQL	0 above HSL D (sand 0-1 m) NL
Total Phenols	10	0	<PQL	0 above HIL D 240,000
PCBs	10	0	<PQL	0 above HIL D 7
OPPs	10	0	<PQL	0 above HIL D
OCPs	10	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non limiting
a PCE was detected in fill sample WLBH01 (0.5-0.95). PCE is a VOC compound historically used in dry-cleaning and as a metal degreasing solvent (NEMP, 2013).
b USEPA Carcinogenic Screening Level (SL) has been adjusted by a factor of 10 to address cancer risk acceptance rates (1:100,000) in Australia.

Table 8.2: Evaluation of Natural Soil Analytical Results – Summary Table (mg/kg)				
Analyte	**N**	**Detections**	**Maximum**	**n > Human Health Screening Criteria**
Asbestos in soil (presence/absence)	1	0	<PQL	-
Arsenic	9	3	12	0 above HIL D 3,000
Cadmium	9	1	1	0 above HIL D 900
Total Chromium	9	6	31	0 above HIL D 3,600
Copper	9	7	44	0 above HIL D 240,000
Lead	9	6	330	0 above HIL D 1,500
Manganese	9	8	190	0 above HIL D 60,000
Mercury (inorganic)	9	1	1	0 above HIL D 730
Nickel	9	5	9	0 above HIL D 6,000
Zinc	9	8	350	0 above HIL D 400,000
TRH (C_6-C_{40})	9	0	<PQL	0 above HIL D and ML
BTEXN	9	0	<PQL	0 above HSL D (sand 0-1 m)
PCE	7	1	19[a]	0 above RSL 1,000[b]
Other VOCs	7	0	<PQL	-
Total PAHs	9	1	19	0 above HIL D 4,000
Carcinogenic PAHs (BaP TEQ)	9	1	3	0 above HIL D 40
Benzo(a)pyrene	9	1	2	-
Total Phenols	6	0	<PQL	0 above HIL D 240,000
PCBs	6	0	<PQL	0 above HIL D 7
OPPs	6	0	<PQL	0 above HIL D
OCPs	6	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non limiting
a PCE was detected in natural sample WLBH01 (1-1.45).
b USEPA Carcinogenic Screening Level (SL) has been adjusted by a factor of 10 to address cancer risk acceptance rates (1:100,000) in Australia.

In assessing the results, the Auditor makes the following observations:

- Metals, light fraction TRH, individual PAHs and PCE were detected in the fill samples at concentrations below the screening criteria. The fill appears to have been impacted by the historical activities undertaken at the site (Section 4). PCE was also detected in the underlying natural soil at WLBH01. The source of PCE is likely to be the former laundry/dry cleaner at 87 Botany Road (Lot 2 DP27454), which is located immediately to the west of the site in the Worksite Area.

- Fill samples detected high lead concentrations with a maximum value of 1,200 mg/kg. Previous investigation by EI detected elevated lead of 2,100 mg/kg above the screening criteria at the site. The source of lead could be attributed to inclusions of ash, fly ash, charcoal and coal detected in the fill.
- Asbestos was not detected in the soil samples analysed by DP. However, DP noted the presence of fragments potentially containing asbestos in the fill at WLTP10.
- Marginal detections of metals, PAHs and PCE below the screening criteria were detected in some natural soil samples. The source of these contaminants can be attributed to the following:
  - Detections of PAHs in the natural soil in WLBH01 could be attributed to cross contamination from the overlying fill soil as the samples was obtained directly beneath the fill.
  - Detections of PCE in the natural soil in WLBH01 could be attributed to the former laundry/dry cleaner at 87 Botany Road. PCE was also detected in the overlying fill at this location, and groundwater in a nearby well.
  - The majority of the metal results are consistent with background concentrations except for lead in WLBH01 which was above typical background levels (10-40 mg/kg). The source of lead could be attributed to cross contamination from the overlying fill soil as the samples was obtained directly beneath the fill.

8.1 Auditor's Opinion

In the Auditor's opinion, the soil analytical results are consistent with the site history and field observations. The results indicate the fill to be locally impacted by lead, PCE and ACM, however more widespread contamination from ACM is possible and considered likely. Low level contamination of fill and underlying natural soil was identified, however this was at concentrations less than the assessment criteria.

Remediation of fill material is required. Off-site disposal of impacted fill and natural soil will require careful management during remediation. The remedial strategy outlined in the RAP is reviewed and summarised in Section 10.

9. EVALUATION OF GROUNDWATER ANALYTICAL RESULTS

Groundwater samples were collected from monitoring wells WLMW04, WLMW05 and WLMW06 by DP as part of the DSI (WLMW03 was destroyed). The analytical results are summarised below in Table 9.1. Sampling locations are presented in Attachment 2.

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)

Analyte	n	Detections	Maximum	n >ANZECC Fresh (2000)	n > ADWG/RSL
Arsenic	3	0	<PQL	0 above criteria of 24	0 above criteria of 10
Cadmium	3	2	**0.2**	**1 above criteria of 0.06**	0 above criteria of 2
Total Chromium	3	0	<PQL	0 above criteria of 1	0 above criteria of 50
Copper	3	3	**3**	**2 above criteria of 1.4**	0 above criteria of 2,000

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)

Analyte	n	Detections	Maximum	n >ANZECC Fresh (2000)	n > ADWG/RSL
Lead	3	0	<PQL	0 above criteria of 3.4	0 above criteria of 10
Manganese	3	4	**570**	0 above criteria of 1,900	**1 above criteria of 500**
Mercury	3	0	<PQL	0 above criteria of 0.06	0 above criteria of 1
Nickel	3	0	<PQL	0 above criteria of 8	0 above criteria of 20
Zinc	3	3	**34**	**4 above criteria of 8**	-
TRH (C_6-C_{10} minus BTEX)	3	1	210	-	0 above criteria of 15,000[a]
TRH (>C_{10}-C_{16} minus naphthalene)	3	0	<PQL	-	-
TRH (>C_{16}-C_{34})	3	0	<PQL	-	-
TRH (>C_{34}-C_{40})	3	0	<PQL	-	-
Chlorodibromomethane	3	1	3	-	0 above criteria of 8.7
Chloroform (Trichloromethane)	3	2	**18**	0 above criteria of 370	**1 above criteria of 3**
PCE	3	1	**150**	**1 above criteria of 70[b]**	**1 above criteria of 50**
BTEX	3	0	<PQL	0 above criteria	0 above criteria
Naphthalene	3	0	<PQL	0 above criteria of 16	-
Total PAHs	3	0	<PQL	-	-
Aldrin+Dieldrin	3	1	0.006	-	0 above criteria of 0.3
Chlordane	3	1	0.02	0 above criteria of 0.03	0 above criteria of 2
Dieldrin	3	1	0.006	0 above criteria of 0.01[c]	-
Heptachlor epoxide	3	1	0.012	-	0 above criteria of 0.3
Total OPPs	3	0	<PQL	-	-
Total PCBs	3	0	<PQL	-	-
Total Phenols	3	0	<PQL	0 above criteria of 320	-

n number of samples
- No criteria available/used

Bold Values exceed criteria
a WHO (2008) assessment criteria for TPH aliphatic fraction adjusted by x10 in accordance with NHMRC (2008) recommendations for incidental ingestion of groundwater.
b In the absence of high reliability guidelines, the low reliability interim working level has been adopted.
c In the absence of high reliability guidelines, the moderate or low reliability guideline concentration has been adopted.

In assessing the results, the Auditor makes the following observations:

- The groundwater analytical results for the majority of the analytes were below the health and ecological screening criteria.
- Elevated cadmium, copper, manganese and zinc concentrations were detected in the groundwater samples. The DSI concluded that the heavy metals can be attributed to diffuse urban-sourced background levels and is not from a site specific source.
- Low concentrations of OCPs, less than the ecological screening criteria, were detected in groundwater sample WLMW06. DP stated that OCPs were not detected in the soil samples tested from the site and no other sources of pesticides were identified.
- An elevated concentration of PCE was detected in groundwater sample WLMW05 located close to the western site boundary, near the former laundry/dry cleaner at 87 Botany Road. PCE was also detected in the fill and natural soil in the vicinity of this monitoring well. Groundwater from this well also contained a chloroform concentration above the ADWG screening criteria.
- The DSI concluded that the source of VOCs was from the former use of 87 Botany Road as a laundry/dry cleaner. VOCs in soil and groundwater may pose a risk to site receptors and will require further assessment.
- The DSI concluded that the potential on-site sources will be removed during site works and that groundwater treatment requirements should be considered for groundwater disposal.

9.1 Auditor's Opinion

In the Auditor's opinion, the groundwater analytical results indicate that groundwater at the site has been impacted from the historical on-site and off-site landuse. The VOCs and OCP concentrations detected in groundwater could pose a potential risk to site receptors. DP has recommended further investigation to adequately characterise the extent and magnitude of PCE contamination. Based on the results of the additional investigation, an assessment of risk or additional remediation may be required. Other contaminants detected in groundwater are not considered to be present at concentrations presenting a risk to site receptors.

10. EVALUATION OF PROPOSED REMEDIATION

10.1 Conceptual Site Model

A conceptual site model (CSM) is a representation of the source, pathway and receptor linkages at a site. DP has developed a CSM based on the PSI and DSI. Table 10.1 provides the Auditors review of the CSM used by DP to inform remediation of the site.

Table 10.1: Review of the Conceptual Site Model		
Element of CSM	**Consultant**	**Auditor Opinion**
Contaminant source and mechanism	Soil contamination from former industrial land use and imported fill material containing lead, VOC and asbestos. Detections of OCPs in groundwater. The source of OCPs has not been identified. VOC contamination migrating onto the site from offsite source, 87 Botany Road formerly used as a laundry/dry cleaner. Unexpected contamination finds during excavation.	Source and mechanism for soil considered appropriate. The source of OCPs in groundwater has not been identified, however is likely to be related to historical use of the site and the wider Worksite Area.
Affected media	Fill material, vapour and groundwater.	Affected media have been identified.
Receptor identification	Future site users, construction workers, adjacent land users, surface water and groundwater.	The receptors have been appropriately identified. The closest surface water receptor is Sheas Creek located 530 m to the southwest and is therefore unlikely to be impacted by site contamination.
Exposure pathways	Inhalation of dust and vapours, lateral migration of groundwater, direct contact.	Incidental ingestion is also considered a potential exposure pathway.
Presence of preferential pathways for contaminant movement	Trenches for buried services may act as potential migratory pathways.	Preferential pathways for groundwater and vapour migration are likely to be present on the site, including current and planned subsurface services The sump and associated pipes identified in the Worksite Area are likely to be a source and preferential pathway for VOC contamination. Excavation of the site may create preferential pathways for groundwater flow towards the site. The locations of preferential pathways have not been identified.

Table 10.1: Review of the Conceptual Site Model		
Element of CSM	**Consultant**	**Auditor Opinion**
Evaluation of data gaps	The RAP recommends additional on-site and off-site testing for VOCs. Proposed dewatering of the excavation may draw contaminated water onto the site. The RAP states that the contaminants in groundwater will require treatment prior to disposal. However, treatment options have not been addressed in the RAP.	Presence of VOCs in soil and groundwater could pose a vapour risk, which has not been adequately assessed. Data gaps can be addressed prior to or during remediation of the site.

10.2 Remediation Required

The Auditor has assessed the RAP by comparison with the checklist included in OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The RAP was found to address the required information, as detailed in Table 10.2, below.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Remedial Goal The RAP stated four remediation goals as outlined below: *'render the site suitable for the proposed land use; maintain records of the remediation and earthworks undertaken including validation as required; mitigate adverse impacts on surrounding land and waterways during the remediation by the management of dust, water and noise emissions; and maximise the protection of workers involved with remediation and earthworks'.*	In the Auditor's opinion, the goals are appropriate considering the proposed redevelopment of the site.
Discussion of the extent of remediation required DP identified the entire excavation footprint (Attachment 2) as the horizontal remediation extent and the vertical extent to be the depth of contaminated soil or the base of the excavation. Due to the nature of the development, bulk excavation will require removal of site soil to the desired levels (28 mbgl). The base and walls of the excavation will be validated.	The proposed extent of soil remediation is considered adequate. Further excavation would be undertaken in the event of validation failure. The RAP recommends additional testing of groundwater and vapour for contamination.
Remedial Options The RAP stated that due to the bulk excavation requirement for the proposed development, excavation and off-site disposal was the only viable option to address contaminated fill material.	Acceptable for soil. A range of options to address groundwater and soil vapour contamination were not presented. This will require consideration following the additional testing.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Selected Preferred Option Excavation and off-site disposal of contaminated soil.	Acceptable for soil. A preferred option to address groundwater and soil vapour contamination was not presented.
Rationale Development of the site will involve bulk excavation from the surface to a depth of up to 28 mbgl. The majority of the impacted soil will be excavated and disposed off-site.	Acceptable.
Waste Characterisation and Disposal The DSI has identified the following waste streams based on *in situ* testing of fill material (Attachment 3): special waste – asbestos – hazardous waste (HW); special waste – asbestos – restricted solid waste (RSW); special waste – asbestos – general solid waste (GSW); GSW; Acid Sulfate Soil (ASS); and VENM. DP are to provide documented waste classifications based on an inspection of the material and available analytical data. Further *ex situ* waste characterisation will be undertaken if considered necessary. Waste material is to be removed by a licensed contractor. Each load will be documented, including weighbridge slips, trip tickets and consignment disposal confirmation. Waste will be disposed of at a facility legally able to accept the material.	Acceptable.
Containment No requirement at this stage.	Acceptable.
Proposed Validation Testing Validation samples are to be collected following removal of waste with different classifications and fill material, as well as the footprint of stockpile areas. *Excavations (base <500 m^2):* Base – one sample per 25-50 m^2. With a minimum of 3 samples. Walls – one sample per 10 m length exposed with additional samples collected at depths based on observations. *Excavations (base ≥500 m^2):* Base – grid based sampling to meet the density recommended in the NSW EPA *Sampling Design Guidelines* (minimum of 10 samples). Walls – one sample per 20 m length exposed with additional samples collected at depths based on observations. *Stockpiles:* In accordance with NEPM (2013). The RAP states that samples collected will be analysed for the contaminants of concern. However, it does not list the contaminants.	The Auditor considers the validation sampling densities acceptable. Samples should be analysed for the contaminants of concern, which are considered to include asbestos, metals, TRH, PAHs, VOCs and OCPs. The density of testing for imported material would need to be commensurate with the documentation provided, source, observations and the consistency of the results. VENM certificates based on the template available on the NSW EPA website should be provided.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Imported material is expected for temporary works such as construction of piling platforms. The RAP includes a material importation protocol and criteria for implementation. The protocol requires review and approval of documentation by the environmental consultant, inspection of the material at the source site, inspection during importation and additional testing (details not provided in the RAP).	
Interim Site Management Plan (before remediation) The RAP recommends a surface clearance for asbestos by an asbestos assessor prior to the commencement of excavation. Further investigation for VOC contamination has been recommended prior to remediation.	Acceptable. No other interim management is considered necessary given the site is sealed with concrete and asphalt, fenced and occupied by JHCPBGJV.
Unexpected Finds The RAP includes a contingency plan for unexpected finds, UST removal, stopping work and assessment of the find by an occupation hygienist, asbestos consultant or environmental consultant. The RAP includes contingencies in the event contaminated groundwater and/ or hazardous ground gas (HGG) are detected during site works. Validation of unexpected finds should be undertaken in accordance with the procedures in the RAP.	The unexpected finds procedure (UFP) is considered acceptable.
Site Management Plan (operation phase) including stormwater, soil, noise, dust, odour and OH&S The RAP includes a site management plan for implementation during remediation and validation that covers specific requirements for asbestos (including notification, air monitoring), specific requirements for chemical contaminants, fencing and signage, security and restriction of access, PPE, decontamination, disposal of water, clearance inspection and certificates.	The site management plan is considered acceptable for remedial planning.
Contingency Plan if Selected Remedial Strategy Fails The RAP states that in the event of validation failure, the remediation contractor will undertake further 'chase out' excavation and disposal, followed by validation sampling.	The remedial strategy to address fill material has a low risk of failure, as validation failure would lead to further excavation which is required for the dive structure.
Contingency Plans to Respond to Site Incidents The RAP includes a soil contingency plan for the handling and disposal of material.	Acceptable.
Remediation Schedule and Hours of Operation Not provided in the RAP.	The hours of operation are to be governed by consent conditions.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Licence and Approvals The RAP notes that the development is approved as critical State significant infrastructure under the *Environmental Planning and Assessment Act 1997* (EP&A Act). SEPP55 does not apply to the development. Waste disposal is to be tracked, and the receiving facility is to be licensed to accept the material. Council approval will be required for disposal of groundwater in to the stormwater system if required during works. The RAP notes that an EPL will be in place for the disposal of water. Asbestos removal contractors are to be appropriately licensed. Air monitoring for asbestos to be conducted during remediation.	Acceptable.
Contacts/Community Relations Contacts were provided for the consultant and Auditor. The details of the project manager and remediation contractor are to be included following appointment. The emergency procedures and contact details are to be displayed at the site entrance. Direct community consultation is not proposed.	Acceptable
Long-term environmental management plan No requirement at this stage.	Acceptable.
Validation Reporting The RAP included a validation plan which addresses the validation DQOs, QA/QC and DQIs in accordance with NEPM (2013). The validation requirements include: site inspections, sampling, documentation and reporting.	Acceptable.

It is considered that the remediation approach recommended by DP is largely appropriate. Staged remediation of the different waste streams would be feasible and considered appropriate for this site. The presence of volatile contaminants in groundwater above the screening criteria may require additional remedial measures to be considered and implemented. Further investigation of groundwater and soil vapour conditions are proposed to inform the need for additional remediation. The scope of the additional investigation should been provided to the Auditor for review.

10.3 Auditor's Opinion

In the Auditors' opinion, the proposed remediation works are adequate to address contaminated fill material during redevelopment of the site through: excavation and off-site disposal of contaminated fill material and natural soil; implementation of the UFP; and successful validation.

VOC contamination identified in soil and groundwater requires further investigation to delineate the vertical and lateral extent of contamination. The investigation should adequately characterise groundwater and soil vapour contamination in order to assess the risk to human health and the environment. Based on the assessment, additional remedial strategies may be required in order to make the site suitable for the proposed use. The results of the investigations and any additional remediation proposed should be documented and provided to the Auditor for review.

11. CONCLUSIONS AND RECOMMENDATIONS

The RAP concluded *"… that the site can be rendered suitable for the proposed development subject to implementation of this RAP"*.

Based on the information presented in the referenced reports and observations made on site, the Auditor concludes that the proposed process for remediation of fill material is practical and that the site can be made suitable for the proposed land use if remediated in accordance with the following RAP:

> *'Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Waterloo Station, Botany Road and Cope Street, Waterloo, prepared for John Holland CPB Ghella JV, Project 85608.14, April 2018',* report reference: Revision 0, dated 13 April 2018, prepared by Douglas Partners.

Further investigation to determine the extent and magnitude of VOC concentrations in soil vapour and groundwater is proposed. The scope and results of the investigation should be provided to the Auditor for review. Should the results of the investigation indicate a need for additional remediation to address groundwater and soil vapour contamination, an addendum to the RAP should be prepared and provided to the Auditor for review.

At the completion of remediation of the site, a Section A Site Audit Statement and supporting Site Audit Report certifying suitability for the proposed use should be prepared.

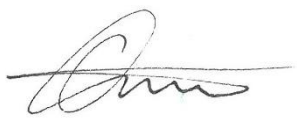
Remediation and reporting can be conducted in stages provided suitable provisions are made to avoid cross-contamination of remediated areas.

* * *

Consistent with the NSW EPA requirement for staged 'signoff' of sites that are the subject of progressive assessment, remediation and validation, I advise that:

- This advice letter does not constitute a Site Audit Report or Site Audit Statement.
- At the completion of the remediation and validation I will provide a Site Audit Statement and supporting documentation.
- This interim advice will be documented in the Site Audit Report.

Yours faithfully
Ramboll Australia Pty Ltd



Tom Onus
EPA Accredited Site Auditor 1505

Attachments: 1 Site Locality

2 The DSI Sampling Location Plan

3 Waste Classification and Soil Disposal Plan

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: John Holland CPB Ghella JV	
OFFICE: Sydney	DRAWN BY: PSCH
SCALE: 1:2000 @ A3	DATE: 10.10.2017

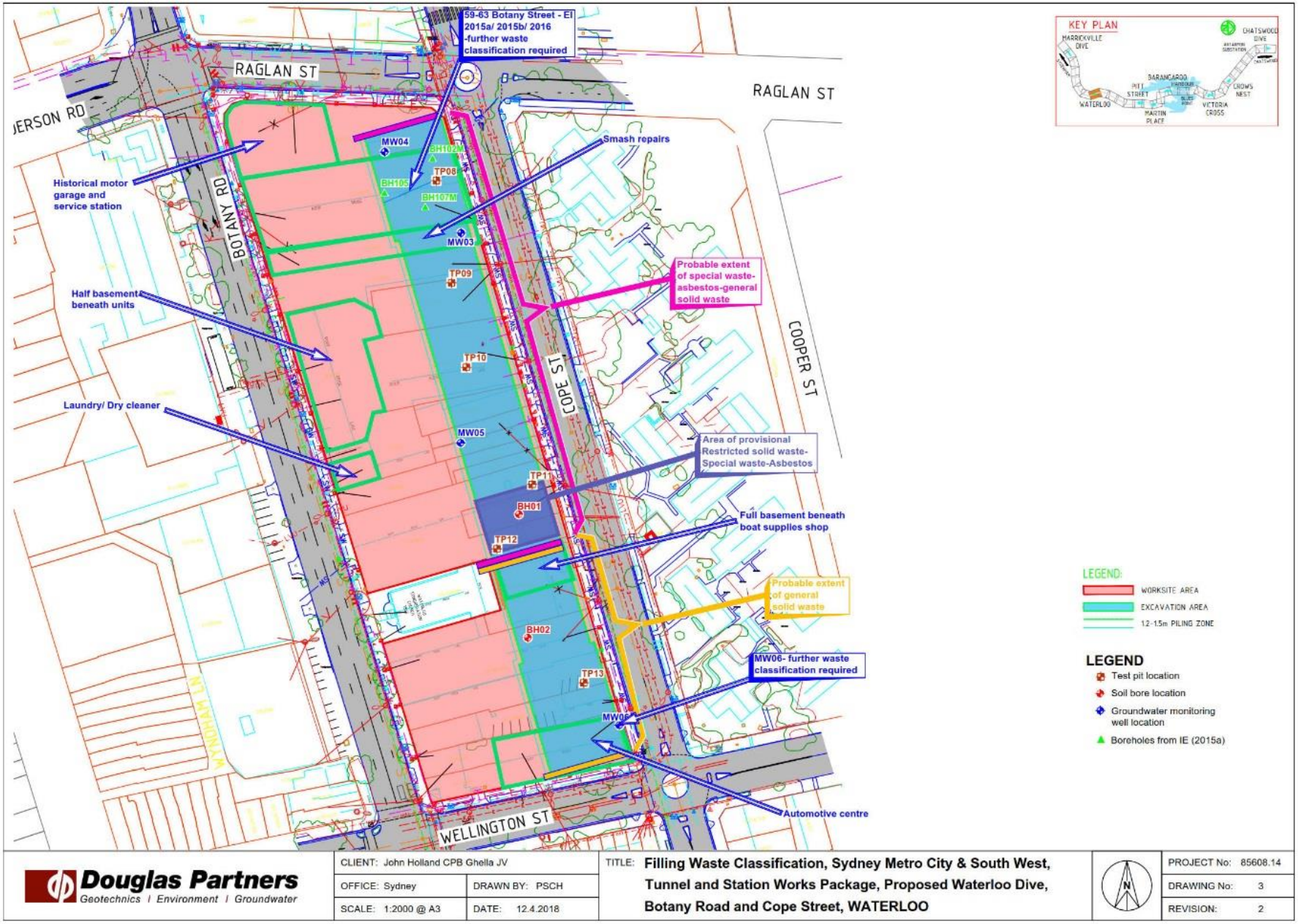
TITLE: **Site Locations and Features, Sydney Metro City & South West, Tunnel and Station Works Package, Proposed Waterloo Dive, Botany Rad and Cope Street, WATERLOO**

PROJECT No:	85608.14
DRAWING No:	1
REVISION:	0

Attachment 1: Site Locality Plan

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: Test Locations, Sydney Metro City & South West, Tunnel and Station Works Package, Proposed Waterloo Dive, Botany Road and Cope Street, WATERLOO	PROJECT No: 85608.14
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 2
	SCALE: 1:2000 @ A3 / DATE: 10.10.2017		REVISION: 0

Attachment 2: The DSI Sampling Location Plan



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: Filling Waste Classification, Sydney Metro City & South West, Tunnel and Station Works Package, Proposed Waterloo Dive, Botany Road and Cope Street, WATERLOO	PROJECT No: 85608.14
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 3
	SCALE: 1:2000 @ A3 / DATE: 12.4.2018		REVISION: 2

Attachment 3: Waste Classification and Soil Disposal Plan

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