Contamination | Remediation | Geotechnical

TOGA WICKS PARK DEVELOPMENTS PTY LTD

Additional Site Investigation

182-198 Victoria Road & 28-30 Faversham Street, Marrickville

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EXECUTIVE SUMMARY

Background

TOGA Pty Ltd engaged EI Australia Pty Ltd (EI) to complete an Additional Site Investigation for 182-198 Victoria Road, Marrickville ('the site').

The site was further identified as comprising **Error! Unknown document property name.**. The land (7262m^2 in total area) was bound by Victoria Road to the west, with commercial, residential and recreational properties comprising the immediate surroundings.

At the time of this investigation, the site was being used for commercial purposes and four principal buildings were present on the site, identified as follows:

- Smash Repairs Workshop;
- Spray Painting Workshop;
- Stone Cutting Workshop; and
- Offices.

This report complements previous assessments of the site, completed by Aargus Pty Ltd (Aargus) in 2014 and 2018. It has been prepared in support of a Development Application (DA) to Inner West Council for mixed commercial and medium-density residential redevelopment of the land.

Objectives

The primary objectives of this investigation were to:

- Investigate the degree of any potential contamination by means of intrusive sampling and laboratory analysis, for relevant contaminants of concern; and
- Where site contamination was confirmed, make recommendations for the appropriate management of any contaminated soils and/or groundwater.

Findings

The work was conducted with reference to the regulatory framework outlined in **Section 1.3** of this report and investigation findings indicated the following:

- There was no evidence, by way of a fill / dip point, to suggest that an underground petroleum storage system (UPSS) was present on the site.
- The site was free of statutory notices issued by the NSW Environment Protection Authority (EPA).
- The sub-surface layers were comprised of anthropogenic filling (Silty Sandy CLAY / Gravelly SAND / Silty GRAVEL, with some building rubble and ash; 0.1-1.9m thickness), overlying natural (Sandy) Silty CLAY and Clayey SAND (2.6-7.4m thickness) and (weathered) sandstone.
- Groundwater was encountered between 0.3-2.1m below ground level (BGL) in the monitoring wells, with the inferred flow direction being south easterly, toward Alexandra

Canal. Local groundwater was considered to be slightly acidic (pH 5.25-5.95) and slightly saline to brackish (Electrical Conductivity: 831-5347 µS/cm).

- Near surface (≤1.5m BGL) soils contaminated by polycyclic aromatic hydrocarbons (PAHs) and asbestos were present on the site, with concentrations of these chemicals of potential concern (COPCs) exceeding the human health-based soil investigation levels (SILs) for residential settings with minimal access to soils. The PAH and asbestos contamination was not considered to be gross (i.e. high level); however, it was generally widespread in lateral terms, being identified at ten separate sampling locations across the site:
  - Aargus (2014): BH1, BH4, BH5, BH6, BH7, BH14, BH21 and BH22; EI (2019): BH9M and BH13.
- Heavy metal (copper, lead, nickel and zinc), total recoverable hydrocarbon (TRH) and poly-fluoroalkyl substance (PFAS) contamination of soil was also apparent; however, for these COPCs, the impacts were of concern to ecological values, rather than human health.
- In terms of the vertical extent of contamination, the imported fill layer contained most of the contaminant load; however, some of the reworked (disturbed) natural soils were also impacted.
- Based on the analaytical results, acid sulfate soils are not present onsite.
- The local groundwater was contaminated by heavy metals (copper, nickel and zinc), volatile (chlorinated) hydrocarbons (toluene, ethylbenzene, xylenes, trichloroethene (TCE) and acetone) and PFAS. Further groundwater monitoring (i.e. additional GMEs) was warranted.

Conclusion and Recommendations

Based on the findings of this ASI, and with consideration of the Statement of Limitations (**Section 12**), EI consider the site can be made suitable for the proposed development, given the following recommendations are implemented:

- Preparation and implementation of a Remediation Action Plan (RAP), which should;
  - Outline the management of soils impacted with heavy metals (copper, lead, nickel and zinc), TRH, PAH, PFAS and asbestos.
  - Design supplementary investigations for further groundwater monitoring (i.e. additional GMEs) as part of the site validation program.
  - Validation of excavated areas to ensure soils and groundwater are suitable for the proposed development.
  - Validation of any material being imported to the site in accordance with EPA guidelines, to confirm its suitability for the proposed (residential) land use.
- Preparation of a final site validation report by a qualified environmental consultant, certifying site suitability for the proposed development.

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1. INTRODUCTION

1.1 Background and Purpose

Mr Matt Dobbs of TOGA Pty Ltd engaged EI Australia Pty Ltd (EI) to complete an Additional Site Investigation for 182-198 Victoria Road & 28-30 Faversham Street, Marrickville ('the site').

The site was located approximately 6km southwest of the Sydney central business district, within the Local Government Area of Council (**Figure 1**). It was further identified as comprising **Error! Unknown document property name.**. The land (7262m^2 in total area; **Figure 3**) was bound by Victoria Road to the west, with commercial, residential and recreational properties comprising the immediate surroundings.

At the time of this investigation, the site was being used for commercial purposes and four principal buildings were present on the site (**Figure 2**), identified as follows:

- Smash Repairs Workshop;
- Spray Painting Workshop;
- Stone Cutting Workshop; and
- Offices.

This report complements previous assessments of the site, completed by Aargus Pty Ltd (Aargus) in 2014 and 2018. It has been prepared in support of a Development Application (DA) to Inner West Council for redevelopment the land and for the purpose of enabling the developer to meet their obligations under the *Contaminated Land Management Act 1997* (CLM Act), for the assessment and management of contaminated soil and/or groundwater.

1.2 Proposed Development

The proposed redevelopment shall involve demolition of all existing structures, followed by the construction of a multi-storey, mixed use commercial and residential building, overlying a basement car parking facility (**Appendix C**).

1.3 Regulatory Framework

The following regulatory framework and guidelines were considered during the preparation of this report:

- ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
- DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- DECCW (2009) Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (UPSS Guidelines);
- EPA (1995) Sampling Design Guidelines;
- EPA (2014) Waste Classification Guidelines;
- EPA (2017) Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme;
- HEPA (2018) PFAS National Environmental Management Plan;
- NEPC (2013) Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater;

- NEPC (2013) Schedule B(2) Guideline on Site Characterisation;
- OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites;
- Contaminated Land Management Act 1997; and
- State Environment Protection Policy 55 (SEPP 55) – *Remediation of Land*.

1.4 Project Objectives

The primary objectives of this investigation were to:

- Investigate the degree of any potential contamination by means of intrusive sampling and laboratory analysis, for relevant contaminants of concern; and
- Where site contamination was confirmed, make recommendations for the appropriate management of any contaminated soils and/or groundwater.

1.5 Scope of Works

In order to achieve the above objectives and in keeping the project cost-effective while generally complying with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*, the scope of works was as follows:

- Review relevant topographical, (hydro)geological and soil landscape maps for the project area;
- Review the previous (Aargus, 2014) environmental assessments of the site;
- Searches of NSW EPA databases which held records relating to the Contaminated Land Management Act 1997 and Protection of the Environment Operations Act 1997;
- Location of existing underground services, assisted by plans supplied by *Dial-Before-You-Dig* and a site walkover inspection, the latter including a ground penetrating radar (GPR) survey;
- Construction of boreholes at eleven locations across accessible areas of the site (identified as BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH10, BH11, BH12, BH13 and BH14M), the drilling depths being to a maximum of 13.4m below ground level (or prior refusal);
- Multiple level soil sampling within fill and natural soils at each of the bores;
- Installation of a groundwater monitoring well in five of the bores (BH1M, BH3M, BH6M, BH9M and BH14M), constructed to standard environmental protocols, to investigate potential groundwater contamination;
- One round of groundwater sampling from each of the constructed monitoring wells; and
- Laboratory analysis of selected soil and groundwater samples for relevant analytical parameters.

Data Analysis and Reporting

This report was prepared to document desk study findings, the conceptual site model, data quality objectives, investigation methodologies and results. It also provides a record of observations made during the detailed site walkover inspection, borehole and monitoring well construction logs and a discussion of laboratory analytical results in regards to potential risks to human health, the environment and the aesthetic uses of the land.

2. SITE DESCRIPTION

2.1 Property Identification, Location and Physical Setting

The site identification details and associated information are presented in **Table 2-1**, while the site locality is shown in **Figure 1**.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	182-198 Victoria Road & 28-30 Faversham Street, Marrickville
Location Description	Approximately 6km south west of Sydney CBD. An irregular (roughly rectangular) shaped block of land, bound by Victoria Road to the west. Commercial (light industrial), residential and recreational properties comprise the immediate surroundings.
Geographical Coordinates	Northern corner of site (GDA94-MGA55): Easting: 885095.825, Northing: 6240120.153 (Source: http://maps.six.nsw.gov.au)
Site Area	7,262m² (JBW Surveyors Ref. 125017 Wicks Park Site Á'Boundaries; dated: 01/02/18)
Lot and Deposited Plan (DP)	**Error! Unknown document property name.** (192-198 Victoria Road)
State Survey Marks	One State Survey Mark (SSM) is situated in close proximity to the site: SS47493 (at intersection of Victoria Road and Mitchell Street) (Source: http://maps.six.nsw.gov.au)
Local Government Authority	Council
Parish	**Error! Unknown document property name.**
County	**Error! Unknown document property name.**
Current Zoning	B4 – Business Zone (Marrickville Local Environment Plan, 2011)
Current Land Uses	Commercial and light industrial, including offices, the manufacture and sale of stonework benchtops (stone cutting workshop), a smash repairs workshop and a spray painting workshop. Carparking in the centre of Lot 10 in DP 701368.

2.2 Surrounding Land Use

The site was situated within an area of mixed land use (predominantly commercial / light industrial, but also residential and recreational). Uses of surrounding land are further described in **Table 2-2**.

Table 2-2 Surrounding Land Uses

Direction Relative to Site	Land Use Description
North east	Commercial / industrial properties.
South east	A commercial lot, followed by a large area that is predominantly industrial in use and Sydenham Road.
South west	Wicks Park (also housing an electrical sub-station), followed by Victoria Road and residential properties.
North west	Victoria Road, followed by commercial and then residential properties. Residential properties are of high density closer to the site, decreasing in density further west.

Wicks Park (directly south) and Marrickville Public School (250m north west) were identified as sensitive receptors within proximity of the site.

2.3 Regional Setting

Regional topography, (hydro)geology and soil landscape information are summarised in **Table 2-3**.

Table 2-3 Regional Setting Information

Attribute	Description
Topography	The site is generally flat, with a slight decline to the south east (≤5o). The highest elevation is located in the north corner (RL 3.3m AHD), the lowest is located halfway down the eastern border, just north of the stone cutting workshop (RL 1.81m AHD). (True North Surveys survey plan, Ref. 8333DU, dated 01/09/2016)
Site Drainage	Consistent with the general slope of the site. Stormwater is assumed to flow south east towards Alexandra Canal via drainage systems discharging to various stormwater easements and the municipal stormwater system.
Regional Geology	According to the 1:100 000 scale Coastal Quaternary Geological Sheet (Sydney), the site is underlain by anthropogenic deposits consisting of modern disturbed land (Qmx). According to the Sydney 1:100,000 Geological Sheet, the site is underlain by Holocene deposits consisting of peat, sandy peat and mud (Qhs).
Soil Landscapes	The Soil Conservation Service of NSW Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy, 1989) indicated that the site overlies a Birrong (bg) landscape, which typically includes 'level to undulating alluvial floodplain draining Wianamatta Group Shales'. Dominant soil materials include dark brown, pedal silty clay loam, bleached hardsetting clay loam, orange mottled silty clay, brown mottled silty clay and light grey mottled saline clay. [Note: Soils encountered during this investigation were considered to be consistent with those from Disturbed Terrain, as described by Chapman and Murphy (1989)]
Acid Sulfate Soil (ASS) Risk	According to the Botany Bay Acid Sulfate Soil Risk Map (1:25,000 scale; Murphy, 1997), the subject land lies within the map class description of Disturbed Terrain. In such cases, soil investigations are required to determine the presence of acid sulfate soil (ASS). The Marrickville Council Local Environmental Plan 2011 - Acid Sulfate Soils Risk Class 1:1,000 Scale Map indicated that the site lies within a Class 2 ASS area. Council consent is therefore required prior to commencing any works below the natural ground surface, or works by which the water table is likely to be lowered. An ASS assessment therefore formed part of this investigation.
Likelihood and Depth of	Based on observations during previous investigations, filling is present across the entire

Attribute	Description
Filling	site and approximately 0.1-1.9 metres in thickness.
Typical Soil Profile	Anthropogenic filling (Silty Sandy CLAY / Gravelly SAND / Silty GRAVEL, with some building rubble and ash; 0.1-1.9m thickness), overlying natural (Sandy) Silty CLAY and Clayey SAND (2.6-7.4m thickness) and (weathered) sandstone.
Depth to Groundwater	Groundwater was encountered between 0.3-2.1m below ground level (BGL) during the investigation phase and the inferred flow direction was south east, toward Alexandra Canal. Onsite groundwater conditions are discussed further in Section 8.2.
Aquifer Type	(Sandy) Silty CLAY and Clayey SAND form the main aquifer for the region, which are underlain by sandstone bedrock.
Groundwater Salinity	Local groundwater considered to be slightly acidic (pH 5.25-5.95) and slightly saline to brackish (EC: 831-5347 µS/cm). Onsite groundwater conditions are discussed further in Section 8.2.
Nearest Surface Water Feature	Alexandra Canal, located approximately 2km south east of the site. Alexandra Canal is understood to be tidally influenced and thus is considered to be a marine system for impact assessment purposes. It drains into Botany Bay (via the Cooks River).

2.4 Site Walkover Inspection

EI staff made a number of observations during a detailed site inspection on 18 December 2018. A plan showing the site layout and some observations is provided in **Figure 2**, site photographs are provided in **Appendix D**.

- At the time of this investigation, the site was being used for commercial purposes and four principal buildings were present on the site, as described in **Table 2-4**.

Table 2-4 Building Descriptions

Location	Description
Smash Repairs Workshop Naecourt Auto Body / Prestige Smash Repairs 184-188 Victoria Road Lot 100 in DP 1239681 Northwest portion of site	One storey, brick and metal commercial building (184-186 Victoria Road). Comprised of automobile repair areas, store rooms, offices and amenities. Adjacent to the southern side was a brick and terracotta tile cottage (188 Victoria Road), used for residential purposes. The buildings had metal and tile roofing, brick external walls, brick and plasterboard internal walls, timber and metal framework, fibre cement sheeting (FCS) and concrete floors.
Spray Painting Workshop 182 Victoria Road Lot 6 in DP 226899 Northeast portion of site	Two storey, brick and metal commercial building. Attached to the southern side was a one storey, metal commercial building. Attached to the northern side was a metal and FCS awning. Comprised of automobile spray painting areas (including spray booth), store rooms, offices and amenities. The buildings had metal roofing, brick and metal external walls, brick, metal and plasterboard internal walls, timber and metal framework, FCS and concrete floors.
Stone Cutting Workshop Rosa Stone Part of 190-198 Victoria Road	One storey, concrete block and metal commercial building. Comprised of stone cutting areas, store rooms, offices and amenities. The building had metal roofing, concrete block external and internal walls, plasterboard internal wall panels, timber and metal framework,

Location	Description
Part of Lot 10 in DP 701368 Southeast portion of site	FCS and concrete floors.
Offices Part of 190-198 Victoria Road Part of Lot 10 in DP 701368 Southwest portion of site	Two storey, brick and metal commercial building. Comprised of offices and showrooms, storage areas and amenities. The building had metal roofing, brick external walls, brick and plasterboard internal walls, timber and metal framework, FCS and concrete floors.

- Non-building areas were concrete paved, apart from a gravel driveway adjacent to the north(western) boundary (part of Lot 6 in DP 226899);
- Concrete slabs displayed some deforming and cracking. (Re)patchwork was observed in several areas;
- An electricity sub-station, likely to contain PCBs and hydrocarbon oils, was situated immediately southwest of the Offices (adjacent to the south western corner). Although this did not form part of the site, it represented a source of potential site impact, via migration of mobile (leaked liquid) contaminants;
- The site was generally flat, with a slight decline to the south east. Surface contamination and local groundwater were likely to migrate in this direction;
- There was no evidence, by way of a fill / dip point, to suggest that an underground petroleum storage system (UPSS) was present on the site. A GPR Survey further supported this assumption (**Appendix E**);
- Waste materials, including office furniture, oil drums, plastic signs, cardboard boxes and vegetation, were present on the site, particularly on 190 and 192-198 Victoria Road;
- A diverse range of chemical containers was encountered on the site, including spray painting chemicals, oils and adhesives.The smash repair and spray painting workshops had spray booth facilities. A full inventory of the types of chemicals stored and used on the site was included in the Aargus (2014b) Detailed Site Investigation report (**Section 3.1**);
- Fragments of FCS were found on the ground surface near the mid-north boundary (in the vicinity of BH12; **Figure 2**);

Regulatory Compliance

On 14 January 2019, EI performed an on-line search of the *Contaminated Land Public Record*. This is a database maintained by the NSW Environment Protection Authority (EPA), listing:

- Orders made under Part 3 of the Contaminated Land Management Act 1997;
- Approved voluntary management proposals under the *Contaminated Land Management Act 1997* that have not been fully carried out and where the approval of the EPA has not been revoked;
- Site Audit Statements provided to the EPA under Section 53B of the Contaminated Land Management Act 1997 that relate to significantly contaminated land;
- Where practicable, copies of any documentation formerly required to be part of the public record; and
- Actions taken by the EPA under Sections 35 and 36 of the Environmentally Hazardous Chemicals Act 1985.

The search conducted for this investigation confirmed that the EPA had no regulatory involvement in relation to the current site under the *Contaminated Land Management Act 1997*.

On 14 January 2019, EI performed an on-line search of the EPA's *List of NSW Contaminated Sites*, which includes properties on which contamination had been identified (and thus notified to the EPA), but not deemed significant enough to warrant formal regulation. The search conducted for this investigation confirmed that the current site was not included on the *List*.

On 14 January 2019, EI performed an on-line search of the EPA's register of environmental protection licences, applications, notices, audits, pollution studies and reduction programs issued / requested under the *Protection of the Environment Operations Act 1997*. The search conducted for this investigation confirmed that the EPA had no regulatory involvement in relation to the current site under the *Protection of the Environment Operations Act 1997*.

3. PREVIOUS INVESTIGATIONS

3.1 Available documents

The following previous environmental reports were provided to assist with this investigation:

- Aargus (2014a) *Geotechnical Investigation Report*. Aargus Pty Ltd Report Ref. GS5611/1A, Revision 0, dated 22 January 2014.
- Aargus (2014b) *Detailed Site Investigation*. Aargus Pty Ltd Report Ref. ES5611/2, Revision 0, dated 30 April 2014.
- Aargus (2014c) *Acid Sulfate Soils Assessment*. Aargus Pty Ltd Report Ref. ES5611/3, Revision 0, dated 8 May 2014.
- Aargus (2018) *Due Diligence*. Aargus Pty Ltd Ref. ES7185, Revision 0, dated 16 March 2018.

The Aargus (2014 / 2018) investigations concerned 182-198 Victoria Road and 18-28 Faversham Street, Marrickville (comprising 1.037 hectares in total area). All were commissioned by E&D Danias Pty Ltd (Danias Group). A summary of the tasks and key findings from each report relevant to the current investigation is outlined in **Table 3-1**.

Table 3-1 Summary of Previous Investigation Works and Findings

Assessment Details	Project Tasks and Findings
Geotechnical Investigation (Aargus, 2014a)	
Objective	To assess the ground conditions and general geotechnical design requirements of the land. Recommendations for the design and construction of future development at the site were provided in the corresponding report.
Scope of Works	The scope of works included: ▪ Review of Dial-Before-You-Dig plans; ▪ A site walkover inspection; ▪ Underground services location, using electromagnetic detection equipment; ▪ Mechanical auger drilling of three boreholes (BH1, BH2 and BH3), drilled to depths of 4.3-8m BGL; ▪ Standard Penetrometer Tests (STPs) within the boreholes, to assess in situ strength of subsurface layers; ▪ Collection of soil samples during drilling, for laboratory analysis of pH, salinity and aggressivity to steel and concrete; and ▪ Data interpretation and reporting. Note 1 The field works for this investigation coincided with the Aargus (2014b) DSI, for which a total of twenty-two (22) bores were drilled, identified as BH1-BH22. At BH14, BH17 and BH20, a groundwater monitoring well was installed (identified as GW1, GW2 and GW3, respectively). Note 2 BH2, BH18 and BH19 and BH20 (GW3) were all located on the 18-28 Faversham Street portion. Note 3 The geotechnical component was based on logs and STPs from bores BH1, BH2 and BH3 (drilled to 4.9m, 8m and 4.3m BGL, respectively), as well as the standing water levels (SWLs) measured in GW1, GW2 and GW3.
Findings	The majority of the site was covered by 0.1-0.2m thick concrete pavement. The driveway at 182 Victoria Road was comprised of silty gravel, roadbase.

Assessment Details	Project Tasks and Findings
	Based on the logs for boreholes BH1, BH2 and BH3, the subsurface conditions were generalised as: ▪ FILL grey and brown, soft, loose, silty sandy clay, gravelly sand and silty gravel (0.1-0.35m thickness); overlying ▪ REWORKED IN SITU SOILS greenish grey with red mottling and dark grey, medium plasticity, soft to firm, moist, silty clays (0.6-1m thickness); overlying ▪ ALLUVIAL SOILS grey with reddish mottling, medium to high plasticity, firm to stiff, moist, silty clay (1-1.4m thickness); overlying ▪ RESIDUAL SOILS grey with red mottling, medium to high plasticity, firm to very stiff, moist, silty clay and sandy clay (1.4-5m thickness); overlying ▪ SANDSTONE grey with dark brown / red mottling and iron staining, fine to medium grained, extremely weathered, very low strength, with some clay bands (from 3.8-7.6m BGL onwards). Groundwater was encountered during the borehole drilling, at depths varying from 2.6-4m BGL. SWLs in GW1-GW3 were measured at 1.45-4.33m BGL (17 October 2013) and 1.15-1.23m BGL (29 October 2013). Natural site soils were found to be non- to slightly saline (≤2 dS/m electrical conductivity), slightly alkaline (7.9-8.4 pH) and non-aggressive to steel and reinforced concrete.
Detailed Site Investigation (Aargus, 2014b)	
Objectives	The primary objectives of this DSI were as follows: ▪ Identify potential areas where contamination may have occurred from current and historical activities; ▪ Identify potential contaminants associated with potentially contaminating activities; ▪ Assess the potential for soils and groundwater to have been impacted by current and historical activities; and ▪ Assess the suitability of the site for redevelopment.
Scope of Works	The scope of works for this DSI included: ▪ Review historical land use, based on current and historical titles information, aerial photographs, groundwater bore searches, EPA notices, council records, anecdotal evidence, services location and records on waste management practices; ▪ Review of the physical site setting and site conditions, based on a site inspection, including research of the location of sewers, drains, holding tanks and pits, spills, patches of discoloured vegetation, etc; ▪ A soil boring and sampling program, involving the drilling of twenty-two (22) bores distributed across the site adopting a systematic grid pattern, allowing for accessibility and site features (BH1-BH22; BH2, BH18, BH19 and BH20 being located on the 18-28 Faversham Street portion); ▪ Groundwater monitoring well installation and sampling (at BH14 (GW1), BH17 (GW2) and BH20 (GW3)); ▪ Laboratory analysis of representative (fill and natural) soil and groundwater samples for the contaminants of potential concern (COPCs), with comparison of the results against regulatory guidelines; ▪ The integration of a Quality Assurance / Quality Control (QA/QC) program, involving both field and laboratory QC samples; and ▪ Data interpretation and reporting, including recommendations for additional investigation and site management, where relevant.
Findings	The site history review established that the site was developed for commercial and residential purposes in the 1930s (or thereabouts). Commercial and light industrial activities increased over time and included spray painting, car (body) repairs, steel fabrication,

Assessment Details	Project Tasks and Findings
	sculpture works and stone masonry. A diverse range of chemicals were stored and used on the land, such as acids and alkalis, solvents (in particular paints and dry cleaning agents), petroleum hydrocarbon oils, adhesives and detergents. At the time of the Aargus (2014) investigations, 182-198 Victoria Road was occupied by a large warehouse with attached offices in the south western portion (occupied by Rosa Stone), a residential property and small warehouse with spray booth in the north western portion (occupied by smash repair business), three warehouses in the central northern portion (occupied by Gorilla Construction and used for metal work), concrete access / parking areas and an unsealed driveway along the northern boundary. 18-28 Faversham Street was occupied by commercial buildings / proprietors. The search for Water NSW registered bores established that five (5) groundwater bores were localed within a 1km radius of the site, all of which were for monitoring purposes. The corresponding drilling depths were 1.3-4.25m BGL. During the soil boring / sampling program: ▪ No hydrocarbon odours were detected in any of the examined soils; ▪ Hydrocarbon-like staining was observed at BH5, BH6, BH7 and BH18; and ▪ No fragments of FCS were detected in any of the examined soils. Soil headspace samples were screened in-field for volatile organic compounds (VOCs) using a portable photoionisation detector (PID). PID measurements ranged from 0-0.7 ppm, indicating no widespread contamination by volatile (petroleum) hydrocarbons. Elevated concentrations of lead, zinc, copper and carcinogenic PAHs (including benzo(a)pyrene) were identified in the soil materials at boreholes BH1, BH2, BH4, BH5, BH6, BH7, BH8, BH9, BH10, BH11, BH12, BH13, BH14, BH18, BH19, BH20, BH21 and BH22. Asbestos contamination was also present in the fill at hotspots BH1 (chrysotile asbestos), BH7 (chrysotile and crocidolite asbestos) and BH22 (chrysotile asbestos), the BH7 filling containing a trace of trichloroethene (TCE; 1 mg/kg) as well. Overall, the maximum depth of contamination was 1.3m BGL. Groundwater was encountered during the borehole drilling, at depths varying from 2.6-4m BGL. SWLs in GW1-GW3 were measured at 1.45-4.33m BGL (17 October 2013) and 1.15-1.23m BGL (29 October 2013). The inferred hydraulic gradient was south easterly (towards Alexandra Canal, 1.8m distance). The local groundwater was slightly acidic to neutral (pH: 5.95-6.85), brackish to saline (EC: 1192-5134 µS/cm) and low in dissolved oxygen (DO: 1.58-1.74 mg/L). Elevated concentrations of dissolved heavy metals (copper and zinc) were identified in the groundwater samples from GW1 and GW2. The levels of all other COPCs were below either the corresponding quantitation limit, or the adopted assessment criterion.
Conclusions and Recomendations	Aargus (2014b) concluded that the site required "review, additional works and/or delineation", given the presence of heavy metals (lead, zinc and copper), PAHs and/or asbestos in the majority of the test bores. Upon collation of all the data, an appropriate remedial / management strategy would then be developed, culminating in the preparation of a Remedial Action Plan (RAP) in accordance with EPA guidelines.
ASS Assessment (Aargus, 2014c)	
Objective	To determine the presence of ASS.
Scope of Works	Review of geological and soil landscape maps for the area (including an ASS risk map), a site walkover inspection, targeted soil boring and sampling (boreholes BH1-BH3; coinciding with the geotechnical / DSI bores), laboratory analysis of selected natural soil samples for pH (including 30% peroxide pH (pHfox)), data interpretation against recognised ASS criteria and reporting.
Findings	None of the examined soils displayed evidence (visual or olfactory) of the presence of ASS,

Assessment Details	Project Tasks and Findings
	actual or potential. For the tested (representative) samples, all pHf values were well above 4, the threshold below which is indicative of actual ASSs. Following 30% peroxide digestion of the samples, all pHfox values were well above 3, the threshold below which is indicative of potential ASSs. These results suggested "a lack of unoxidised sulphides".
Conclusions	Aargus concluded that the soils at the site (to 7.5m BGL, at least) did not contain significant quantities of actual and potential ASSs. It was considered that the net acid generating ability of the soils was minimal.
Due Diligence (Aargus, 2018)	
Objective	To review the contamination status of the site, based on the results from the completed (Aargus 2014) investigations. Notes: An additional eight boreholes (identified as A, B, C, D, F, G, H and I) were drilled as part of this study, complementing the twenty-two (22) bores constructed for the Aargus (2014b) DSI. The locations of these bores were not presented on a sampling location plan in the corresponding report; however, it was stated they were "placed in the central and north eastern portion of the buildings on Faversham Street, and within the south eastern warehouse on Victoria Road".
Findings	Site filling varied in thickness between 0.5-1.9m, the average depth being 0.7m. The general soil profile was: ▪ FILL (0.5-1.9m thickness); overlying ▪ CLAY (0.6-5.5m thickness); overlying ▪ SHALE. ASSs were not present beneath the site. The SWL was approximately 1.5m BGL, with the aquifer being in natural clay. Groundwater quality complied with the acceptance criteria. Fill soil hotspots of lead, PAHs and/or asbestos were identified at twelve (12) of the thirty (30) borehole locations, assuming the land use scenario was residential with minimal access to available soils (i.e. medium density, apartment / units). These locations were BH1, BH2, BH4, BH5, BH6, BH7, BH14, BH18, BH19, BH20, BH21 and BH22. Note: BH2, BH18, BH19 and BH20 (GW3) were all located on the 18-28 Faversham Street portion; hence, only eight (8) of the identified hotspots applied to the current site, those being BH1, BH4, BH5, BH6, BH7, BH14, BH21 and BH22, which displayed elevated PAHs and/or asbestos (lead only exceeding the EIL in some cases).
Recommendations	Aargus stated that: ▪ An additional investigation report was required, covering soil and groundwater; and ▪ A remedial action plan would also be required for the site.

3.2 Summary of contamination

Commercial (including light industrial) and residential uses of the site dated back to 1930 (at least). The commercial / light industrial activities increased over time and included spray painting, car (body) repairs, steel fabrication, sculpture works and stone masonry.

A diverse range of chemicals were stored and used on the land, such as acids and alkalis, solvents (in particular paints and dry cleaning agents), petroleum hydrocarbon oils, adhesives and detergents. However, there was no evidence that a UPSS was present.

ASSs were not present beneath the site, at least to 7.5m BGL.

Local groundwater was at approximately 1.5m BGL, the aquifer being in natural clay. It was slightly acidic to neutral (pH: 5.95-6.85), brackish to saline (EC: 1192-5134 µS/cm) and low in dissolved oxygen (DO: 1.58-1.74 mg/L). Apart from elevated concentrations of dissolved heavy metals (copper and zinc), all COPCs complied with recognised acceptance criteria.

Localised areas of near-surface (≤1.3m BGL) lead-, PAH- and asbestos- contaminated soils were present on the property. The impacted soils would need to be remediated as part of the proposed site redevelopment.

4. CONCEPTUAL SITE MODEL

In accordance with NEPM (2013) *Schedule B2 - Guideline on Site Characterisation* and to aid the assessment of the collected data, EI developed a conceptual site model (CSM) assessing plausible linkages between potential contamination sources, migration pathways and receptors. The CSM provided a framework for the review of the reliability and useability of the collected data and helped identify gaps in the existing site characterisation.

4.1 Subsurface Conditions

Based on investigations completed by EI, the sub-surface layers were comprised of:

- Anthropogenic fill layers: Including clay, sand and gravel (0.5-1.9m thickness); overlying
- Natural: Medium to high plasticity, sandy and silty clays (0.6-5.5m thickness);
  - ASSs were not present.
- Bedrock: Weathered to fresh sandstone / shale. .

The local groundwater table was at approximately 1.5m BGL, the aquifer being in natural clay. It was slightly acidic to neutral (pH: 5.95-6.85), brackish to saline (EC: 1192-5134 µS/cm) and low in dissolved oxygen (DO: 1.58-1.74 mg/L). Apart from elevated concentrations of dissolved heavy metals (copper and zinc), it appeared to be otherxise not contaminated.

4.2 Potential Contamination Sources

On the basis of the site history findings (described in **Section 3**), EI considered potential chemical hazards and onsite contamination sources to be as follows:

- Imported fill soils of unknown origin, distributed across the site;
- Impacts from commercial and industrial activities at the site and its immediate surroundings;
- Hazardous materials, including asbestos-containing materials (ACMs) and lead-based paints, from previous and existing building fabrics; and
- Deeper, natural soils containing residual impacts, representing potential secondary sources of contamination.

4.3 Chemicals of Concern

Based on the findings of the site contamination appraisal, the COPCs were considered to be:

- Soil - heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), C_6-C_{40} total petroleum / recoverable hydrocarbons (TPHs / TRHs), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs; including the monocyclic aromatic hydrocarbon compounds benzene, toluene, ethylbenzene and xylenes (BTEX)), organochlorine and organophosphate pesticides (OCPs / OPPs), polychlorinated biphenyls (PCBs), phenols, per and poly-fluoroalkyl substances (PFAS), pH and asbestos.
- Groundwater - dissolved heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, VOCs (including chlorinated VOCs (CVOCs) and BTEX), PAHs, PFAS, phenols and pH.

4.4 Other Contaminants of Potential Concern

4.4.1 Per or poly-fluoroalkyl substances (PFAS)

EPA (2017) requires that PFAS is considered in assessing contamination. EI use the following decision tree (**Table 4-1**) based on EnRisk (2016) for prioritising the potential for PFAS to be present on site and whether PFAS sampling of soil and water is required.

Table 4-1 PFAS Decision Tree

Preliminary Screening	Decision
Did fire training occur on-site?	No
Did fire training occur, or is an airport or fire station upgradient of or adjacent to the site? 1	No
Have "fuel" fires ever occurred on-site? e.g. ignition of fuel (solvent, petrol, diesel, kero) tanks?	Possible Potential –historical activities indicate storage of such chemicals
Have PFAS been used in manufacturing or stored on-site ?2	Possible Potential – long history of industrial site use
If Yes to any questions, has site analytical suite been optimised to include preliminary sampling and testing for PFAS in soil (ASLP Testing) and water?	Yes Identified COPC in Section 4.3

Note 1 Runoff from fire training areas may impact surface water, sediment and groundwater.
Note 2 PFAS is used wide range of industrial processes and consumer products, including in the manufacture of non-stick cookware, specialised garments and textiles, Scotchguard™ and similar products (used to protect fabric, furniture, leather and carpets from oils and stains), metal plating and in some types of fire-fighting foam (https://www.nicnas.gov.au/chemical-information/factsheets/chemical-name/perfluorinated-chemicals-pfas)

4.4.2 Emerging chemicals

The EPA uses Chemical control orders (CCOs) as a primary legislative tool under the EHC Act 1985 to selectively and specifically control particular chemicals of concern, and limit their potential impact on the environment. CCOs provide the EPA a rapid and flexible mechanism for responding to emerging chemical issues. As with PFAS, EI has considered chemicals controlled by CCOs and other potential emerging chemicals in this assessment as outline in **Table 4-2**.

Table 4-2 Emerging or controlled chemicals

Chemicals of Concern (CCO or emerging)	Decision
Were aluminium smelter wastes used or stored on site (CCO,1986)?	No
Do dioxin contaminated wastes (CCO,1986) have the potential to impact the site? 1	Yes
Were organotin products (CCO,1989) used or stored on site ?2	No
Were polychlorinated biphenyls (PCBs) used or PCB wastes (CCO, 1997) stored on-site?3	Yes Possibly contained within pesticides.
Were scheduled chemical or wastes (CCO, 2004) used or stored4	Yes
Are other emerging chemicals suspected?5	No
If Yes to any questions, has site sampling suite been optimised to include specific	Yes

Chemicals of Concern (CCO or emerging)	Decision
sampling for other chemicals of concern in soil, air and water	Identified COPC in Section 4.3

Note 1 From burning of certain chemicals, smelting or chemical manufacturing or fire on or near the site.
Note 2 From anti-fouling paints used or removed at boat & ship yards and marinas.
Note 3 From older transformer oils & electrical capacitors
Note 4 Twenty-four mostly organochlorine pesticides and industrial by-products
Note 5 Other chemicals considered as emerging e.g. 1,4 dioxane (associated with some cVOCs),

4.5 Potential Sources, Exposure Pathways and Receptors

Potential contamination sources, exposure pathways and human and environmental receptors that were considered relevant for this investigation are summarised in **Table 4-3**, along with a qualitative assessment of the potential risks posed by complete exposure pathways.

Table 4-3 Conceptual Site Model

Site Area	Subsurface Profile	Potential Sources	Potential Contaminants	Media	Sensitive Receptor	Migration & Exposure Pathways	Potential Risk of Complete Exposure Pathway
Entire Site	Fill overlying natural clays and bedrock	Industrial activities, filling, weathering and demolition of building products, deeper impacted soils	Heavy metals, TRHs, PAHs, VOCs, OCPs, OPPs, PCBs, phenols, PFAS, pH and asbestos	Building fabric Soils/ Groundwater Air/Soil Vapour LNAPL/DNAPL (if present)	Wicks Park, Marrickville Public School and nearby residential properties Site Workers during demolition and construction Future site residents	Seepage into the subsurface soils and groundwater. Dermal Contact Ingestion Inhalation	All M-H risk Risks reduced to low, post development, which will include site remediation

Note 1 L = Low Risk
Note 2 M = Moderate Risk
Note 3 H = High Risk

4.6 Data Gaps

Based on Council DA approval requirements, a program of intrusive sampling and analysis for the COPCs was warranted, to complement (expand on) the previous Aargus (2014/2018) investigations. A key objective was to establish (delineate) the degree of any contamination, in particular lead, PAHs and asbestos, so that a RAP could be drafted. Where permissible, parts of the site not previously sampled would be targeteted during the additional field work.

5. SAMPLING, ANALYTICAL AND QUALITY PLAN (SAQP)

The SAQP plays a crucial role in ensuring that the data collected as part of these, and ongoing, environmental works conducted at the site, are representative and provide a robust basis for assessment decisions. This SAQP includes the following:

- Data quality objectives, including a summary of the objectives of the ASI;
- Investigation methodology, including the media to be sampled, descriptions of sampling points and methods, in-field screening procedures and details of the analytes to be measured;
- Analysis Methods;
- Sample handling, preservation and storage; and
- Analytical QA/QC.

5.1 Data Quality Objectives (DQO)

In accordance with the USEPA (2006) *Data Quality Assessment* and the EPA (2017) *Guidelines for the NSW Site Auditor Scheme*, Data Quality Objectives (DQOs) were established by the EI team to determine the appropriate level of data quality needed for the specific data requirements of the project. The DQO process that was applied for this ASI is documented in **Table 5-1**.

Table 5-1 Summary of Project Data Quality Objectives

DQO Steps (NSW DEC, 2006)	Details	Comments (changes during investigation)
1. State the Problem Summarise the contamination problem that will require new environmental data, and identify the resources available to resolve the problem; develop a conceptual site model.	The site is to be developed for mixed, commercial / residential (apartment) use. Additional investigation required to complement the Aargus (2014 / 2018) works and delineate identified soil contamination. Targetted and systematic sampling to be performed. The combined findings enabled a RAP to be prepared, to remediate or contain contaminants.	
2. Identify the Goal of the Study (Identify the decisions) Identify the decisions that need to be made on the contamination problem and the new environmental data required to make them.	Historical information and previous sampling results indicated that near-surface (≤1.3m BGL) site soils had been impacted by lead, PAHs and asbestos, due to previous commercial activities, the importation of filling from unknown sources and/or hazardous building materials. Current ASI to expand the available data set.	
3. Identify Information Inputs (Identify inputs to decision) Identify the information needed to support any decision and specify which inputs require new environmental measurements.	Inputs to the decision making process include: ▪ Areas of environmental concern outlined in the review of previous investigations (refer to Section 3.2); ▪ National and NSW EPA guidelines endorsed under the NSW Contaminated Land Management Act 1997; ▪ Field observations, as well as soil and groundwater samples obtained from locations, and to depths, deemed appropriate for detailed investigation purposes; ▪ In-field and laboratory analyses of selected soil and groundwater samples for the COPC, to verify the presence and extent of on-site contamination; ▪ Evaluation of the potential risks to sensitive receptors; and ▪ Consideration of whether the site can be made suitable for the proposed land use, based on the preferred remediation strategy.	
4. Define the Boundaries of the Study Specify the spatial and temporal aspects of the environmental	Lateral – the investigation will be conducted within the cadastral boundaries of the site (Appendix C and Figure 3). Vertical – From existing ground surface, underlying fill and natural soil horizons, to the underlying water-bearing zone.	Field works of the EI (2019) ASI coincided with an additional (EI) geotechnical assessment. Soil sampling for environmental (contamination delineation) purposes conducted at EI bores

DQO Steps (NSW DEC, 2006)	Details	Comments (changes during investigation)
media that the data must represent to support decision.	Temporal – Results are valid on the day of data / sample collection and remain valid as long as no changes occur on site or contamination (if present) does not migrate on site or on to the site from off-site sources.	BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH10, BH11, BH12, BH13 and BH14M. Groundwater sampling for environmental purposes conducted at EI wells BH1M, BH3M, BH6M, BH9M and BH14M.
5. Develop the Analytic Approach (Develop a decision rule) To define the parameter of interest, specify the action level, and integrate previous DQO outputs into a single statement that describes a logical basis for choosing from alternative actions.	Laboratory test results would be accepted if: ▪ All contracted laboratories are accredited by NATA for the analyses undertaken; ▪ All laboratory analytical data is generally within pre-determined data acceptance criteria, in accordance with laboratory QA/QC policies and DQOs; ▪ QA/QC results demonstrate acceptable reliability and representativeness of the data set; and ▪ Laboratory limits of reporting (LORs) are below the adopted acceptance/assessment criteria for the tested COC, wherever possible. The decision rules for the ASI are: ▪ If the concentrations of contaminants in the soils, groundwater and/or soil vapour data exceed the land use criteria, then assume the corresponding area / medium is impacted and requires remediation. ▪ Decision criteria for QA/QC measures are defined by the Data Quality Indicators (DQI) in Table 5-2.	
6. Specify Performance or Acceptance Criteria (Specify limits on decision errors) Specify the decision-maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data.	Specific limits for this project to be in accordance with the appropriate guidance made by the NSW EPA, standard procedures for field sampling and handling, and the adopted indicators of data quality. This should include the following points to quantify tolerable limits: ▪ A decision can be made based on a probability that 95% Upper Confidence Limits (UCLs) of the data will satisfy the given site criteria. Therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect. ▪ A decision can be made based on the probability that a contamination hotspot of a certain circular diameter will be detected with 95% confidence using a selected density of systematic data points. The decision error will be limited to a probability of 5% that a contamination hotspot may not be detected. ▪ If contaminant concentrations in groundwater exceed the adopted criteria, further investigation will be considered prudent. If no contamination is detected in groundwater,	

DQO Steps (NSW DEC, 2006)	Details	Comments (changes during investigation)
	further action will not be warranted.	
7. Develop the Detailed Plan for Obtaining Data (Optimise the design for obtaining data) Identify the most resource-effective sampling and analysis design for general data that are expected to satisfy the DQOs.	Soil sampling (borehole) locations were chosen using a mixed, targeted / systematic sampling pattern - complementing the Aargus (2014) locations, with emphasis on areas not previously accessible. An upper soil profile sample (soil extracted immediately beneath the concrete hardstand / pavement) was collected at each borehole location and tested for chemicals of concern, to assess the conditions of fill layer, and impacts from activities above ground. Further sampling was also to be carried out in deeper soil layers. These samples were selected for testing based on field observations (including visual and olfactory evidence, as well as in-field soil pH and vapour (headspace) screening), whilst giving consideration to characterise the subsurface soil stratigraphy. Five groundwater monitoring wells were installed as part of the EI (2019) ASI, to enable further charatacterisation of local quality conditions. Written instructions were issued to guide field personnel in the required fieldwork activities.	Soil profiling and sampling for EI (2019) environmental (additional contamination delineation) purposes performed at eleven (11) boreholes, identified as BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH10, BH11, BH12, BH13 and BH14M. BH11 (hand auger hole) was aborted at 0.3m BGL, due to the presence of very fine sand which was not retained in the auger bucket. A sample for laboratory analysis was not collected at this location (in-field pH and PID screening performed, however). Boreholes BH5 and BH8 drilled for geotechnical purposes only (no environmental sampling). There was no BH4. Groundwater sampling for environmental purposes conducted at all five EI wells, identified as BH1M, BH3M, BH6M, BH9M and BH14M. None of the Aargus (2014) wells were suitable for use during the ASI.

5.2 Data Quality Indicators

To ensure that the investigation results were of an acceptable quality, the data set was assessed against the quality indicators (DQIs) outlined in **Table 5-2**. Further assessment of data quality is discussed in **Section 7**.

Table 5-2 Data Quality Indicators

Data Quality Objective	Data Quality Indicator	Acceptable Range
Accuracy	Field – Trip blank (laboratory prepared)	< laboratory LOR
	Field – Trip spike (laboratory prepared)	80-120% recovery
	Field – Spilt (inter-laboratory) duplicate	< 30% RPD
	Laboratory – control spike and matrix spike	Prescribed by the laboratories
Precision	Field – Blind (intra-laboratory) duplicate	< 30% RPD
	Laboratory – duplicate and matrix spike samples	Prescribed by the laboratories
Representativeness	Field – Trip blank (laboratory prepared)	< laboratory LOR
	Laboratory – Method blank	Prescribed by the laboratories
Completeness	Completion (%)	-

Note 1 LOR = limit of reporting (quantitative limit prescribed by the laboratory for the given analytical method)
Note 2 RPD = relative percentatge difference

6. ASSESSMENT METHODOLOGY

6.1 Sampling Rationale

With reference to the preliminary CSM described in **Section 4**, additional soil and groundwater investigation works were planned in accordance with the following rationale:

- Sampling fill and natural soils from eleven (11) test bore locations (BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH10, BH11, BH12, BH13 and BH14M), located in a mixed, targeted / systematic (grid-based) sampling pattern across the site (**Figure 3**), the targeted locations being building areas not previously accessible;
- A single groundwater monitoring event (GME) at five monitoring wells (BH1M, BH3M, BH6M, BH9M and BH14M), located in both up- and down- gradient areas, to further assess local conditions and potential impacts; and
- Laboratory analysis of representative soil and groundwater samples for the identified chemicals of potential concern.

6.2 Investigation Constraints

Due to drilling rig access restrictions, BH10, BH11 and BH13 were drilled using the manual auger method. At BH10 and BH13, hand auger refusal was encountered at relatively shallow depth due to coarse filling (BH10: 0.4m BGL) and very stiff clay (BH13: 0.95m BGL), respectively. At BH11, auger penetration was limited due to the presence of very fine sand (not retained in the auger bucket) and consequently the hole was aborted at 0.3m BGL. A sample for laboratory analysis was not collected at this location (in-field pH and PID screening performed, however).

Boreholes BH5 and BH8 were drilled for geotechnical purposes only (no environmental sampling). There was no BH4.

None of the Aargus (2014) groundwater monitoring wells were deemed suitable for use during the ASI (i.e. inaccessible and/or damaged).

6.3 Assessment Criteria

The assessment criteria adopted for this project are outlined in **Table 6-1**. These were selected from available published guidelines that are endorsed by national or state regulatory authorities, with due consideration of the exposure scenario that is expected for various parts of the site, the likely exposure pathways and the identified potential receptors.

Table 6-1 Adopted Investigation Levels for Soil and Groundwater

Environmental Media	Adopted Guidelines	Rationale
Soil	NEPC (2013) HILs, HSL, EILs, ESLs and Management Limits for TRHs	Soil Health-based Investigation Levels (HILs) Soil sample results assessed against the NEPC (2013) HIL-B thresholds for residential exposure settings with minimal access to soil. Soil Health-based Screening Levels (HSLs) The NEPC (2013) HSL-D thresholds for vapour intrusion at commercial / industrial sites were applied to assess potential human health impacts from residual vapours resulting from petroleum hydrocarbon fractions, BTEX and naphthalene. NEPC (2013) HSL thresholds for “all forms of asbestos” applied for

Environmental Media	Adopted Guidelines	Rationale
		the soil asbestos results. Ecological Investigation Levels (EILs) Soil sample results assessed against the NEPC (2013) EILs for arsenic, copper, chromium (III), nickel, lead, zinc, DDT and naphthalene, which have been derived for protection of terrestrial ecosystems. Ecological Screening Levels (ESLs) Soil sample results assessed against the NEPC (2013) ESLs for selected petroleum hydrocarbon / TRH fractions for protection of terrestrial ecosystems. Management Limits for Petroleum Hydrocarbons Where (if) the HSLs and/or ESLs were exceeded for the F1-F4 TRH fractions, soil sample results were assessed against the NEPC (2013) Management Limits to assess propensity for phase-separated hydrocarbons (PSH), fire and explosive hazards and adverse effects on buried infrastructure.
	HEPA (2018) criteria for PFAS	Soil Health-based Guidelines for PFAS Soil PFAS results assessed against the HEPA (2018) human health-based guidelines for the investigation of residential sites with minimal opportunities to soil access. Ecological Guidelines for PFAS Soil PFAS results assessed against the HEPA (2018) interim soil ecological-based guidelines for indirect exposure within residential settings.
Groundwater	ANZG (2018) GILs for Marine Waters	Groundwater Investigation Levels (GILs) for Marine Water ANZG (2018) provides GILs for typical, slightly-moderately disturbed aquatic ecosystems, which are based on the ANZECC / ARMCANZ (2000) Trigger Values (TVs). Generally, the criterion for 95% level of protection was adopted; however, the 99% TVs were applied for the bio-accumulative metals cadmium and mercury. Marine criteria were considered relevant as the closest, potential surface water receptor was Alexandra Canal, understood to be tidally influenced.
	NEPC (2013) Groundwater HSLs for Vapour Intrusion	Health-based Screening Levels (HSLs) The NEPC (2013) groundwater HSL-D thresholds for vapour intrusion were used to assess for potential human health impacts from residual vapours resulting from petroleum hydrocarbon, BTEX and naphthalene impacts.
Groundwater (cont.)	NEPC (2013) GILs for Drinking Purposes	Drinking Water GILs The NEPC (2013) GILs for drinking water quality were applied for specific parameters, for which marine GILs were not provided.
	HEPA (2018) criteria for PFAS	Guidelines for PFAS HEPA (2018) provides guideline values for site investigations in Australia. The freshwater values for 95% species protection in slightly-moderately disturbed aquatic ecosystems, as well as the health-based, drinking water criterion, were adopted for this ASI.

For the purposes of this investigation, the adopted soil assessment criteria are referred to as the Soil Investigation Levels (SILs) and the adopted groundwater assessment criteria are referred to as the

Groundwater Investigation Levels (GILs). SILs and GILs are presented alongside the analytical results in the corresponding summary tables, which are discussed in **Section 8**.

6.4 Soil Investigation

The soil investigation works conducted at the site are described in **Table 6-2**. Test bore and well locations are illustrated in **Figure 3**.

Table 6-2 Summary of Soil Investigation Methodology

Activity/Item	Details
Fieldwork	Conducted on 17-20 December 2018. Eleven boreholes drilled (BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH10, BH11, BH12, BH13 and BH14M) across the site, with samples taken in both the fill and natural soil layers, where permissible. Soil pH and vapour (headspace) screening performed in-field.
Drilling Method and Investigation Depth	Test bores BH1M, BH2, BH3M, BH6M, BH7, BH9M, BH12 and BH14M were drilled using a ute mounted, drilling rig with 110mm diameter, TC-bit, solid flight augers. Except for BH9M, each required a 300mm diameter concrete cutter prior to drilling. Final bore depths were 6.6m BGL, 12.1m BGL, 13.4m BGL, 4.0m BGL, 12.2m BGL, 6.4m BGL, 5.1m BGL and 4.8m BGL, respectively, all terminating in natural soil or on sandstone bedrock. Due to rig access restrictions, test bores BH10, BH11 and BH13 were drilled using manual (hand auger) techniques. Each required a 300mm diameter concrete cutter prior to drilling. Final bore depths were 0.4m BGL, 0.3m BGL and 0.95m BGL, respectively, due to refusal on coarse filling (BH10: 0.4m BGL), non-retained fine sand (BH11: 0.3m BGL) and very stiff clay (BH13: 0.95m BGL).
Soil Logging	Drilled soils were classified in the field with respect to lithological characteristics and evaluated on a qualitative basis for odour and visual signs of contamination. Soil classifications and descriptions were based on Unified Soil Classification System (USCS) and Australian Standard (AS) 4482.1-2005. Bore logs are presented in Appendix F.
Field Observations (including visual and olfactory signs of contamination)	Dark (oil-like) staining was not observed in any of the drilled / examined soils. Apart from the presence of ash in the near surface fill and silty clay at BH9M (<0.8m BGL), no visual evidence of contamination was observed in any of the drilled / examined soils. Fragments of FCS were found on the ground surface in the vicinity of BH12; however, no such fragments were observed in any of the drilled / examined soils. Petroleum hydrocarbon (solvent-like) odours were detected in all drilled soils at BH6M (0.2-4m BGL), the odour diminishing with depth. No suspicious odour was detected in any of the other drilled / examined soils. None of the examined soils displayed visual evidence of the presence of ASS, actual or potential. A hydrogen sulfide odour was not detected in any of the drilled / examined soils.
Soil Sampling	Soil samples were collected by metal trowel into laboratory-supplied, acid-washed, solvent-rinsed glass jars and plastic, zip-lock bags (the former for general analytes, except PFAS and asbestos; the latter for asbestos analysis). For PFAS-test samples, soil was placed into a laboratory-supplied, plastic jar using a separate (dedicated) trowel. Blind and split field duplicates were separated from the primary samples and placed into glass jars. A small amount of soil was also collected into a zip-lock bag for in-field headspace screening of VOCs using a RAE Systems MiniRAE 3000 PID (fitted with a 10.9 eV lamp and calibrated according to instrument instructions prior to use).

Activity/Item	Details
	Soil aliquots were screened in-field for pH using a HANNA HI 99121 Direct Soil pH Meter (calibrated according to instrument instructions prior to use). Note 1 Nitrile gloves were worn during the collection of soil samples, except the PFAS-test samples. A sample for laboratory analysis was not collected at BH11 - only in-field pH and soil headspace (PID) screening were performed at this location. Selected soils soil samples were commissioned for laboratory analysis of pH (pHf and pHfox), to confirm the field data and broaden the ASS assessment (Appendices H and I).
Management of Soil Cuttings	Soil cuttings were used as backfill for completed boreholes and concrete cores layed back in place.
Decontamination Procedures	Drilling Equipment - The drilling rods and auger bucket were decontaminated between sampling locations with potable water until the augers were free of all residual materials. Sampling Equipment – sampling equipment (i.e. metal trowels) was scrubbed and washed with potable water until free of all residual materials, then rinsed with laboratory-supplied, purified water.
Sample Preservation and Transport	Samples for laboratory analysis were stored in a refrigerated (ice-filled) chest, whilst on-site and in transit to the corresponding laboratory. Soil samples were transported to Eurofins │ mgt (Eurofins; the primary laboratory) under strict chain-of-custody (COC) conditions. Signed COC certificates and sample receipt documentation were provided by Eurofins for confirmation purposes (Appendix H), as discussed in Section 7. A split (inter-laboratory) soil field duplicate was submitted to Envirolab Services (Envirolab; the secondary laboratory) under strict COC conditions. Signed COC certificates and sample receipt documentation were provided by Envirolab for confirmation purposes (Appendix H), as discussed in Section 7. All samples were submitted and analysed within the required holding period, as documented in the corresponding laboratory reports (Appendix I).
Laboratory Analysis and Quality Control	Soil samples were analysed by Eurofins and Envirolab for the COPCs. In addition to the split (inter-laboratory) soil field duplicate (QT1), QA/QC testing comprised a blind (intra-laboratory) soil field duplicate (QD1), an equipment rinsate blank (QR1), a laboratory-prepared, trip spike soil sample (QTS1) and a laboratory-prepared, trip blank soil sample (QTB1). The corresponding laboratory reports are presented in Appendix I.

6.5 Groundwater Investigation

The groundwater investigation works conducted at the site are described in **Table 6-3**. Monitoring well locations are illustrated in **Figure 3**.

Table 6-3 Summary of Groundwater Investigation Methodology

Activity/Item	Details
Fieldwork	Groundwater monitoring wells were installed and developed on 17 December (BH3M), 18 Decemebr (BH14M), 19 December (BH6M and BH9M) and 20 December 2018 (BH1M). Water level gauging, well purging, field testing and groundwater sampling were conducted on 9 January 2019 (BH1M, BH3M, BH6M and BH9M) and 11 January 2019 (BH14M).
Well Construction	On-site, mechanically drilled, test bores were converted to groundwater monitoring wells as follows:

Activity/Item	Details
	▪ one, 4.5m deep, up-gradient well identified as BH1M; ▪ one, 7.1m deep, down-gradient well identified as BH3M; ▪ one, 3.7m deep, up-gradient well identified as BH6M; ▪ one, 4.8m deep, up-gradient well identified as BH9M and ▪ one, 4m deep, down-gradient well identified as BH14M. Well construction involved 50mm, Class 18 uPVC, threaded, machine-slotted screen and casing, with slotted intervals set to screen to at least 500mm above the standing water level (to allow sampling of phase-separated hydrocarbon product, if present). The base and top of each well were sealed with a uPVC cap. Annular, graded sand filter was added to approximately 300mm above the top of screen interval. Granular bentonite was applied above the annular filter to seal the screened interval. Drill cuttings were used to backfill the bore annulus to just below ground level. Surface completion comprised a steel road box cover, set in neat cement and finished flush with the concrete slab level. Well details are tabulated in Table 8-3 and documented in the bore logs presented in Appendix F.
Well Development	Well development was conducted for each well directly after installation. This involved agitation within the full length of the water column using a dedicated, HDPE, disposable bailer, followed by removal of water and accumulated sediment using a 12V, HDPE submersible bore pump (Proactive Environmental, model Super Twister). Pumping was continued until wells went dry (>25L purged).
Well Gauging and Groundwater Flow Direction	Monitoring wells BH1M, BH3M, BH6M and BH9M were initially gauged for SWL and PSHs on 9 Janaury 2018, while monitoring well BH14M was gauged on 11 January 2019. All measured SWLs are shown in Table 8-4. Phase-separated hydrocarbons were not detected in any of the wells (nor was any sheen or hydrocarbon filming). Groundwater flow (i.e. the hydrualic gradient) was inferred to be south easterly, in the direction toward Alexandra Canal.
Well Purging, Field Testing and Sampling	Prior to purging, groundwater was extracted from each well using a stainless steel bailer, then transferred directly into a laboratory-supplied, PFAS sample bottle. Each well was then purged and sampled by the low-flow / minimal drawdown method, using a MicroPurge (MP15) pump / kit. The MicroPurge system incorporated a low density polyethylene (LDPE) pump bladder and LDPE delivery tubing, employing pressurised carbon dioxide gas to regulate groundwater flow. Pumping pressure and cycles were adjusted to regulate extraction flow rate and avoid excessive drawdown of water level. Measurement of water quality parameters (dissolved oxygen (DO), electrical conductivity (EC), temperature (T), reduction-oxidation potential (Redox) and pH) was conducted repeatedly during well purging. Once three consecutive field measurements were achieved for the purged waters (i.e. to within ± 10% for DO, ± 3% for EC and ± 0.05 for pH), samples for the remaining analytes (i.e. dissolved metals, TRHs, VOCs (including BTEX), PAHs and phenols) were then collected. Purged water volumes removed from each well and final (pre-sampling) field test results are summarised in Table 8-4. Refer also to Appendix G for the field data sheets. All groundwater samples were collected directly into dedicated, pre-labelled containers. All sample containers were laboratory-supplied and only opened once immediately prior to sampling. Notes: Nitrile gloves were worn during the collection of groundwater samples, except the PFAS-test samples (i.e. during bailing). Groundwater aliquots for dissolved metals analysis were field-filtered using 0.45µm pore-size filters (single use).

Activity/Item	Details
Field Observations (including visual and olfactory signs of contamination)	Apart from slight hydrogen sulphide odours at BH1M and BH14M, no suspicious (i.e. volatile organic / petroleum hydrocarbon) odour was detected in the purged / sampled waters from any of the five wells. All waters exhibited light to dark brown or light to dark grey colours, with suspended sediments (i.e. significant turbidity).
Decontamination Procedures	Prior to and between well purging / sampling, the stainless steel bailer was decontaminated by rinsing with potable water, then PFAS-free detergent solution (Alconox®), followed by potable and laboratory-purified waters. The water level and physico-chemical quality probes were washed in a solution of potable water and Decon 90, then rinsed with potable water. Decontamination of the pump system was not required as new, dedicated bladders and tubing were used for each well. Decontamination of the field filtering system was not required as new, dedicated syringes and filters (0.45µm pore-size) were used for each dissolved metal sample.
Sample Preservation and Transport	Sample containers were supplied by the laboratory with the following preservatives: ▪ one 250mL, clear LDPE bottle (unpreserved; for PFAS analysis); ▪ one 500mL, amber glass, acid-washed and solvent-rinsed bottle (for general organic analytes); ▪ two 40mL glass vials, pre-preserved with dilute hydrochloric acid and Teflon-sealed (for VOC analysis); and ▪ one 250mL, HDPE bottle, pre-preserved with dilute nitric acid (1mL; for field-filtered water designated dissolved metals analysis). All containers were filled to the brim with sample, then capped. They were stored in a refrigerated (ice-filled) chest, whilst on-site and in transit to the corresponding laboratory. Since ice was used to keep the samples cool, all melt water was continuously drained from the esky to prevent cross-contamination of samples. Water samples were transported to Eurofins under strict COC conditions. Signed COC certificates and sample receipt documentation were provided by Eurofins for confirmation purposes (Appendix H), as discussed in Section 7. A split (inter-laboratory) water field duplicate was submitted to Envirolab under strict COC conditions. Signed COC certificates and sample receipt documentation were provided by Envirolab for confirmation purposes (Appendix H), as discussed in Section 7. All samples were submitted and analysed within the required holding period, as documented in the corresponding laboratory reports (Appendix I).
Laboratory Analysis and Quality Control	Groundwater samples were analysed by Eurofins and Envirolab for the COPCs. In addition to the split (inter-laboratory) water field duplicate (GWQT1), QA/QC testing comprised a blind (intra-laboratory) water field duplicate (GWQD1), an equipment rinsate blank (GWQR1), a laboratory-prepared, trip spike water sample (GWQTS1) and a laboratory-prepared, trip blank water sample (GWQTB1). The corresponding laboratory reports are presented in Appendix I.

7. DATA QUALITY ASSESSMENT

The assessment of data quality is defined as the scientific and statistical evaluation of environmental data to determine if they meet the objectives for the project (USEPA 2006). For this investigation, the data quality assessment included evaluation of the sampling procedures and the accuracy and precision of the reported laboratory results (based on external (field) and internal QC samples). The findings are discussed in detail in **Appendix J**.

The QC measures generated from the field sampling and laboratory analytical program are summarised in **Table 7-1**.

Table 7-1 Quality Control Process

Data Quality	Control	Conformance [Yes, Part, No]	Report Sections
Preliminaries	Data quality objectives established	Yes	See DQO/DQI; 5.1-5.2
Field work	Suitable documentation of fieldwork methods, observations including borehole logs, sample register, field notes, calibration forms	Yes	See Appendices F, G, H
Sampling Plan	Use of relevant and appropriate sampling plan (density, type, and location)	Yes	See sample rationale; 6.1
	All media sampled and duplicates collected	Yes	See methodology; 6.4-6.5
	Use of approved and appropriate sampling methods (soil and groundwater)	Yes	See methodology; 6.4-6.5
	Selection of soil samples according to field PID readings (where VOCs are present)	Yes	See methodology; 6.4
	Preservation and storage of samples upon collection and during transport to the laboratory	Yes	See methodology; 6.4-6.5
	Appropriate rinsate, field and trip blanks taken	Yes	See methodology; 6.4-6.5
	Completed field and analytical laboratory sample COC procedures and documentation	Yes	See Appendices H, I
Laboratory	Sample holding times within acceptable limits	Yes	See laboratory QA/QC; Appendices I, J
	Use of appropriate analytical procedures and NATA-accredited laboratories	Yes	See laboratory reports; Appendices I, J
	LOR/PQLs low enough to meet adopted criteria	Yes	See laboratory notes; Appendices I, J
	Laboratory blanks	Yes	See laboratory QA/QC; Appendices I, J
	Laboratory duplicates	Yes	See laboratory QA/QC; Appendices I, J
	Matrix spike/matrix spike duplicates (MS/MSDs)	Yes	See laboratory QA/QC; Appendices I, J
	Surrogates (or System Monitoring Compounds)	Yes	See laboratory QA/QC; Appendices I, J

Data Quality	Control	Conformance [Yes, Part, No]	Report Sections
	Analytical results for replicated samples, including (blind / split) field and laboratory duplicates, expressed as relative percentage difference (RPD)	Yes	See Appendices I, J
	Checking for the occurrence of apparently unusual or anomalous results (e.g. laboratory results that appear to be inconsistent with field observations or measurements)	Yes	See Appendix J
Reporting	Report reviewed by senior staff to assess project meets desired quality, EPA guidelines and project outcomes.	Yes	See report author and reviewer section at beginning of document

7.1 Quality Overview

On the basis of the completed assessment, the overall quality of the analytical data from this additional investigation was considered to be of an acceptable standard for interpretive use and preparation of an updated CSM.

8. RESULTS

8.1 Soil Investigation Results

8.1.1 Subsurface Conditions

Based on the combined Aargus (2014 / 2018) and EI (2019) borehole logs, the general site lithology may be described as a layer of anthropogenic filling overlying natural (sandy) silty clays and (weathered) sandstone. A more detailed description is presented in **Table 8-1**.

Table 8-1 Generalised Subsurface Profile

Layer	Description	Thickness (m)
Fill	Silty Sandy CLAY / Gravelly SAND / Silty GRAVEL; grey and brown, soft, loose, some building rubble and ash.	0.1 – 1.9
Natural Clay	(Sandy) Silty CLAY; (dark) grey with red and brown mottling, medium to high plasticity, soft to firm and very stiff, moist, no odour.	2.6 – 7.4
(Weathered) Sandstone	SANDSTONE; grey with dark brown / red mottling and iron staining, fine to medium grained, extremely weathered, very low strength, some clay bands.	From 4-8m BGL +

Note 1 + maximum depth of drilling was 13.4m BGL
Note 2 According to Aargus (2014), natural site soils were non- to slightly saline (≤2 dS/m EC) and non-aggressive to steel and reinforced concrete

8.1.2 Field Observations and PID / pH Results

Soil samples were obtained from the EI (2019) test bores at various depths ranging between 0.15-6.8m BGL. All examined soil samples were evaluated on a qualitative basis for odour and visual signs of contamination (e.g. hydrocarbon odours, oil staining, petrochemical filming, asbestos fragments, ash, charcoal) and the following observations were noted:

- Dark (oil-like) staining was not observed in any of the drilled / examined soils;
- Apart from the presence of ash in the near surface fill and silty clay at BH9M (<0.8m BGL), no visual evidence of contamination was observed in any of the drilled / examined soils;
- Fragments of FCS were found on the ground surface in the vicinity of BH12; however
- No such fragments were observed in any of the drilled / examined soils;
- Petroleum hydrocarbon (solvent-like) odours were detected in all drilled soils at BH6M (0.2-4m BGL), the odour diminishing with depth; however
- No suspicious odour was detected in any of the other drilled / examined soils;
- None of the examined soils displayed visual evidence of the presence of ASS, actual or potential; and
- A hydrogen sulfide odour was not detected in any of the drilled / examined soils.

Elevated soil headspace VOC concentrations were detected in samples from BH6M (0.7-1.8m BGL; PID readings: 53.1-62.5 ppm), consistent with the detection of petroleum hydrocarbon (solvent-like) odours in the drilled soils at that location. All other PID readings were low (<10 ppm; **Appendix F**), indicating that soil contamination from volatile organic compounds was not widespread.

Field and laboratory pH analyses (**Table T3**) indicated that fill soils were neutral to alkaline (pH_f: 6.84-9.49), while the natural clays were acidic to neutral (pH_f: 5.17-7.40). All pH_f values were well above 4, the threshold below which is indicative of actual ASSs, while all pH_{fox} values were well above 3, the threshold below which is indicative of potential ASSs (i.e. unoxidised sulphides). These results were consistent with those from Aargus (2014c), confirming that the soils at the site (to 7.5m BGL, at least) did not contain significant quantities of actual and potential ASSs.

8.2 Groundwater Investigation Results

8.2.1 Monitoring Well Construction

Five groundwater monitoring wells were installed as part of this additional site investigation (BH1M, BH3M, BH6M, BH9M and BH14M), each screening the unconsolidated, reworked (disturbed) natural clays and sands. Well construction details are summarised in **Table 8-2**.

Table 8-2 Monitoring Well Construction Details

Well ID	Bore / Well Depth (m BGL)	Reduced Level (m AHD)	Screened Interval (m BGL)	Lithology Screened
BH1M	6.6 / 4.5	3.05	1.5-4.5	Silty CLAY
BH3M	13.4 / 7.1	2.56	2.0-7.0	Silty CLAY
BH6M	4.0 / 3.7	3.10	1.7-3.7	Silty CLAY / SAND
BH9M	6.4 / 4.8	3.30	2.8-4.8	Silty CLAY / Clayey SAND
BH14M	4.8 / 4.0	2.00	2.0-4.0	Silty CLAY / Clayey SAND

Note 1 m BGL = metres below ground level
Note 2 Reduced levels are the ground surface elevation, measured off the supplied survey plan and given in metres Australian Height Datum (m AHD)

8.2.2 Field Observations and Water Test Results

A single GME was conducted for this additional site investigation (9 Janaury 2018: BH1M, BH3M, BH6M and BH9M; 11 January 2019: BH14M). SWL results, well purge volumes and field-based water test results are summarised in **Table 8-4**. Copies of the completed Field Data Sheets are included in **Appendix G**.

Table 8-4 Groundwater Field Data

Well ID	SWL (m BGL)	TWD (m BGL)	Water Column (m)	Purge Volume (L)	DO (mg/L)	Field pH	Field EC (µS/cm)	Temp (oC)	Redox (mV)	Odour / Turbidity
BH1M	1.08	4.5	3.42	3.5	0.06	5.88	1950	22.6	244	Slight H2S odour / turbid
BH3M	1.18	7.1	5.92	3.5	0.12	5.95	5347	20.0	207	No odour / turbid
BH6M	0.88	3.7	2.82	4.0	0.34	5.25	831	25.2	327	No odour / turbid
BH9M	1.34	4.8	3.46	3.5	0.19	5.73	2019	23.0	141	No odour / slightly turbid

Well ID	SWL (m BGL)	TWD (m BGL)	Water Column (m)	Purge Volume (L)	DO (mg/L)	Field pH	Field EC (µS/cm)	Temp (oC)	Redox (mV)	Odour / Turbidity
BH14M	0.30	4.0	3.70	2.5	0.48	5.37	2626	24.6	206	Slight H2S odour / turbid

Note 1 SWL = Standing Water Level, as measured from ground surface prior to groundwater sampling
Note 2 L = litres (referring to total volume of groundwater purged from the well prior to final field (physico-chemical) measurement and sample collection)
Note 3 Redox (mV) values were adjusted (relative) to the Standard Hydrogen Electrode by adding 205mV to the field measurement

Phase-separated hydrocarbons were not detected in any of the wells (nor was any sheen or hydrocarbon filming). The inferred groundwater flow direction (i.e. hydrualic gradient) was south easterly, in the direction toward Alexandra Canal.

The physico-chemical data indicated that the local groundwater was slightly acidic (pH 5.25-5.95), slightly saline to brackish (EC: 831-5347 µS/cm), low in dissolved oxygen and relatively anoxic (reducing).

8.3 Laboratory Analytical Results

8.3.1 Soil Analytical Results

A summary of the laboratory results showing test sample quantities, minimum / maximum analyte concentrations and samples found to exceed the SILs, is presented in **Table 8-5**. More detailed tabulation showing the tested concentrations for individual samples alongside the adopted soil criteria are presented in **Table T1** at the end of this report. Note that **Tables 8-5** and **T1** include sample data from the previous Aargus (2014) investigations.

Table 8-5 Summary of Soil Analytical Results

No. of primary samples	Analyte	Min. Conc. (mg/kg)	Max. Conc. (mg/kg)	Sample(s) exceeding SIL
Hydrocarbons				
39	Carcinogenic PAHs (as B(a)P TEQ)	<0.5	74	Aargus: BH4 (0.3-0.5), BH5 (0.2-0.4), BH6 (0.2-0.4), BH14 (0.2-0.3), BH21 (0.3-0.5) EI: BH9M_0.2-0.3
39	Benzo(a)pyrene	<0.05	52	EI: BH9M_0.2-0.3
39	Total PAHs	<0.5	819	None
39	Napthalene	<0.1	0.2	None
39	Benzene	<0.1	<0.2	None
39	Toluene	<0.1	<0.5	None
39	Ethylbenzene	<0.1	<1.0	None
39	Total xylenes	<0.3	<2.0	None
39	F1	<20	74	None
39	F2	<50	190	EI: BH6M_1.2-1.3
39	F3	<100	1200	Aargus: BH9 (0.4-0.6), BH11 (0.2-0.4), BH12 (0.3-0.5), BH21 (0.3-0.5), BH22 (0.2-0.3), D2 (duplicate of BH4 (0.3-0.5)), D3 (duplicate of BH11 (0.2-0.4))

No. of primary samples	Analyte	Min. Conc. (mg/kg)	Max. Conc. (mg/kg)	Sample(s) exceeding SIL
				EI: BH3M_0.3-0.4, BH9M_0.2-0.3
39	F4	<50	440	None
Pesticides				
24	OCPs	<0.1	0.57	None
24	OPPs	ND	ND	None
Phenols				
2	Total phenols	<1	<1	None
Metals (Total)				
60	Arsenic	1	48	None
60	Cadmium	<0.1	3.4	None
60	Chromium	4	43	None
60	Copper	1	275	Aargus: BH1 (0.5-1.0), BH5 (0.2-0.4), BH6 (0.2-0.4), BH8 (0.1-0.3), BH11 (0.2-0.4), BH12 (0.3-0.5), BH14 (0.2-0.3), D4 (duplicate of BH11 (0.2-0.4)) EI: BH6M_0.2-0.3, BH9M_0.2-0.3
60	Lead	9.6	1176	Aargus: BH5 (0.2-0.4), BH6 (0.2-0.4), BH12 (0.3-0.5), BH21 (0.3-0.5), BH13 (0.8-1.0)
60	Mercury	<0.05	1.1	None
60	Nickel	<0.5	110	EI: BH6M_1.2-1.3, BH7_1.4-1.5
60	Zinc	1.2	1770	Aargus: BH4 (0.3-0.5), BH5 (0.2-0.4), BH6 (0.2-0.4), BH7 (0.4-0.6), BH8 (0.1-0.3), BH9 (0.4-0.6), BH10 (0.4-0.5), BH11 (0.2-0.4), BH12 (0.3-0.5), BH14 (0.2-0.3), BH21 (0.3-0.5), BH22 (0.2-0.3), D1 (duplicate of BH9 (0.4-0.6)), D2 (duplicate of BH4 (0.3-0.5)), D4 (duplicate of BH11 (0.2-0.4)), BH7 (1.1-1.3), BH12 (0.7-0.9) EI: BH2_0.2-0.3, BH6M_0.2-0.3, BH7_0.2-0.3, BH9M_0.2-0.3, BH13_0.3-0.4, BH14M_0.2-0.3
PCBs				
24	Total PCBs	<0.5	<5	EI: BH10_0.3-0.4, BH14M_0.2-0.3
Asbestos				
34	Asbestos	Not detected	Asbestos detected	Aargus: BH1 (0.0-0.5), BH7 (0.4-0.6), BH22 (0.2-0.3) EI: BH13_0.3-0.4
PFAS				
10	PFOA	<0.005	<0.005	None
10	PFOS	<0.005	0.037	BH6M_0.2-0.3, BH13_0.3-0.4

No. of primary samples	Analyte	Min. Conc. (mg/kg)	Max. Conc. (mg/kg)	Sample(s) exceeding SIL
10	PFOS + PFHxS	<0.005	0.037	None

Heavy Metals

All heavy metal concentrations were below the corresponding human health-based SILs for residential settings with minimal access to soils. Exceedances of the derived EILs were identified for copper (113-275 mg/kg; to 1m BGL), lead (758-1176 mg/kg; to 1m BGL), nickel (110 mg/kg for BH6M_1.2-1.3 and 43 mg/kg for BH7_1.4-1.5) and zinc (200-1770 mg/kg; to 1.3m BGL), at several locations and mostly in the imported fill layer. The 95% UCLs for these metals were 78.3 mg/kg, 309 mg/kg, 11.8 mg/kg and 437 mg/kg, respectively (n=60; assuming the LOR value where a sample concentration was reported as <LOR).

TRHs

All concentrations of the screened TRH fractions (F1-F4) were below the corresponding human health-based SILs for residential settings with minimal access to soils. Exceedances of the adopted ESLs were identified for the $>C_{10}$-C_{16} (F2; 190 mg/kg for BH6M_1.2-1.3) and $>C_{16}$-C_{34} (F3; 300-1200 mg/kg; to 0.6m BGL) fractions.

VOCs (including BTEX and Naphthalene)

Apart from a trace of trichloroethene (TCE) in BH7 (0.4-0.6; 1 mg/kg; Aargus (2014b)) and a trace of tetrachloroethene (PCE) in BH13_0.3-0.4 (0.7 mg/kg; EI (2019)), no detectable concentration of any of the screened VOCs (including BTEX and naphthalene) were identified in the tested samples, with all LORs being below the corresponding SILs (where available). The traces of TCE and PCE were not considered to be of significance (i.e. they would not pose any risk to human health and/or the environment).

PAHs

Except for BH4 (0.3-0.5; 7.7 mg/kg sum carcinogenic PAHs), BH5 (0.2-0.4; 5.2 mg/kg sum carcinogenic PAHs), BH6 (0.2-0.4; 5.8 mg/kg sum carcinogenic PAHs), BH14 (0.2-0.3; 9.1 mg/kg sum carcinogenic PAHs), BH21 (0.3-0.5; 10 mg/kg sum carcinogenic PAHs) and BH9M_0.2-0.3 (819 total PAHs and 74 mg/kg sum carcinogenic PAHs), all PAH concentrations were below the corresponding human health-based SILs for residential settings with minimal access to soils. The contamination appeared to be confined to the imported fill layer.

Except for BH9M_0.2-0.3 (52 mg/kg), all benzo(α)pyrene concentrations were below the corresponding ESL.

Note:
For all Aargus (2014b) soil samples, each total PAH concentration was tabulated as <1 mg/kg in the text of the corresponding report, suggesting a recording error, given that sum carcinogenic PAHs and benzo(α)pyrene exceeded this value in various cases. In the absence of the original laboratory analytical reports, which were not included in the copy of the Aargus (2014b) DSI report supplied to EI, this discrepancy cannot be clarified.

Phenols

No detectable concentration of any of the screened phenolic compounds was identified in the tested samples, with all LORs being below the corresponding SILs.

Pesticides and PCBs

For all tested samples, the concentrations of all screened OCP and OPP compounds were below the corresponding LOR or SIL (with the LOR being below the respective SIL in each case).

No detectable concentration of any of the screened PCB compounds was identified in the tested samples, noting that in two cases the LOR was raised above the adopted SIL due to matrix interference (i.e BH10_0.3-0.4 and BH14M_0.2-0.3).

Asbestos

Asbestos was identified in four fill soil samples, those being BH1 (0-0.5), BH7 (0.4-0.6), BH22 (0.2-0.3) and BH13_0.3-0.4.

PFAS

For all tested samples, the concentrations of all screened PFAS compounds were below the corresponding LOR or the human health-based SIL for residential settings with minimal access to soils (where available; with the LOR being below the respective SIL in each case).

Except for perfluorooctanesulfonic acid (PFOS) in BH6M_0.2-0.3 (0.037 mg/kg) and BH13_0.3-0.4 (0.013 mg/kg), the concentrations of all screened PFAS compounds were below the corresponding ecological guideline value (where available; again the LOR being below the respective guideline).

8.3.2 Groundwater Analytical Results

Laboratory analytical results for the groundwater samples are presented in **Table T2**, which includes the adopted GILs. Note that **Table T2** includes sample data from the previous Aargus (2014) investigations.

Dissolved Heavy Metals

Concentrations in excess of the adopted GILs were identified for the groundwater sampled from all seven monitoring bores (GW1, GW2, BH1M, BH3M, BH6M, BH9M and BH14M), as follows:

Copper:	GW1 (2 µg/L), BH6M-1 (3 µg/L) and GWD1 (3 µg/L);
Nickel:	BH1M-1 (58 µg/L), BH3M-1 (64 µg/L), BH6M-1 (50 µg/L), BH9M-1 (82 µg/L), BH14M-1 (71 µg/L) and GWD1 (52 µg/L); and
Zinc:	BH1M-1 (35 µg/L), BH3M-1 (45 µg/L), BH6M-1 (220 µg/L), BH9M-1 (26 µg/L), BH14M-1 (150 µg/L) and GWD1 (23 µg/L).

Note:
GWD1 was a duplicate sample of BH6M-1.

All other dissolved metal concentrations were below the corresponding LOR or GIL (with the LOR being below the respective GIL in each case).

TPHs / TRHs

All TPH and TRH concentrations were below the corresponding LOR or GIL (with the LOR being below or equivalent to the respective GIL in each case).

VOCs (including BTEX)

Trace concentrations of several of the screened VOCs were identified in four groundwater samples, as follows:

Toluene:	BH6M-1 (1 µg/L);
Ethylbenzene:	BH6M-1 (5 µg/L) and GWD1 (6 µg/L);
Total Xylenes:	BH6M-1 (7 µg/L) and GWD1 (9 µg/L);
Trichloroethene (TCE):	BH1M-1 (3 µg/L); and
2-Propane (Acetone):	BH6M-1 (11 µg/L) and BH14M-1 (18 µg/L).

All other concentrations were below the corresponding LOR (with the LOR being below the respective GIL in each case, where available). The ethylbenzene concentrations for BH6M-1 and GWD1 were equivalent to, or slightly in excess of, the adopted GIL.

PAHs and Phenols

For all tested samples, the concentrations of all screened PAH and phenolic compounds were below the corresponding LOR or GIL (where available; with the LOR being below the respective GIL in each case).

PFAS

Trace concentrations of several of the screened PFAS compounds were identified in three groundwater samples, as follows:

Perfluorooctanoic acid (PFOA):	BH1M-1 (0.08 µg/L), BH6M-1 (0.04 µg/L) and BH14M-1 (0.02 µg/L);
Perfluorooctanesulfonic acid (PFOS):	BH1M-1 (0.01 µg/L) and BH6M-1 (0.08 µg/L); and
PFOS + Perfluorohexanesulfonic acid (PFHxS):	BH1M-1 (0.01 µg/L) and BH6M-1 (0.08 µg/L).

All other concentrations were below the corresponding LOR. The PFOS concentrations for BH1M-1 and BH6M-1 exceeded the adopted GIL. The PFOS + PFHxS concentration for BH6M-1 exceeded the drinking water guideline (although this was due to solely to the PFOS content).

9. SITE CHARACTERISATION

9.1 Residual Soil Impacts

Based on the combined Aargus (2014 / 2018) and EI (2019) data, near surface (≤1.5m BGL) soils contaminated by PAHs and asbestos were present on the site, the impacts from these COPCs exceeding the human health-based SILs for residential settings with minimal access to soils. The PAH and asbestos contamination was not considered to be gross (i.e. high level); however, it was generally widespread in lateral terms, being identified at ten separate sampling locations across the site (Aargus (2014): BH1, BH4, BH5, BH6, BH7, BH14, BH21 and BH22; EI (2019): BH9M and BH13).

Heavy metal (copper, lead, nickel and zinc), TRH (F2/F3) and PFAS (PFOS) contamination was also apparent; however, for these COPCs, the impacts were of concern to ecological values, rather than human health.

In terms of the vertical extent of contamination, the imported fill layer contained most of the contaminant load; however, some of the reworked (disturbed) natural soils were also impacted.

It was concluded that impacted (fill) soils would need to be remediated as part of the proposed development.

Based on the analaytical results, acid sulfate soils are not present onsite.

9.2 Groundwater Impact

Heavy metal- (copper, nickel and zinc), volatile (chlorinated) hydrocarbon- and PFAS- (PFOA and PFOS) contaminated groundwater was identified during this ASI. While the metal levels were consistent with background conditions for the Marrickville (Alexandra Canal) industrial area, the presence of VOCs (toluene, ethylbenzene, xylenes, TCE and acetone) and PFAS (PFOA and PFOS) suggested that groundwater quality has been influenced by more localised (site-derived) sources.

It was concluded that further groundwater monitoring (i.e. additional GMEs) should form part of the proposed development (i.e. be integrated into the site validation program). The existing wells are therefore to be protected during the early (land clearance / levelling) stages of the works.

9.3 Review of Conceptual Site Model

On the basis of the additional investigation findings, the CSM discussed in **Section 4** was considered to appropriately identify contamination sources, migration mechanisms and exposure pathways, as well as potential onsite and offsite receptors. Previously known data gaps, as outlined in **Section 4.6**, were considered to have been addressed have been addressed.

9.4 Considerations for Site Remediation

The site will require soil remediation in order for it to be suitable for the proposed land use. Given that the redevelopment includes a basement car parking facility (**Appendix C**), the most feasible remediation strategy involves contaminated soil excavation and off-site disposal at EPA-licensed landfill facilities.

To this end, the near-surface (≤1.5m BGL) soils have been classified in accordance with the EPA (2014a) *Waste Classification Guidelines*, the process being assisted by the analysis of selected EI (2019) samples for their weak acid-extractable metal and PAH contents utilising the *toxicity characteristics leaching procedure* (TCLP). Refer to **Appendices H** and I for the rebatch requests and subsequent laboratory analytical reports. The TCLP data and adopted waste criteria, the latter derived from the EPA (2014b) *Waste Classification Guidelines*, are included in **Table T1** at the end of this report.

Asbestos Waste

Fill soils in the vicinities of BH1, BH7 and BH22 (Aargus, 2014) and BH13 (EI, 2019) were classified as *Special Waste (Asbestos Waste)*, due to the presence of ACMs. These soils must be treated (i.e. excavated) first during the remediation phase.

It is suggested that at each test location, the entire fill layer be removed from within an area of approximately 3m x 3m at the surface (that being the minimum zone of remediation), with additional wall and/or base excavations conducted as dictated by the validation program. The corresponding soil validation samples will be screened for asbestos (at least).

General Solid Waste

All remaining fill soils across the site, plus any reworked / disturbed natural soils ≤1.5m BGL, were classified as *General Solid Waste (Non-Putrescible)*. This includes the PAH-impacted materials in the vicinities of BH4, BH5, BH6, BH14 and BH21 (Aargus, 2014) and BH9M (EI, 2019).

It is acknowledged that some of the PAH (including benzo(a)pyrene) data for the site-wide filling exceeded the respective EPA (2014a) *SCC1 General Solid Waste* and *SCC2 Restricted Solid Waste* thresholds. However, persuant to the provisions in Clause 28 of the *Protection of the Environment Operations (Waste) Regulation 1996*, the EPA has authorised the general approval of the immobilisation of PAHs, including benzo(a)pyrene, in ash- / coal- contaminated, excavated materials (Approval Number 1999/05). This approval is based on the theory that the residual PAHs will be naturally immobilised (i.e. strongly bound) within a vitrified carbonaceous and siliceous matrix.

The filling from this site was considered to comply with this waste stream because:

- its colour (typically (dark) grey and brown), texture (silty sandy clay / gravelly sand / silty gravel, with building rubble and ash) and use (imported fill) were consistent with being an ash- / coal-contaminated, soil material;
- it did not contain any free liquid; and
- despite elevated concentrations of total PAHs (up to 819 mg/kg) and benzo(a)pyrene (up to 52 mg/kg), the TCLP-leachable levels were negligible (<0.0001 mg/L for benzo(a)pyrene).

Therefore, in accordance with the provisions of EPA General Approval Number 1999/05 and the procedures set out in the EPA (2014a) Waste Classification Guidelines, the remaining, (non-ACM) site-wide filling was classified as General Solid Waste.

Upon removal of the site-wide fill, exposed surface soil validation samples will be screened for asbestos, PAHs, heavy metals (including copper, lead, nickel and zinc), TRHs and PFAS (at least).

10. Conclusions

The site located at 182-198 Victoria Road & 28-30 Faversham Street, Marrickville was the subject of an Additional Site Investigation that was conducted in order to assess the degree of on-site contamination associated with current and former uses of the property. Based on the findings of this investigation, it was concluded that:

- There was no evidence, by way of a fill / dip point, to suggest that a UPSS was present on the site.
- The site was free of statutory notices issued by the NSW EPA.
- The sub-surface layers were comprised of anthropogenic filling (Silty Sandy CLAY / Gravelly SAND / Silty GRAVEL, with some building rubble and ash; 0.1-1.9m thickness), overlying natural (Sandy) Silty CLAY and Clayey SAND (2.6-7.4m thickness) and (weathered) sandstone.
- Groundwater was encountered between 0.3-2.1m BGL in the monitoring wells and the inferred flow direction was south easterly, toward Alexandra Canal. Local groundwater was considered to be slightly acidic (pH 5.25-5.95) and slightly saline to brackish (EC: 831-5347 µS/cm).
- Near surface (≤1.5m BGL) soils contaminated by PAHs and asbestos were present on the site, the impacts from these COPCs exceeding the human health-based SILs for residential settings with minimal access to soils. The PAH and asbestos contamination was not considered to be gross (i.e. high level); however, it was generally widespread in lateral terms, being identified at ten separate sampling locations across the site (Aargus (2014): BH1, BH4, BH5, BH6, BH7, BH14, BH21 and BH22; EI (2019): BH9M and BH13).
- Heavy metal (copper, lead, nickel and zinc), TRH (F2/F3) and PFAS (PFOS) contamination of soil was also apparent; however, for these COPCs, the impacts were of concern to ecological values, rather than human health.
- In terms of the vertical extent of contamination, the imported fill layer contained most of the contaminant load; however, some of the reworked (disturbed) natural soils were also impacted.
- Acid sulfate soils are not present onsite.
- The local groundwater was contaminated by heavy metals (copper, nickel and zinc), volatile (chlorinated) hydrocarbons (toluene, ethylbenzene, xylenes, TCE and acetone) and PFAS (PFOA and PFOS). Further groundwater monitoring (i.e. additional GMEs) was warranted.
- Based on the findings of this ASI, and with consideration of the Statement of Limitations (**Section 12**), EI consider the site can be made suitable for the proposed development, given the recommendations detailed in **Section 11** are implemented.

11. RECOMMENDATIONS

In view of the above findings and in accordance with the NEPM (2013) guidelines, it was considered that the site could be made suitable for the proposed development on completion of the following tasks:

- Preparation and implementation of a Remediation Action Plan (RAP), which should;
  - Outline the management of soils impacted with heavy metals (copper, lead, nickel and zinc), TRH, PAH, PFAS and asbestos.
  - Design supplementary investigations for further groundwater monitoring (i.e. additional GMEs) as part of the site validation program.
  - Validation of excavated areas to ensure soils and groundwater are suitable for the proposed development.
  - Validation of any material being imported to the site in accordance with EPA guidelines, to confirm its suitability for the proposed (residential) land use.
- Preparation of a final site validation report by a qualified environmental consultant, certifying site suitability for the proposed development.

12. STATEMENT OF LIMITATIONS

The findings presented in this report are the result of discrete and specific sampling methodologies used in accordance with best industry practices and standards. Due to the site-specific nature of soil sampling from point locations, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program.

While normal assessments of data reliability have been made, EI assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA), statements from sources outside of EI, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to EI's investigations and assessment.

EI's assessment is necessarily based upon the result of the site investigation and the restricted program of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. Neither EI, nor any other reputable consultant, can provide unqualified warranties nor does EI assume any liability for site conditions not observed or accessible during the time of the investigations.

This report was prepared for the above named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

This report and associated documents remain the property of EI subject to payment of all fees due for this assessment. The report shall not be reproduced except in full and with prior written permission by EI.

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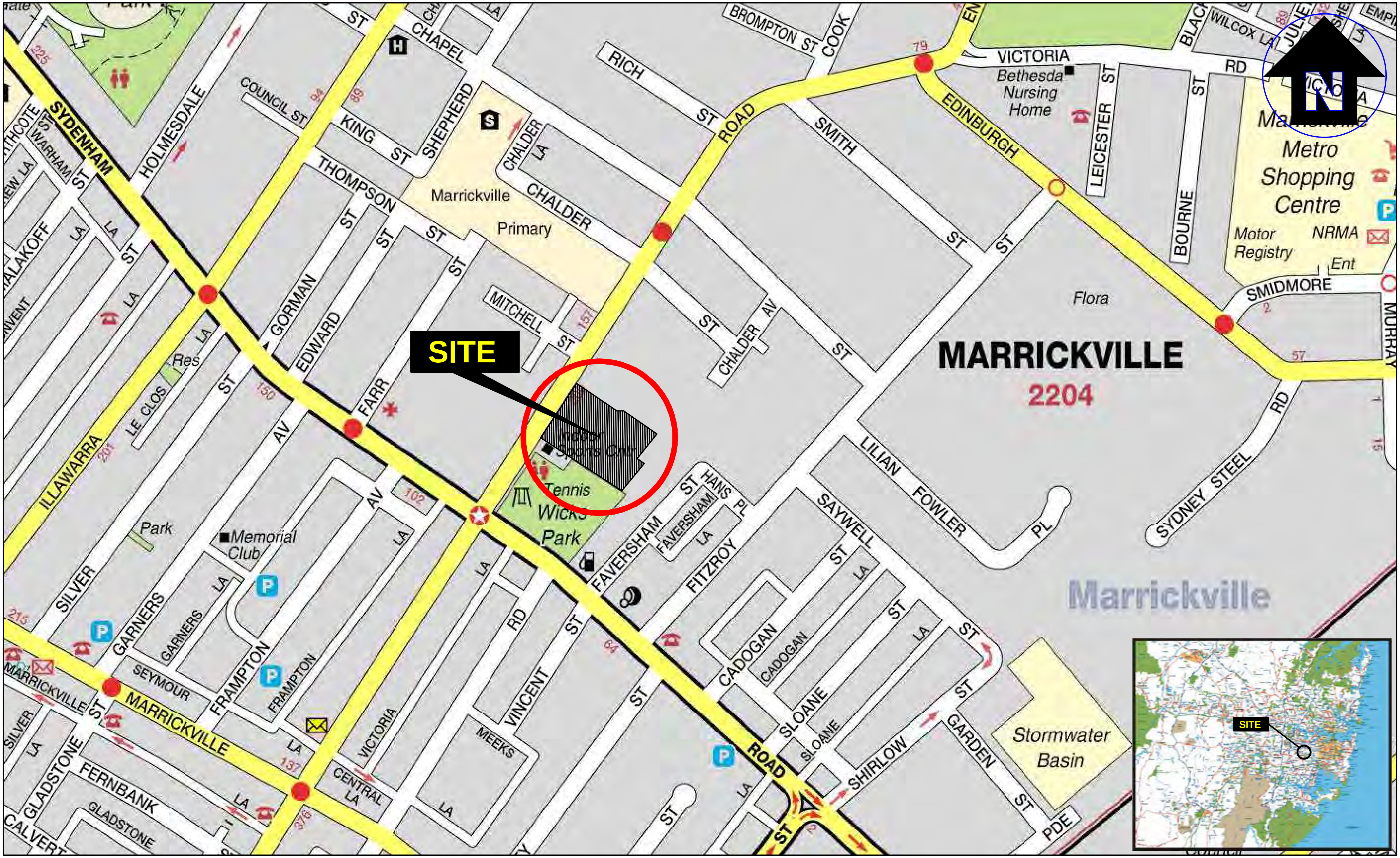
ABBREVIATIONS

ACM	Asbestos-containing materials
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid sulfate soils
B(a)P	Benzo(a)Pyrene (a PAH compound), - B(a)P TEQ Toxicity Equivalent Quotient
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody
COPCs	Chemicals of Potential Concern
cVOCs	Chlorinated Volatile Organic Compounds (a sub-set of the VOC analysis suite)
DA	Development Application
DEC	Department of Environment and Conservation, NSW (see OEH)
DECC	Department of Environment and Climate Change, NSW (see OEH)
DECCW	Department of Environment, Climate Change and Water, NSW (see OEH)
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DP	Deposited Plan
EC	Electrical Conductivity
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority
ESL	Ecological Screening Level
F1	C_6-C_{10} TRH less the sum of BTEX concentrations (Ref. NEPC (2013) Schedule B1)
F2	>C_{10}-C_{16} TRH less the concentration of naphthalene (Ref. NEPC (2013) Schedule B1)
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
km	Kilometres
LNAPL	Light Non-Aqueous Phase Liquid
LOR	Limit of Reporting (quantitative limit for the respective laboratory analytical method)
m	Metres
m AHD	Metres Australian Height Datum
m BGL	Metres Below Ground Level
mg/L	Milligrams per Litre
µg/L	Micrograms per Litre
mV	Millivolts
MW	Monitoring Well
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
PAHs	Polycyclic Aromatic Hydrocarbons
pH	Potential Hydrogen (measure of the acidity or basicity of an aqueous solution)
PQL	Practical Quantitation Limit (limit of detection for respective laboratory instruments)
PSH	Phase-Separated Hydrocarbons
QA/QC	Quality Assurance / Quality Control
RAP	Remediation Action Plan
SRA	Sample Receipt Advice (document confirming laboratory receipt of samples)
SWL	Standing Water Level
TDS	Total Dissolved Solids (a measure of water salinity)

TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbons (superseded term equivalent to TRH)
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit (of the arithmetic mean)
USEPA	United States Environmental Protection Agency
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

Appendix A - Figures



Drawn:	L.C.
Approved:	-
Date:	-
Scale:	Not To Scale

TOGA Wicks Park Developments Pty Ltd

Additional Site Investigation

182 - 198 Victoria Road & 28-30 Faversham Street, Marrickville, NSW

Site Locality Plan

Figure: 1

Project: E24098 E03_Rev0

eiaustralia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

NOTE:

1	chemical storage associated with stone cutting workshop
2	commercial landuary/ hotel linnen services
3	GW monitoring well installed in previous unknown investigation
4	spray painting booth
5	solderring/ welding activity
6	asbestos fragments on ground
7	substain No.284
8	entire site is covered by concrete except the area shown as gravel roadbase

LEGEND

- Approximate site boundary
- Approximate paint workshop area
- Approximate stone cutting building area
- Approximate offices area
- Approximate smash reapair workshop area
- Approximate residential brick cottage area
- Approximate gravel roadbase area
- Approximate exposed soil/vegetation area

eiaustralia
Contamination | Remediation | Geotechnical

Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	L.C.
Approved:	M.G.
Date:	17-01-19

TOGA Wicks Park Developments Pty Ltd
Additional Site Investigation
182 - 198 Victoria Road & 28-30 Faversham Street, Marrickville, NSW

Site Feature Plan

Figure: 2

Project: E24098 E03_Rev0

LEGEND

- Approximate site boundary
- Approximate basement boundary
- Approximate location of borehole not being tested
- Approximate enviro borehole location
- Approximate enviro monitoring well location
- Approximate Geo-tech borehole location
- Approximate combined borehole location
- Approximate combined monitoring well location
- Approximate borehole location (Aargus, 2014)
- Approximate monitoring well location (Aargus, 2014)
- Approximate Borehole/monitoring well location out of EI(2019) scope (Aargus, 2014)

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Contamination | Remediation | Geotechnical

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Drawn:	L.C.
Approved:	M.G.
Date:	04-02-19

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Additional Site Investigation

182 - 198 Victoria Road, & 28-30 Faversham Street, Marrickville, NSW

Sampling Location Plan

Figure: 3

Project: E24098 E03_Rev0