Remediation Validation Report

42-52 Raymond Avenue, Matraville NSW

Prepared for Perpetual Corporate Trust Limited ATF 42 Matraville Investment Trust
November 2021

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42-52 Raymond Avenue, Matraville NSW

Report Number

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Client

Perpetual Corporate Trust Limited ATF 42 Matraville Investment Trust

Date

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Version

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Prepared by	**Approved by**
	
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16 November 2021	16 November 2021

Executive Summary

ES1 Introduction and objectives

EMM Consulting Pty Limited (EMM) was engaged by Perpetual Corporate Trust Limited ATF 42 Matraville Investment Trust (Matraville Investment Trust) to undertake remediation and validation works in accordance with the Remediation Action Plan (RAP)[1] for redundant underground petroleum storage system (UPSS) infrastructure and surrounding soil within the western portion of the property identified as 42-52 Raymond Avenue, Matraville NSW (the Site).

The objective of the remediation works was to remove the UPSS infrastructure and surrounding impacted soils, where practicable, to support the suitability of the Site for redevelopment in accordance with the current zoning (general industrial).

The purpose of this report is to document the remediation works which were undertaken in accordance with the RAP, which comprised decommissioning and removal of UPSS infrastructure and excavation of contaminated soil to the extent practicable and in accordance with the Specialist Engineering Assessment (SEA)/Sydney Water approvals.

ES2 Scope of works

Preparation of this validation report was undertaken in general accordance with NSW EPA (2020) and NSW DECC (2010b), comprising the following scope of works:

- a summary of the remediation works completed;
- a summary of the results of the localised soil assessment (validation sampling) against the adopted validation criteria outlined in the RAP;
- variations to the remedial strategy undertaken during the implementation of the works;
- details on waste classification, tracking and off-site disposal;
- details of environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents; and
- information demonstrating compliance with appropriate regulations and guidelines, including a statement regarding the suitability of the remediation area for the proposed land use, or recommendations for future management if required.

ES3 Remedial contingencies

A significantly greater quantity of asbestos containing material (ACM) than anticipated was identified during the remediation excavation works. The bottom of some tanks had been filled in with ACM material. Material surrounding the tanks was also found to be ACM impacted. As it was not feasible to dispose of the larger than expected quantity of ACM impacted soil material off-Site (ie follow the original preferred remedial strategy), an alternative strategy had to be implemented based on the most practical application of currently available remediation technologies.

[1] EMM (2021) Remediation Action Plan, 46-52 Raymond Avenue, Matraville NSW, prepared for Epson Enterprises, March 2021

The most appropriate strategy was determined based on the information contained within the RAP (EMM 2021), which stated that on-site capping/containment would be the appropriate strategy for a contingency action.

Excavated soils removed from around the tanks were replaced in the excavation voids after being suitably validated (noting residual asbestos contamination) as the adopted remedial contingency (refer to Section 7). Clean fill validated as virgin excavated natural materials (VENM) was also used to reinstate the excavations over the backfill material, separated by a high density polyethylene plastic marker layer. Compaction was completed by track rolling. It is noted that cement stabilised sand was used as backfill for the deepest 300 millimetres (mm) of the T1 excavation in line with SEA/Sydney Water requirements.

The only material destined for off-Site disposal was from the stockpile identified as SP04 due to significant hydrocarbon odours and staining observed. The material was sourced from the T1 excavation, beneath and adjacent to where the tank was located and visibly leaking product.

ES4 Results

Material destined for off-Site disposal (Stockpile SP04) was classified as Restricted Solid Waste in accordance with the NSW EPA Waste Classification Guidelines: Part 1 Classifying Waste.

Due to access limitations imposed by the requirements of the SEA/Sydney Water, investigations downgradient and below the former UPSS (adjacent to the stormwater canal) was limited. While all validation samples met the validation criteria for laboratory analytical results (excluding the presence of asbestos), the T1 excavation base samples did not meet the validation criteria for aesthetical considerations due to observed hydrocarbon odours and staining. Deeper excavation during the remediation works was not permitted based on the SEA/Sydney Water requirements. It is therefore considered possible that residual soil and/or groundwater hydrocarbon impacts associated with the former on-Site UPSS may be encountered at depth (below 2.5 metres (m)) within proximity to the former location of T1, including downgradient.

The remediation works confirmed that ACM material at the Site was extensive, and as a result the remedial contingency of on-site containment had to be applied to the original remedial strategy. This involved reinstatement of ACM impacted material to excavation voids, followed by capping, as off-Site disposal. While one excavation base sample (T4) contained asbestos, due to the refined remedial approach (backfill of ACM material), this was considered acceptable.

ES5 Conclusions

The remediation works:

- were undertaken in accordance with legislative guidelines, Site-specific Sydney Water requirements and current industry best practice;
- executed the remediation strategy in accordance with the RAP (EMM 2021); and
- implemented contingency options in accordance with the RAP were considered warranted based on the subsurface conditions encountered during remediation works at the Site. Variations to the preferred remediation strategy have been documented in this Validation Report. This included excavated asbestos impacted material reinstated to excavation voids and then capped due to the greater extent of asbestos impacted material encountered.

EMM notes that SEA/Sydney Water requirements affected the remediation methodology proposed (as originally anticipated in the RAP), whereby the spatial limitations imposed on the extent of excavation that could be conducted adjacent to the heritage listed stormwater channel prevented lateral (to the west) and vertical remediation of residual hydrocarbon impacted soil at the Site.

EMM notes that, given the primary sources of hydrocarbon contamination (ie the UPSS) have been removed and extensive excavation and disposal of hydrocarbon contaminated soil has been completed during these remediation works, the residual contamination and potential source of groundwater impact has been significantly reduced so far as is reasonably practicable. The Site may be considered suitable for land use purposes under the current land zoning (IN1: General industrial) subject to appropriate recommendations outlined in this report being implemented in accordance with legislative guidelines.

ES6 Recommendations

Management of residual contamination (ACM and hydrocarbon impacted soil) will need to be considered under future construction management plans. Uncovering of residual hydrocarbon contamination is not expected based on current redevelopment plans however there may be ACM uncovered during redevelopment. Additional monitoring (such as airborne fibre monitoring) and management (such as covering of stockpiles, sediment controls, and additional PPE) may be required based on the extent of contamination uncovered. These measures and controls should be presented by the appointed Contractor for review and endorsement prior to implementation.

In accordance with the RAP (EMM 2021), all efforts were made to install at least one (1) groundwater monitoring well within the UPSS source area or downgradient to assess conditions. This was not feasible during the detailed site investigation (DSI) or remediation and validation works due to the spatial constraints of working within close proximity to the Sydney Water canal along the western boundary of the Site, and due to slope stability/safety concerns in the location where installation of a groundwater well would be desirable. Based on current site redevelopment plans it is not expected that these constraints will be removed. Should redevelopment design plans change then the feasibility to assess post-remediation groundwater conditions should be reviewed.

The risks to human health and the environment associated with residual hydrocarbon impact in soil and capped ACM impacted soil at the Site must be managed by an Environmental Management Plan (EMP) prepared by a suitably qualified environmental consultant. As the reinstatement of ACM impacted soil was an interim measure (to be addressed in conjunction with broader ACM contamination beyond the remediation area), an interim EMP is required for any intrusive works to ensure that risks are managed.

A Site-specific Asbestos Management Plan (AMP) is also required under Part 8.4 of the NSW Work Health and Safety Regulation 2017 where there is potential for asbestos materials to be encountered. This will relate to works that may intersect, excavate or otherwise encounter any areas with potential, likely and confirmed asbestos. It is noted that this may include other areas of the Site beyond the scope of this validation report (ie outside of the UPSS remediation area).

Subject to completion of any further remediation works which may be undertaken during construction, a Long Term EMP (LTEMP) may be required to manage residual post-construction contamination risks. For any encapsulated ACM in soils, this would be primarily to ensure that capping material remains intact. The LTEMP should specify the monitoring requirements and procedures for future ground disturbance in the area of the Site where encapsulation has been undertaken.

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1 Introduction

1.1 Background

EMM Consulting Pty Limited (EMM) was engaged by Perpetual Corporate Trust Limited ATF 42 Matraville Investment Trust (Matraville Investment Trust) to undertake remediation and validation works in accordance with the Remediation Action Plan (RAP) (EMM 2021a) for redundant underground petroleum storage system (UPSS) infrastructure and surrounding soil within the western portion of the property identified as 42-52 Raymond Avenue, Matraville NSW (the Site).

EMM understands that the Site is proposed to be developed into a new warehouse facility. The property comprises approximately 1.98 hectares (ha) of land in an industrial area of Matraville in southern Sydney near Port Botany. The Site was previously occupied by a warehouse building, which has since been demolished.

EMM was engaged by Epsom Enterprises Pty Ltd (Epsom) to undertake a detailed site investigation (DSI) in mid-2020 (EMM, 2020). During the DSI fieldworks, UPSS infrastructure was identified in the western portion of the Site, and a RAP was developed by EMM (EMM, 2021a) to manage the removal of UPSS infrastructure. EMM also facilitated the approval of the proposed remediation works with Sydney Water, the asset owner of the heritage listed storm water channel, Bunnerong Stormwater Channel No 11, located immediately adjacent the Site's western boundary.

The site location is presented in Figure 1.1.

1.2 Objectives

The objective of the remediation works was to remove the UPSS infrastructure and surrounding impacted soils, where practicable, to support the suitability of the Site for redevelopment in accordance with the current zoning (General Industrial).

The purpose of this report is to document the remediation and associated validation works which were undertaken in accordance with the RAP and Sydney Water approvals and which comprised decommissioning and removal of UPSS infrastructure and excavation of contaminated soil to the extent practicable. Further details on the scope of work are discussed in Section 2.1.

Source: EMM (2021); MetroMap (2021); DFSI (2017); GA (2011); ASGC (2006)

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GDA 1994 MGA Zone 56

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KEY

- Site boundary
- Major road
- Minor road
- Watercourse/drainage line

INSET KEY

- Main road
- NPWS reserve

Site location

42-52 Raymond Avenue, Matraville NSW
Remediation validation report
Figure 1.1

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2 Scope of work

In accordance with regulatory and legislative requirements outlined in Section 2.5, the following scope of work was completed as part of the remediation works.

2.1 Removal and disposal of UPSS and contents

A specialist remediation contractor, Liberty Industrial Pty Ltd (Liberty) was engaged to undertake the following scope of work, under the supervision of EMM as a suitably qualified environmental consultant:

- preparation of project documentation, including the required decommissioning plan containing methodology, safe work method statement (SWMS) and project occupational health, safety and environment (OHSE) management plan;
- mobilise to Site, setup exclusion zones and environmental controls;
- de-gas underground fuel tanks and holding pits using compressed CO_2 gas to reduce flammable atmospheres within the tank shells;
- excavate and stockpile soils to expose the length of each tank. Disconnect all attached fuel pipework at the tank top;
- cut an opening in the tank top shell under degassed/inert conditions;
- flush out tank internal and product lines from pump bases/remote fill locations with tank wash solution and Disposal of liquid wash solution to an approved off-site facility (EMM notes that the composition of liquid in tank T1 is not suitable for recycling and requires inter-state disposal and destruction). Tank internal entry was not required;
- remove all concrete anchors (if any) associated with tanks;
- remove all tanks (except T2), brick pits and pipework in accordance with the SEA report, the Sydney Water approval and the RAP;
- dispose all materials (tanks, pipework, bricks, concrete) in accordance with NSW EPA (2014) Waste Classification Guidelines at an appropriately licenced disposal facility;
- complete in-situ remediation (UPSS abandonment) of Tank 2, including cutting the tank down so that it is not above ground level; and
- backfill tank void volumes with validated excavated material from the Site and imported virgin excavated natural material (VENM).

To manage risks in accordance with the Sydney Water approval, EMM engaged Calibre Group Pty Ltd (Calibre) as the Water Services Coordinator (WSC) for the works. Calibre completed Site inspections and monitoring in accordance with the approval requirements and provide a post construction (dilapidation) report to be submitted to Sydney Water at the completion of the works.

2.2 Soil remediation (post-UPSS removal)

Following removal of the UPSS, the remediation contractor undertook the following under the supervision of EMM:

- review Sydney Water approval and SEA report requirements to excavate adjacent to stormwater assets listed on the S170 NSW State Agency Heritage Register and adopt the proposed excavation methodology which mitigates potential damage to the asset;
- excavate contaminated soils to the extent practicable, vertically limited to the groundwater table and laterally constrained to soil directly around the tanks, within the requirements of the SEA/Sydney Water;
- stockpile excavated soils for sampling and analysis to determine waste classification and appropriate disposal options;
- undertake validation sampling and analysis of excavation walls;
- backfill of excavations using validated material (stockpiled), stablised sand and approved imported VENM, and compact material;
- dispose all stockpiled soils unsuitable for backfilling in accordance with NSW EPA (2014) at a licenced disposal facility; and
- demobilise all plant and equipment from Site.

2.3 Validation sampling and reporting

The validation scope included:

- after removal of the UPSS infrastructure, validation samples were collected by EMM from the soils within the resulting excavations in accordance with a sampling plan/methodology specified within the RAP;
- the use of a photoionisation detector (PID) and visual observations to guide the extent of remediation and validation sampling, as outlined in the RAP;
- the soil samples were analysed by a NATA accredited laboratory for the suite specified in the RAP:
  - TRH;
  - benzene, toluene, ethylbenzene, xylene and naphthalene (BTEXN);
  - polycyclic aromatic hydrocarbons (PAH);
  - asbestos; and
  - heavy metals;
- materials imported to the remediation area were classified as VENM in accordance with NSW EPA (2014);
- preparation of waste classification reports for off-Site disposal of impacted soils in accordance with NSW EPA (2014); and

- at the completion of the remedial works, preparation of this validation report in general accordance with NSW EPA (2020) and NSW DECC (2010b), comprising:
    - a summary of the remediation works completed;
    - a summary of the results of the localised soil assessment (validation sampling) against the adopted validation criteria outlined in the RAP;
    - variations to the remedial strategy undertaken during the implementation of the works;
    - details on waste classification, tracking and off-site disposal;
    - details of environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents; and
    - information demonstrating compliance with appropriate regulations and guidelines, including a statement regarding the suitability of the remediation area for the proposed land use, or recommendations for further investigation to achieve this, which must be submitted to the relevant local authority.

2.4 Sydney Water requirements

The remediation approach was developed to ensure appropriate asset protection controls were established in the design phase, mitigating risks to the Bunnerong Stormwater Channel No 11 required for the approval for working over or adjacent to a Sydney Water asset. This remediation methodology was approved by Sydney Water (reference 20-000728) on 10 May 2021, presented in Appendix A.

The application required the development and submission of a SEA report (Appendix A) and supporting geotechnical report for an assessment of the stability of the stormwater channel wall during construction.

EMM notes that, due to the Sydney Water requirements, the extent of excavation possible between the UPSS and the stormwater channel and below the groundwater table was limited. As such, compliance with these restrictions required that any contamination present beyond these boundaries could not be removed.

2.5 Regulatory and legislative requirements

Relevant legislation and regulations that were used to guide this document are summarised below.

2.5.1 NSW Protection of the Environment Operations Act 1997

The NSW Protection of the *Environment Operations Act 1997* (POEO Act) is administered by the NSW Environment Protection Authority (EPA). It prohibits any person to cause pollution of waters, land or air and provides penalties for specified offences. The POEO Act enables the NSW Government to set out explicit protection of the environment policies and adopt more innovative approaches to reducing pollution. The POEO Act also requires "scheduled activities" listed at Schedule 1 of the POEO Act to be carried out in accordance with an Environment Protection Licence (EPL).

None of the activities conducted during the remediation and validation works met the definition of a premises-based Schedule Activity and, as such, an EPL was not required. However, under Part 2 of Schedule 1 (Activities not premises-based), transportation of trackable waste was undertaken and documented in accordance with the Act and other legislative guidance (eg NSW POEO Waste Regulation 2014).

2.5.2 Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019 (UPSS Regulation)

The UPSS Regulation aims to minimise the risk to human health and the environment by requiring best practice design, installation, maintenance, and monitoring of UPSS in NSW.

Since 1 September 2019, most sites with UPSS in NSW are regulated by local government authorities, in accordance with legislation and guidance published or endorsed by NSW EPA (or their predecessor agencies). The Site is within the Randwick City Council local government area (LGA).

The NSW EPA 2019 Underground Petroleum Storage Systems - Guidelines for implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019 provides information on legislative requirements for the decommissioning of underground tanks, including references to the relevant regulatory requirements. Figure 2.1 below has been extracted from NSW EPA (2019) and provides a summary of the requirements for decommissioning UPSS.

Workcover NSW 2005 Code of Practice: Storage and Handling of Dangerous Goods states that where two years have lapsed since any dangerous goods were last put into or taken from a tank, the person responsible for the site must remove any remaining dangerous goods, and abandon the tank in compliance with:

- AS1940 – 2004: Storage and Handling of Flammable and Combustible Liquids; and
- AS4976 - 2008: Removal and Disposal of Underground Petroleum Storage Tanks.

The procedures as outlined in the two above Australian Standards are for the permanent abandonment (decommissioning) of tanks, as they render them no longer usable and trigger requirements to be met under the Protection of the Environment Operations (UPSS) Regulation 2019 (the UPSS Regulation).

The UPSS Regulation also makes it unlawful to allow or ignore contamination that results from a leaking UPSS. Based on the outcomes of the remediation works further consideration of the duty to report the site would be recommended under Part 5.7 of the POEO Act. EMM recommends that legal advice should be sought for these matters.

The UPSS Regulation and the associated guidance notes provided by NSW EPA require that a validation report for the abandonment or removal of underground fuel infrastructure, including USTs, includes an assessment of the suitability of the Site for the continuation of the current land use.

Furthermore, Randwick City Council (Council) Contaminated Land Policy requires that UST removal is conducted in accordance with the Australian Institute of Petroleum's Code of Practice "The Removal and Disposal of Underground Storage Tanks" (AIP CP22-1994) and the requirements of NSW WorkCover (now SafeWork NSW).

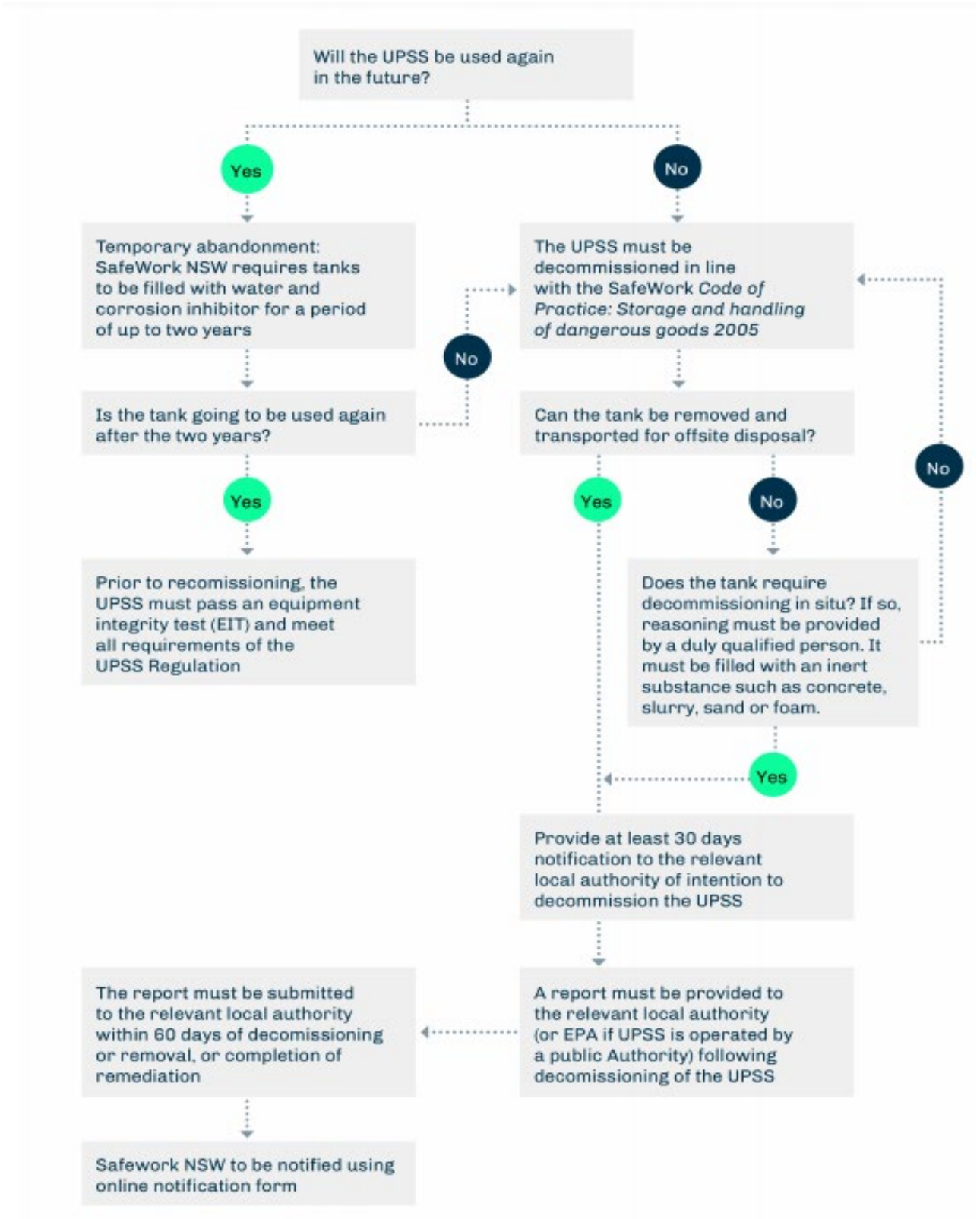

Figure 2.1 Overview of requirements for abandoning or removing UPSS (NSW EPA 2019)

2.5.3 Environmental Planning and Assessment Act (2000) and State Environmental Planning Policy (SEPP) no.55 – Remediation of Land

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) is a planning instrument under the *Environmental Planning and Assessment Act 2000* (EPA Act) that applies to State land. SEPP 55 also specifies when remediation works will require Development Consent from the Local Government Authority (LGA).

SEPP 55 provides guidance on the requirements for remediation works in NSW, including where remediation works require development consent (Category 1 remediation works) or not (Category 2 remediation works).

The works are considered to be Category 2 works, which required:

- notification to Council at least 30 days prior to works commencing; and
- at least 14 days prior to works commencing, provide copies of investigations reports and a remediation action plan, plus contact details, to Council.

These actions were completed by EMM.

2.5.4 Heritage Act 1977 (NSW)

This Act provides for the identification and registration of items of State or Local Heritage significance. The *Heritage Act 1977* provides for a State Heritage Register where items of State or Local Heritage significance can be listed, and also provides for the issue of Heritage Orders by the Minister or the Heritage Council to control potential developments that may harm the heritage value of the item.

The proposed remediation area near the western edge of the Site is adjacent to a Sydney Water Corporation (SWC) stormwater drainage canal and was identified on the NSW State Agency Heritage Register.

2.5.5 National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended on 16 May 2013

National Environment Protection Measures (NEPMs) are developed by the National Environment Protection Council to protect or manage particular factors of the environment. NEPMs establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices.

While appropriate screening criteria for human health and ecological receptors can be selected based on the land use category of the Site, these are only general in nature as the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM) notes that investigation levels are not intended to be used as remediation criteria and that remediation of contaminated land is outside the scope of the ASC NEPM. While Site-specific criteria can be developed through a human or ecological risk assessment, it was not considered to be necessary for meeting the remediation objectives at the Site for remediation of UPSS infrastructure.

2.6 Guidance documents and Codes of Practice

The following key legislation and guidelines are relevant to the remediation works undertaken are:

- POEO (Waste) Regulation 2005.
- *Contaminated Land Management Act 1997* (CLM Act).
- Work Health and Safety Regulation 2017 (WHS Regulation).

- *Work Health and Safety Act 2011* (WHS Act).
- NSW Protection of the Environment Operations (waste) Regulation 2014.
- Code of Practice: Demolition Work SafeWork New South Wales 2016.
- Code of Practice: How to Safely Remove Asbestos, SafeWork New South Wales 2016.
- Code of Practice: How to Manage and Control Asbestos in the Workplace, SafeWork New South Wales 2016.
- Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003(2005)].
- Relevant Codes of practice for working with lead including SafeWork Australia/NIOSH (1994) National Code of Practice for the Control and Safe Use of Inorganic Lead at Work and Demolition Work.
- CRC CARE, 2011. Health Screening Levels for petroleum hydrocarbons in soil and groundwater. CRC CARE, Technical report series No. 10. Friebel, E. and Nadebaum, P., 2011 (CRC CARE, 2011).
- NSW Department of Environment and Conservation (DEC) 2007. Guidelines for the Assessment and Management of Groundwater Contamination March 2007 (NSW DEC, 2007).
- NSW EPA 2017. Guidelines for the NSW Site Auditor Scheme (3rd Edition), October 2017 (NSW EPA, 2017).
- NSW Environment Protection Authority (EPA) 1995. Sampling Design Guidelines, September 1995 (NSW EPA, 1995).
- NSW Environment Protection Authority (EPA) 2020. Consultants reporting on contaminated land, April 2020 (NSW EPA, 2020).
- NSW EPA Waste Classification Guidelines 2014 – Part 1: Classification of Waste (NSW EPA 2014) as amended October 2016.
- NSW EPA (2014a) Technical Note: Investigation of Service Station Sites, dated April 2014.
- NSW EPA (December 2020), Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019.
- NSW DECCW (January 2010) – UPSS Technical Note: Decommissioning, Abandonment and Removal of UPSS.
- NSW DECCW (January 2010) – UPSS Technical Note: Site Validation Reporting.
- AS 1940–2004: Storage and handling of flammable and combustible liquids (AS 2004b).
- AS 4976–2008: The removal and disposal of underground petroleum storage tanks (AS 2008b).
- AS 2601-2001: The demolition of structures- summary.
- NSW WorkCover Authority 2005, Code of Practice: Storage and handling of dangerous goods.

3 Site setting

3.1 Site Identification

The Site is a rectangular shaped land parcel located between Raymond Avenue and Botany Road. The Site identification details are provided below in Table 3.1 and the Site layout is presented in Figure 3.1.

Table 3.1 Site identification

Item	Description
Site address	42-52 Raymond Avenue, Matraville NSW
Legal description[1]	Lot 1 in Deposited Plan (DP) 369668, Lot 1 in DP 511092 and Lot 32 in DP8313
Site area[1]	Approximately 2 hectares
Local government authority	Randwick City Council
Current zoning[2]	IN1: General industrial
Current land use	Vacant (formerly industrial)
Proposed land use	Industrial/commercial
Site location	Refer to Figure 1.1
Site layout	Refer to Figure 3.1

Notes:

1. Spatial Information Exchange Viewer (www.maps.six.nsw.gov.au)
2. State Environmental Planning Policy (Three Ports) 2013

The Site is predominantly covered with hardstand consisting of concrete slab and bitumen driveways at the northern and eastern boundaries. The western boundary of the Site comprises unsealed ground/garden beds with a small, vegetated area at the southern portion of the Site. The Site was formerly occupied by a large industrial building which was demolished between May to June 2020.

A small electrical substation is located at the south-western corner of the Site, enclosed by a chain-wire fence.

A stormwater drainage channel is present immediately adjacent to the Site's western boundary and a retention pond is located to the south. The drainage channel has been identified as a SWC asset called the Bunnerong Stormwater Channel No. 11 and is listed on the NSW State Agency Heritage Register (Heritage NSW, 2020)

Source: EMM (2021); Nearmap (2020); DFSI (2017)

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GDA 1994 MGA Zone 56

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KEY

- Site boundary
- Area with identified former UPSS infrastructure (July 2020)
- Approximate tank outline
- UPSS feature
- Monitoring well
- Watercourse/drainage line

Site layout

42-52 Raymond Avenue, Matraville NSW
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Figure 3.1

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3.2 Environmental setting

The environmental setting and landscape at the Site is summarised in Table 3.2 below.

Table 3.2 Environmental setting

Topography	The Site is relatively flat and level, with an elevation of approximately 6 m Australian Height Datum (mAHD). The Site features a stormwater drainage channel running along the western border of the Site, which flows into a stormwater retention basin adjacent to the southern Site boundary (Figure 3.1). The surrounding area slopes gently to the south-west, towards Port Botany approximately 500 m to the south.
Geology and Soils	The Site and surrounds are mostly underlain by highly disturbed Quaternary deposits comprising medium to fine grained marine sands with podsols (Herbert, 1983). The soil type is described as coastal sand plains and dunes, lagoons, and swampy areas, with generally leached, siliceous, and/or calcareous sands. Based on the completion of 30 soil bores across the Site as part of the September 2020 DSI (EMM, 2020), fill is typically encountered from surface (or from the base of the concrete slab) to approximately 0.9 m below ground level (m bgl). This fill was predominantly gravelly sand comprised of ceramic, brick, asphalt, concrete, glass and potential asbestos containing material (ACM) fragments (EMM, 2020). Underlying the fill was medium grained sand and minor peat.
Hydrogeology	The Site is within the Botany Groundwater Management Zone 1, which is an extraction exclusion zone. The Botany Sands Aquifer is described as a porous and highly productive aquifer. A large number of registered bores were located within a 1.5 km radius of the Site. Usage of the Botany Sands Aquifer for domestic purposes has been banned since 2006, therefore no beneficial use of groundwater is expected on the Site or in the surrounding area. Three monitoring wells installed in September 2020 indicated groundwater levels at the Site ranged from 3.286 to 3.130 m bgl (2.439 to 2.5 mAHD) and the indicative groundwater flow direction is towards the west (EMM, 2020).
Surface water and drainage	The nearest surface water bodies are the SWC owned Bunnerong Stormwater Channel No 11 adjacent to the western boundary of the Site, and the SWC stormwater retention basin adjacent to the southern boundary of the Site (Figure 3.1). Port Botany is approximately 515 m hydraulically downgradient to the south of the Site. The majority of the Site is sealed by concrete slab. As such, precipitation falling onto the Site is expected to pool on the slab and evaporate or enter preferential pathways (eg drainage lines, cracks or holes). Runoff along the western and southern boundaries would be expected to follow the topographic gradient and infiltrate surface soils where exposed at a rate reflective of the permeability of the underlying soils. Excess water, especially during periods of heavy or prolonged rainfall, is expected to be collected by the Site's stormwater drainage network, or into the stormwater channel west and south of the Site.
Acid sulfate soils	The Site has a low probability of occurrence of ASS (JBS&G 2019a). This is consistent with the topographic and geologic setting of the Site. Therefore, land management activities are not likely to be affected by acid sulfate soil materials.

3.3 Site history

A review of the Site history was included in the PSI and limited DSI (JBS&G 2019a). In summary, the Site has been occupied by an industrial building/warehouse since the 1950s. Previous landowners included Sydney Paper Mills Limited, The Australian Paper and Pulp Company, Australian Paper Manufacturers and Fibre Containers Pty Ltd. Since 2005 Epsom has had sole ownership of the Site.

4 Previous site investigations

4.1 JBS&G Preliminary Site Investigation (PSI) and limited Detailed Site Investigation (DSI) (JBS&G 2019a)

JBS&G (2019a) included a historical review, soil sampling from five locations, installation and screening of sub-slab soil vapour probes at 20 locations and soil vapour sampling at four locations. Groundwater was not assessed during these investigations.

Fill materials were identified in each of the five boreholes, and concentrations of zinc (Zn) and benzo(a)pyrene (B(a)P) were reported to be greater than the ecological assessment criteria in one sample each. No contaminants of potential concern (CoPC) were reported in soil at concentrations greater than the human health assessment criteria. Readings using a photoionisation detector (PID) reported volatile organic compounds (VOCs) up to 18.9 parts per million (ppm) at soil vapour probe locations. Volatile total recoverable hydrocarbons (TRH) were reported in the four soil vapour samples, however at concentrations less than the assessment criteria.

JBS&G (2019a) concluded that contamination was not identified which could prevent continued commercial use of the Site, although it was noted that some areas of concern were not assessed and further investigations were recommended to comply with NSW EPA 1995.

A former 3,000 gallon UST and a 1,000 gallon UST were identified in a Safe Work NSW Dangerous Goods records search; however, the search results were not available at the time the fieldwork was undertaken at the Site. Furthermore, the records did not indicate the location of the 3,000-gallon UST. Potential impacts associated with the USTs were unknown as these features were not specifically targeted by the JBS&G (2019a) soil or soil vapour investigations.

4.2 Hazardous Building Materials Survey (HBMS) (JBS&G 2019b)

The HBMS was completed on the large warehouse located on the Site at the time of reporting. The HBMS identified fragments of ACM in a garden bed at the western Site boundary. Sources of asbestos were also identified in the warehouse building that has since been demolished at the Site. This included roofing that was found to be significantly weathered and a source of friable asbestos within dust identified in the building.

Removal of visible asbestos from the Site surface was advised and the remediation of friable asbestos containing dust and sealing of the roof materials to prevent recontamination was recommended.

4.3 Clearance Certificate Friable Asbestos Removal (Pickford and Rhyder, 2020)

A final asbestos clearance certificate was completed by Pickford and Rhyder (2020) for the Site following removal of asbestos containing material from the former building and structures and from the exposed ground along the western boundary of the Site. Both friable and non-friable asbestos was removed. An excavation approximately 1.5 m wide was made along the western boundary of the concrete pad footprint and cleared to a depth where no further friable asbestos was present. The clearance certificate concluded that the Site was safe for re-occupation.

4.4 Detailed Site Investigation (EMM, 2020)

EMM was engaged by Epsom Enterprises Pty Limited (Epsom) in September 2020 to undertake a DSI to address the identified data gaps of the previous investigations undertaken by JBS&G in 2019. The objective of the DSI was to gather sufficient information to provide Epsom with an understanding of contamination impacts and potential remedial requirements at the Site and to support divestment of the Site.

The DSI works completed in September 2020 included:

- completion of a ground penetrating radar (GPR) survey to identify subsurface anomalies that may represent the locations of the USTs;
- drilling of 25 boreholes up to 5.5 m bgl and collection of soil samples. The boreholes were targeted to the potential USTs as well as providing general coverage across the Site;
- conversion of 3 boreholes to groundwater monitoring wells targeting the area of the USTs; and
- collection of five soil samples using hand tools form a garden bed at the western boundary of the Site.

4.4.1 UPSS infrastructure

A GPR survey completed in September 2020 did not identify the 3,000 gallon UST or the 1,000 gallon UST in the areas indicated on the plan in the SafeWork NSW Dangerous Goods record (originally obtained by JBS&G (2019a)). The USTs are estimated to be up to 40 years old (based on Dangerous Goods records from 1970).

Observations made by EMM identified UPSS infrastructure along the western Site boundary adjacent to the edge of the concrete slab and the stormwater canal wall (Bunnerong Stormwater Channel No 11), covering an area of approximately 150 m^2. EMM observed liquid seeping through the brick wall of the stormwater canal downgradient (west) of the 3,000 gallon UST (T1). A hydrocarbon sheen was also visible on the surface of the water in the canal from the area of seepage, indicating that the UST or related UPSS infrastructure may potentially have been leaking.

Grab samples were collected where practicable of product within the former UPSS tanks on 30 September 2020 by EMM. A summary of these analytical results is provided in Table 4.1 below which indicated that the product sampled within the former UPSS tanks was predominantly composed of the heavier TRH fractions C_{16}-C_{34} and C_{34}-C_{40}. UST T1 was also noted to contain elevated BTEX compounds. Based on the industrial land use at the Site and the heavier hydrocarbon fractions identified, it was inferred that the original product in these USTs may have been diesel or fuel oils.

Table 4.1 Summary of Former UPSS Analytical Results

Tank ID	Description	BTEX	PAH's (Sum of Total)	TRH
T1	Black, medium to high viscosity oil, product volume of ~11,356 L	Xylene Total – 176 mg/kg Benzene – 142 mg/kg Ethylbenzene – 1.4 mg/kg Toluene – 11.4 mg/kg	1,230 mg/kg	C_{10}-C_{40} (Sum of total): 186,000 mg/kg C_{34}-C_{40}: 9,900 mg/kg C_{16}-C_{34}: 97,200 mg/kg C_6-C_{10}: 1,280 mg/kg
T3	Low viscosity, unknown product volume	Below LOR[1]	Below LOR	C_{10}-C_{40} (Sum of total): 5,740 µg/L C_{34}-C_{40}: 820 µg/L C_{16}-C_{34}: 4,760 µg/L C_6-C_{10}: below LOR

Table 4.1 Summary of Former UPSS Analytical Results

Tank ID	Description	BTEX	PAH's (Sum of Total)	TRH
T4	Low viscosity, product volume of ~887 L	Below LOR except for Benzene – 1 ug/L	Below LOR	C_{10}-C_{40} (Sum of total): 2,620 µg/L C_{34}-C_{40}: 370 µg/L C_{16}-C_{34}: 1,460 µg/L C_{6}-C_{10}: 80 µg/L
Holding Tank	Low viscosity, unknown product volume	Below LOR	Below LOR	C_{10}-C_{40} (Sum of total): 62,800 µg/L C_{34}-C_{40}: 34,100 µg/L C_{16}-C_{34}: 28,700 µg/L C_{6}-C_{10}: below LOR

[1] LOR: analytical Limit of Reporting

4.4.2 Soil assessment results

A total of 54 primary samples from 30 soil bore locations across the Site (Figure 4.1) were submitted for laboratory analysis for CoPC. The following soil analytical results were reported:

- one soil sample at BH21/0.2 m representing fill reported benzo(a) pyrene with a concentration of 3.3 mg/kg exceeded the ASC NEPM Table 1B(6) Ecological Screening Level (ESL) for industrial coarse soil of 1.4 mg/kg;
- one soil sample at BH17/1.6 m representing fill reported lead with a concentration of 2,000 mg/kg exceeded the ASC NEPM Table 1A(1) Health Investigation Level (HIL) for industrial D soil of 1.4 mg/kg;
- the 95% upper confidence limit (UCL) for both benzo(a)pyrene and lead was less than the relevant screening criteria;
- soil samples at BH02/0.5 m and BH03/0.9 m, located adjacent to the observed UPSS infrastructure, had the highest detections of TPH and TRH during the DSI investigations but did not exceed the adopted criteria[2]. These results indicate potentially elevated petroleum hydrocarbons in soil within proximity to the UPSS:
  - at BH02/0.5 m, TPH concentrations for the C_{15}-C_{28} and C_{29}-C_{36} fractions were 420 mg/kg and 660 mg/kg respectively while TRH concentration for C_{10}-C_{40} (sum total) was 1,500 mg/kg; and
  - at BH03/0.9 m, TPH concentrations for the C_{15}-C_{28} and C_{29}-C_{36} fractions were 270 mg/kg and 300 mg/kg respectively while TRH concentration for C_{10}-C_{40} (sum total) was 630 mg/kg;
- asbestos was detected in fill material at one location (BH22_1.2), identified as chrysolite, commonly known as white asbestos; and
- all remaining soil samples reported concentrations of CoPC below the adopted investigation and screening levels.

[2] ASC NEPM (2013) Health Screening Levels (HSL) D (Commercial/Industrial), Ecological Screening Levels (ESL) Commercial/Industrial, and Table 1 B(7) Management Limits (Commercial/Industrial)

4.4.3 Groundwater assessment results

Three groundwater wells were installed (MW01, MW02, MW03) with samples collected and analysed for CoPC associated with the identified source of potential contamination (Figure 4.2). The following observations and analytical results were noted:

- groundwater levels at the site ranged from 3.286 to 3.130 m bgl (2.439 to 2.5 m AHD) and the inferred groundwater flow direction was towards the west;
- the three groundwater monitoring wells were installed in accessible locations close to the UPSS, noting steep and uneven terrain along the western Site boundary (between the UPSS and the stormwater channel). Due to these restrictions, the wells were located either up or across hydraulic gradient of the observed UPSS infrastructure;
- there were no odours detected or notable PID results to indicate hydrocarbon impact in groundwater (<2 ppm); and
- there were no exceedances of the adopted criteria for the groundwater assessment. Benzene was reported at a concentration of 3 µg/L and TRH C_6-C_{10} was reported at 40 µg/L in a groundwater sample collected at MW02.

Sample ID	Analyte	NEPM Criteria (mg/kg)	Concentration (mg/kg)
BH21_0.2	Benzo(a) pyrene	0.7	3.3

Sample ID	Analyte	NEPM Criteria (mg/kg)	Concentration (mg/kg)
BH17_1.6	Lead	1,500	2,000

Source: EMM (2021); MetroMap (2021); DFSI (2017)

0 25 50 m

GDA 1994 MGA Zone 56

N

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KEY

- Site boundary
- Area with identified former UPSS infrastructure (July 2020)
- Major road
- Minor road
- Watercourse/drainage line
- Waterbody

Soil results

- Below adopted guidelines
- Exceeds adopted NEPM guidelines
- ▲ Asbestos present

EMM 2020 DSI
soil analytical results

42-52 Raymond Avenue, Matraville NSW
Remediation validation report
Figure 4.1

EMM
creating opportunities

Source: EMM (2021); MetroMap (2021); DFSI (2017)

0 25 50 m

GDA 1994 MGA Zone 56

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KEY

- Site boundary
- Area with identified former UPSS infrastructure (July 2020)
- Major road
- Minor road
- Watercourse/drainage line
- Waterbody
- XXX Groundwater level (metres Australian Height Datum)
- Inferred groundwater elevation contour
- Inferred groundwater flow direction

Groundwater results

- Below adopted guidelines

EMM 2020 DSI groundwater analytical results

42-52 Raymond Avenue, Matraville NSW
Remediation validation report
Figure 4.2

EMM
creating opportunities

4.5 Geotechnical conditions

EMM commissioned Douglas Partners Pty Ltd (Douglas Partners 2021) to complete a geotechnical analysis report to understand the potential risks to the Bunnerong Stormwater Channel No 11 from potential future remediation and excavation activities in the vicinity of the western boundary.

Numerical modelling using PLAXIS 2D was used to estimate the induced displacements on the stormwater channel wall as a result of excavation works. The modelled excavation scenario, based on the proposed work method provided by the remediation contractor, included a plant exclusion area of 7 m from the channel wall. The findings documented in the report were:

- total deflections of up to 7 mm at the top of the wall and 6 mm at the base of the wall during excavation; and
- final deflections reducing to approximately 2 mm of the initial positions at the completion of the remediation works.

5 Conceptual site model

Based on previous investigations and the intrusive investigation works completed by EMM, a conceptual site model (CSM) was developed to represent potential contamination sources, migration pathways and receptors at the Site to develop the RAP and prior to undertaking remediation works.

The CSM is summarised below.

5.1 Nature and extent of contamination

5.1.1 Soil

Historical soil data indicated there were petroleum hydrocarbons present in soil in proximity to the former USTs identified along the western boundary the site (ie BH02 and BH03 in Figure 4.1). The hydrocarbon impact was characterised by elevated TRH concentrations of C_{16}-C_{34} and C_{34}-C_{40} however concentrations did not exceed the adopted soil assessment criteria. Concentrations of TRH beyond the proximity of the former USTs was reported to be below or slightly above the limit of reporting (EMM, 2020).

Due to access limitations for soil boring during the September 2020 DSI (ie the embankment considered unsafe and close proximity to the SWC canal), soil sampling could not be completed between the UPSS and the stormwater canal. It was considered possible that some localised soil and/or groundwater impact associated with the UPSS may be encountered during any potential removal/excavation works adjacent to the stormwater canal.

Based on historical building inspections (JBS&G 2019b) and intrusive investigations (JBS&G 2019a and EMM, 2020), there was potential for ACM fragments within shallow fill material, particularly along the garden bed adjacent to the western Site boundary.

5.1.2 Groundwater

There have been limited groundwater investigations completed at the Site. Based on data obtained from three wells installed in the south west of the Site in September 2020 (EMM, 2020), there were indications of limited hydrocarbon impacts in the vicinity of the UPSS infrastructure (MW02 and MW03 – Figure 4.2), with contaminant concentrations not reported to be greater than the adopted assessment criteria.

It was noted that the three monitoring wells are located up or across hydraulic gradient of the identified UPSS infrastructure and it is possible that groundwater impact could exist in close proximity to, or down hydraulic gradient from, the UPSS infrastructure.

5.2 Sources of contamination and contaminants of potential concern

A summary of the potential sources of contamination and associated CoPC identified as an outcome of the historical investigations is presented in Table 5.1.

Table 5.1 Summary of potential sources of contamination and CoPC

Potential sources of contamination	CoPCs	Likelihood of contamination/release mechanisms
UPSS infrastructure: • 1 x 3,000 gallon (11,356 L) UST full of black oil, medium viscosity, referred to as **T1**; • 2 x approximate 1,000 gallon (3,785 L) USTs, referred to as **T2** and **T3** respectively; • 1 x 887 L UST full of water/oil mixture, referred to as **T4**; and • remnant ancillary infrastructure including supply lines, vent pipes and potential dispensing bowser footing. Refer to **Table 8.1** and **Table 4.1** for further details.	BTEX/TRH/PAHs/VOCs/ phenols/lead	**Likely.** As shown in Table 8.1, USTs were observed to contain black oily product and their integrity is unknown. Leaking of oil through the stormwater canal brickwork (off-site to the west) was observed in the vicinity of the UPSS (EMM, 2020). Leaking of the other USTs and ancillary infrastructure was considered possible particularly given the age of the infrastructure (c1970s).
Electrical substation containing transformers (south-western corner of the Site).	PCBs	**Unlikely.** It is unknown if the transformers contained PCB, however, based on the age of the facility it is possible. Leaking from the former transformer and substation infrastructure was considered possible however significant contamination was considered unlikely due to the size of the facilities and no observations of leakage. No concentrations of PCBs in soils were recorded above the laboratory LOR (EMM, 2020).
ACM used in former buildings, utilities and pipework and impacted soils Site wide.	Asbestos	**Likely**. Confirmed ACM present throughout many of the buildings based on the HBMS (JBS&G, 2019). Clearance certificates were issued for recently demolished buildings; however, some asbestos pipes were noted to remain in-situ. EMM (2020) observed relatively widespread potential ACM fragments in shallow fill material, mostly along the garden bed adjacent to the western Site boundary. Asbestos was positively identified in soil by the laboratory at one sample location (BH22).
Former use of lead paint on buildings, based on the age of the former buildings (pre-1980s) and historical application of lead-based paints during that time.	Lead	**Unlikely.** Flaking and/or lead dust cannot be precluded. As most of the Site is occupied by a concrete slab and driveways, impacts would likely be limited to small areas of exposed soil. Only one soil sample exceeded the adopted assessment criteria (EMM, 2020). Lead was not recorded above the laboratory LOR in groundwater.

Table 5.1 Summary of potential sources of contamination and CoPC

Potential sources of contamination	CoPCs	Likelihood of contamination/release mechanisms
Potential application of pesticides for pest control.	OCP/OPP	**Possible.** Pesticides may have been applied to building footings and void spaces with the potential to impact surrounding soils, including beneath the concrete slab. Trace concentrations of OCP were recorded in soil at two locations within the surface soil (0.2-0.3 m depth) at the southern portion of the site (EMM, 2020). Pesticides were not recorded above the laboratory LOR in groundwater.
Use of aqueous film-forming foam (AFFF) containing per and poly fluoroalkyl substances (PFAS) in fire suppression (the Site is understood to formerly be used to store significant quantities of Dangerous Goods), possible use of PFAS containing products in paper/packaging manufacturing.	PFAS	**Possible.** PFAS and AFFF were generally introduced in Australia for civilian use in the late 1970s until gradual phasing out commenced in the 2000s. It is unknown if AFFF was historically stored or applied at the Site. Trace concentrations of PFAS compounds in soil, primarily perfluorooctanesulfonic acid (PFOS), were reported at 11 locations across the site at varying depths during the September 2020 DSI (EMM, 2020). However, none of these exceeded the adopted assessment criteria.
Chemical storage – bulk storage of chemicals at the Site.	BTEX/TRH/PAHs/VOCs/metals/phenols/OCP/OPP	**Possible.** Spills and leaks may have resulted in seepage into underlying soils, discharge into surface water and infiltration to groundwater. However, the results of the DSI did not indicate significant or widespread contamination.
Use/importation of fill material Site wide. Fill materials may have been imported to the Site for levelling and grading. JBS&G (2019a) identified fill materials across the Site. The presence of contaminants within fill cannot be precluded.	BTEX/TRH/PAHs/VOCs/ phenols/heavy metals/PCBs/ Asbestos/PFAS	**Likely.** Based on the potential leachability of CoPC within fill material and the historical use of the Site, vertical migration of contamination from the fill materials/surface soils into the underlying natural soils is possible although limited by the extent of the hardstand on the Site and further assessment would be required if the slab was to be removed. Fill material imported from unknown origins may also contain contaminants such as asbestos.

5.3 Migration and exposure pathways

The following transport mechanisms may apply at the Site:

- surface run-off of CoPC into surface water channels adjacent to the Site;
- excavation and re-location of soil during future construction activities;
- vertical seepage of CoPC into the underlying soils and into the local groundwater system, particularly in the event that the current extensive hardstand is either partially or completely removed;
- migration of CoPC via groundwater transport, inferred to flow in a south-westerly direction;
- migration and infiltration of vapours from contaminants in soil and/or groundwater beneath the Site; and
- atmospheric dispersion (aeolian transport) of dust, derived from contaminated soil or hazardous building materials (HBM), eg asbestos or lead.

Identified potential exposure pathways for the nominated CoPC include:

- dermal contact and incidental ingestion of soil;
- inhalation of dust (including soil derived) and/or asbestos fibres;
- dermal contact and incidental ingestion of groundwater/surface water;
- inhalation of soil/groundwater vapours in indoor air;
- inhalation of soil/groundwater/surface water vapours in outdoor air;
- inhalation of soil/groundwater vapours within a trench;
- plant uptake and/or ingestion by animals; and
- uptake of CoPC from groundwater (stygofauna and microorganisms).

5.4 Sensitive receptors

The nearest sensitive human receptors identified at the Site include:

- current and future Site users (industrial);
- future construction workers involved in the development of the Site;
- users of surrounding properties; and
- down-gradient users of surface water (such as recreational users of Penrhyn Estuary and Botany Bay).

Based on the Orica Botany Groundwater Extraction Exclusion Area (GEEA), there were not considered to be sensitive human health receptors associated with groundwater beneath the Site and/or downgradient.

The Site is mostly covered by hardstand pavement and building footprints. On this basis, there are limited on-site ecological receptors that could be exposed to environmental impacts at the Site. Possible off-site ecological receptors are limited to potential impacts to flora and fauna associated with groundwater or surface water runoff migrating from the Site into the following adjacent water bodies:

- Bunnerong Stormwater Channel No 11, along the western Site boundary; and
- the stormwater retention basin immediately south of the Site.

5.5 Conceptual site model: summary

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
UPSS – USTs and ancillary underground infrastructure (eg pits and supply lines). Observations of potential leakage through stormwater channel wall in the vicinity of the UPSS. CoPC include: BTEX/TRH/PAHs/VOCs/phenols	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers • Users of surrounding properties	**Yes**
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers	
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Current and future users of surface water • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Yes**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Off-Site adjoining land users/occupants • Groundwater ecosystem	**Possible** CoPC were detected in groundwater (EMM, 2020), however were below the adopted groundwater assessment criteria (GAC). Groundwater would be managed during future construction (if required) and is unlikely to be abstracted for future beneficial due to the GEEA.

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Substation – transformers CoPC include PCBs and TRH	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers • Users of surrounding properties	**Possible** It is noted that concentrations of PCBs in soils were below the laboratory LOR (EMM, 2020).
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers	**Possible**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Current and future users of surface water • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
Potential ACM in former buildings, fragments on surface and potential asbestos impacted soil	Inhalation of dust and/or fibres through atmospheric dispersion and incidental ingestion	• Future construction workers involved in the development of the site • Future site users • Future intrusive maintenance workers • Users of surrounding properties	**Yes**

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Potential residual lead-based paint on former buildings	Paint flaking – dermal contact/incidental ingestion and inhalation of lead entrained dust	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers • Users of surrounding properties	**Yes**
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers	**Yes**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Off-Site current and future users near surface water flow • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Unlikely**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem	**Unlikely**

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Potential application of pesticides for pest control	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • On Site future Site users • Future intrusive maintenance workers	**Possible**
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • On Site future Site users • Future intrusive maintenance workers	**Possible**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Off-Site current and future site users near surface water flow • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Unlikely**

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Use of aqueous film-forming foam (AFFF) containing per and poly fluoroalkyl substances (PFAS) in fire suppression infrastructure or PFAS in paper/packaging manufacturing process	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • On Site future Site users • Future intrusive maintenance workers	**Possible**
	Direct contact/ingestion of soils		**Possible**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Current and future users of surface water • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Unlikely**

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Chemical storage – former bulk storage of chemicals at the Site	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers • Users of surrounding properties	**Yes**
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers	**Yes**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Current and future users of surface water • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Unlikely**

Table 5.2 Conceptual site model

Source	Pathway	Receptor	Potentially complete S-P-R?
Use/importation of fill material Site wide	Seepage into underlying soils and inhalation of soil vapour/dust	• Future construction workers involved in the development of the Site • On Site future Site users • Future intrusive maintenance workers • Users of surrounding properties	**Yes**
	Direct contact/ingestion of soils	• Future construction workers involved in the development of the Site • Future Site users • Future intrusive maintenance workers	**Yes**
	Migration through surface water runoff	• Future construction workers involved in the development of the Site • Current and future users near surface water flow • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Possible**
	Seepage through soil profile into groundwater and migration through groundwater flow – direct contact or incidental ingestion of groundwater or inhalation of vapours	• Future construction workers involved in the development of the Site • Future intrusive maintenance workers • Adjoining land users/occupants • Groundwater ecosystem • Off-site downgradient surface water ecology (Penrhyn Estuary and Botany Bay)	**Unlikely**

6 Remediation strategy

6.1 Data quality objectives

Data Quality Objectives (DQO) have been developed to define the type, quantity and quality of data required to achieve the project objectives. The DQOs have been prepared in accordance with the seven-step DQO process outlined in the ASC NEPM (2013). The adopted DQOs for the remediation at the Site are provided below in Table 6.1.

Table 6.1 Data quality objectives

DQO steps	Details of DQO process
State the Problem	The Site has been identified for redevelopment. UPSS and associated contamination needs to be removed from the Site and soil (and potentially groundwater) conditions further assessed to understand if any further remediation is required, or if the investigation area is suitable for the current land zoning (IN1: General industrial).
Identify the Goals (decisions)	Decisions to be made to meet anticipated future uses are: • Have the identified primary sources of contamination (ie UPSS) been adequately mitigated in accordance with the objectives of the RAP? • Does residual contamination in soils, groundwater or surface water associated with UPSS pose an unacceptable risk to human health or the environment under the future end use?
Identify the information inputs	The inputs required to make the above decisions listed in Step 2 are as follows: • existing Site data (from previous investigations); • proposed land uses and Site boundaries; • appropriate NSW EPA endorsed guideline documents; • appropriately experienced environmental consultants; • geological data and information relevant to subsurface structures; • hydrogeological data; • geotechnical data; • concentrations of CoPC in different fill/soil types and groundwater; • distribution of identified contamination both laterally and vertically; • plans showing the location of underground services and known, present subsurface infrastructure; and • quality assurance and quality control (QA/QC) data.
Define the Study Boundaries	The boundaries of the investigation have been identified as follows: • *Spatial boundaries* – The lateral boundary of the remediation area is limited to the area of UPSS infrastructure shown on Figure 3.1. The western extent of this area is constrained by the Bunnerong Stormwater Channel No 11. The vertical boundary for soil is the base of tank excavations and validation soil samples collected, constrained by the depth of the channel as per the SEA/Sydney Water requirements; and • *Temporal boundaries* – data collected from previous soil and groundwater investigations undertaken in 2019 and 2020 and data collected during the 2021 remediation and validation works.

Table 6.1 Data quality objectives

DQO steps	Details of DQO process
Develop a Decision Rule	The remedial activities described by the RAP would be considered to have achieved the remediation and validation objectives if: • it is established that there are no on-going primary sources of petroleum hydrocarbon contamination remaining in the remediation area; • soil materials excavated from the UST excavations have been adequately characterised and that no heavily impacted materials are returned to the tank excavations during reinstatement; and • groundwater concentrations of CoPCs do not indicate a potential risk to identified human health and environmental receptors.
Specify performance or acceptance criteria that the data need to achieve	Acceptable limits on decision errors and the approach to addressing possible decision errors developed are based on the Data Quality Indicators (DQIs) of sensitivity, precision, accuracy, representativeness, comparability and completeness (SPARCC). The tolerable limit on decision errors for data that EMM considers acceptable is: • probability that 95% of data satisfied the DQIs, therefore the limit on the decision error was 5% that a conclusive statement may be incorrect. In applying statistical analysis of a data set (where appropriate): • no individual sample will report a concentration that exceeds 250% of Site assessment criteria; • a normal distribution will only be used if the coefficient of variance is not greater than 1.2; • the standard deviation of a sample population will not exceed 50% of the Site assessment criteria; and • a robust QA/QC program for soil and groundwater designed and implemented. The possible outcomes of making an error in the decision are: • basing decisions on unreliable data and consequently making incorrect decisions; and • basing decisions on unreliable data and inappropriately recommending the need for further remediation. Relevant performance and/or acceptance criteria were determined for QA/QC purposes and comparison of soil and groundwater analytical results to appropriate assessment criteria.
Optimise the Design	Based on Steps 1 to 6 of the DQO process, the design (ie scope of works or sample and analysis quality plan) for obtaining the required data (ie proposed field and laboratory programs) is presented in Section 8.3.

6.2 Data quality indicators

The project data quality indicators (DQIs) have been established to set acceptance limits on field and laboratory data collected as part of the remediation and validation activities. For both field and laboratory procedures, acceptance limits are set at different levels for different projects and by the laboratories. Non-compliances with acceptance limits have been documented and discussed in the report. The DQIs are presented in Table 6.2 below.

Table 6.2 Data quality indicators

DQI	Field	Laboratory	Acceptability Limits
Completeness	• All critical locations sampled • All samples collected • SOPs appropriate and complied with • Experienced sampler • Documentation correct	• All critical samples analysed and for all CoPC • Appropriate methods implemented • Appropriate laboratory limits of reporting (LORs) • Sample documentation complete Compliance with sample holding times	• As per ASC NEPM (2013) <nominated criteria
Comparability	• Sample SOPs used on each occasion and complied with • Experienced sampler • Climatic conditions • Same types of samples collected	• Same analytical methods used (including clean-up) • Sample laboratory LORs (justify/quantify if different) • Same laboratories (NATA accredited) • Consistent reported units of measurement	• As per ASC NEPM (2013) <nominated criteria
Representativeness	• SOPs appropriate and complied with • Appropriate media sampled • Observed soil strata sampled	• All critical samples analysed and for all CoPC as required for the project objectives	• Appropriate samples analysed
Precision	• SOPs appropriate and complied with • Collection of blind and split duplicate samples	• Analysis of: – Blind duplicate samples (1 in 20 samples) – Split duplicate samples (1 in 20 samples) – Laboratory duplicate sample	 • RPD of < 30% (organics) and <50% (inorganics) • RPD of < 30% (organics) and <50% (inorganics) • RPD of < 50%
Accuracy	• SOPs appropriate and complied with • Collection of rinsate blanks	• Analysis of: – Field/trip blanks (1/day) – Method blanks – Matrix spikes – Matrix spike duplicates – Surrogate spikes – Laboratory control samples – Laboratory prepared spikes – Reagent blank	 • Non-detect for CoPC • Non-detect for CoPC • 70 to 130% • RPD of <30% • 70 to 130% • 70 to 130% • 70 to 130% • Non-detect for CoPC

6.3 Preferred remedial strategy

In assessing the remedial options to meet the key objectives for the Site, the preferred approach to remediating the Site was a mixed approach including excavation, tank removal, off-site disposal and in-situ UPSS abandonment, as detailed in Table 6.3.

Table 6.3 Tank remediation strategy

Tank	Approach
Tank 1	Tank removal and off-site disposal
Tank 2	In-situ remediation (UPSS abandonment)
Tank 3	Tank removal and off-site disposal
Tank 4	Tank removal and off-site disposal
Holding tank	Tank removal and off-site disposal
Interceptor pit	Tank removal and off-site disposal

This option allowed for the removal of the primary contamination source (ie UPSS contents) at each tank and impacted soil immediately surrounding the excavated tanks, while removing any in-situ contamination from within Tank 2. This option provided the most structural protection to the Bunnerong Stormwater Channel No 11, which may be damaged if more extensive soil excavation and tank removal works were to be completed.

6.3.1 Primary source control

Primary source control involves the removal of primary sources of petroleum hydrocarbon related CoPCs at the Site to the extent practicable. Former UPSS infrastructure identified near the western Site boundary has resulted in release of petroleum hydrocarbons to the ground which may be contributing to soil, surface water and/or groundwater impacts at the Site.

Primary source control focuses on excavation, tank removal and in-situ remediation as detailed in Table 6.3, of the former UPSS infrastructure along the western Site boundary. It is noted that T2, which is closest to the stormwater channel, was observed to be filled with inert waste (see Table 4.1). As a result, it was considered unlikely that T2 would present an ongoing primary source of contamination following in-situ remediation and abandonment.

6.3.2 Soil data gap analysis

The presence of the UPSS infrastructure and safety concerns from the unstable/sloping ground surface has hindered investigations of soil beneath the areas with former UPSS infrastructure. Once the infrastructure was removed, soil samples were collected, analysed for CoPCs and assessed against validation criteria as outlined in Section 9. This sampling provided supplementary data to evaluate if the Site is suitable for the current land zoning or if further remediation works are required.

6.3.3 Groundwater data gaps

As stated in the UPSS Technical Note: Site Validation Reporting (NSW DECCW 2010), groundwater assessment must be conducted where soil contamination has been encountered or identified, including particular attention given to the possibility of residual groundwater contamination at abandoned UPSS sites.

Three groundwater monitoring wells are located at the Site (Figure 3.1). Based on water level monitoring conducted during the September 2020 DSI (EMM, 2020), these monitoring wells are located up-hydraulic gradient (MW01 and MW03) or cross-hydraulic gradient (MW02) of the area with the former UPSS infrastructure. In the absence of monitoring locations down hydraulic gradient of the UPSS infrastructure (due to access safe work restrictions) it is unclear if there are hydrocarbon impacts in groundwater.

As stated in the RAP, following removal of the tanks an assessment has been made in this report (refer to Section 11) to consider the likelihood of groundwater contamination resulting from the UPSS (such as the presence of significantly impacted soil, visual presence of contamination).

7 Variations to the remediation strategy

7.1 Remediation contingencies

As stated in the RAP (EMM 2021), it was anticipated that the proposed remedial methodology would be effective in characterising the hydrocarbon impact present. However, additional contingencies were outlined in the RAP should the scenarios detailed below in Table 7.1 arise. This table has been updated to include the outcome of each potential scenario as recorded during the remediation works.

Table 7.1 Summary of potential variations to the remedial strategy (adapted from EMM 2021)

Scenario (EMM, 2021)	Contingencies/actions required (EMM, 2021)	Outcome
Significantly contaminated water (ie free product) is identified during remediation works.	Work will be suspended until EMM can further assess the impacted perched/groundwater and the associated risks. Once the assessment is completed, a decision on any changes to the remediation approach will be made.	The scenario did not eventuate. No actions were required.
Additional underground tanks or fuel infrastructure are encountered at the Site.	All information relating to additional tanks and/or infrastructure will be recorded and discussed with the client regarding the course of action to be taken. The objective of the remediation is to remove all redundant UPSS to the extent practicable.	One (1) additional UST was uncovered adjacent to the southwestern corner of the Holding Tank, named 'T5'. The tank was removed with the excavation footprint successfully validated as per the preferred remedial approach.
Additional hazardous material is encountered which was not previously identified.	All information relating to additional ACM identified during the remediation will be recorded for provision to regulatory bodies and EMM will consult with the client on the course of action to be taken.	A significantly greater quantity of ACM was identified during the remediation excavation works. Some tanks had been filled in with ACM material (Interceptor Pit, Holding Tank, T3 and T5). Material surrounding the tanks was also found to be ACM impacted. ACM impacted soil/fill was segregated, confirmed to have no significant odours or staining, all other CoPC below the validation criteria, and was then used to backfill excavation voids at depth, to be addressed concurrently with broader ACM contamination at the Site during future redevelopment works. A high strength durable plastic marker layer was placed over the material, followed by 300 mm of VENM as a capping layer to the surface level. Refer to Section 7.2 for further details.
Excessive vapours emanating from excavated and stockpiled soil or excavation pits.	Works will be suspended and EMM will advise on how best to proceed regarding safe management of contaminant vapours to remove risks posed to onsite workers. Once the assessment is completed, a decision on any changes to the remediation approach will be issued to the client for review and implementation.	The scenario did not eventuate. No actions were required.
Contamination found in areas previously not identified.	Work will be suspended and EMM will consult with the client on how best to proceed regarding the newly identified contamination. Once the contaminant is evaluated, a decision on any changes to the remediation approach will be issued for review and implantation.	The scenario did not eventuate. No actions were required.

7.2 Backfill and capping of ACM impacted soil

7.2.1 Remediation options assessment

A significantly greater quantity of ACM was identified during the remediation excavation works. The Holding Tank, Interceptor Pit, T3 and T5 had been partially filled in with ACM material. Material surrounding the tanks was also found to be ACM impacted.

EMM consulted with Matraville Investment Trust to discuss alternative strategies/options for the management of the stockpiled ACM impacted material, based on the most practical application of currently available remediation technologies.

The most appropriate strategy was determined based on the information contained within the RAP (EMM 2021), which stated that **on-site capping/containment** would be the appropriate contingency action, as highlighted in Table 7.2 below.

Table 7.2 Soil remediation options assessment (EMM 2021)

Option	Details	Suitability
On-Site treatment	The Site is large and has sufficient space for this option. There is not expected to be a significant volume of contaminated soils requiring treatment (based on the findings of the September 2020 DSI (EMM, 2020). Both in-situ and ex-situ remediation methods may take an extended period to complete and may not be compatible with development at the Site. Off-site disposal of contaminated soil is not required. However, importation of clean fill will be required at this Site to backfill excavations resulting from the tank removal.	Partly suitable
Off-Site treatment	In-situ and ex-situ remediation methods as per on Site treatment but more suitable for sites with limited space. Requires excavation and transport of contaminated soils and reinstatement of excavations. Timeframes may be an issue with redevelopment plans at the Site. Requires transportation of contaminated soils within an urban area to a suitable treatment facility.	Partly suitable
Excavation and off-Site disposal	Landfill disposal which will be the simplest remediation method. Will involve excavation, tank removal and disposal at a licenced facility. Excavation is then back filled with clean, validated fill. Removes secondary source of contamination (impacted soils) to the extent practicable.	Suitable (preferred)
On-Site capping/containment	Involves installation of a physical barrier around the contaminated area to contain potential migration. Does not remove source of contamination. Requires ongoing management to maintain cap or barrier.	Contingency action

7.2.2 Selected strategy implementation

The overarching strategy for fill management at the Site is designed to ensure that no residual waste or existing anthropogenic fill materials remain at the surface, and any residual waste or fill materials that do remain are appropriately capped and covered to mitigate any human health and environmental risks and aesthetic issues.

The strategy for backfill and capping implemented at the Site during remediation works included the following:

- confirm that the asbestos impacted material proposed to be used as backfill meets the validation criteria via sampling and laboratory analysis (excluding asbestos) including no significant odours or staining;
- confirm that excavation voids meet the validation criteria (excluding asbestos), or in areas exceeding the validation criteria, material cannot be further excavated due to the spatial constraints associated with compliance with Sydney Water requirements;
- prior to placement of any capping materials, visually confirm adjacent areas where existing residual waste materials are present (ie ACM fragments along the ground surface surrounding/outside the UPSS remediation area);
- confirm that areas requiring capping are consistent with the proposed landuse (commercial/industrial);
- evaluate the contamination status of VENM/ENM source material prior to importing to the Site;
- confirm that the VENM/ENM source material complies with the requirements of the RAP before importing VENM/ENM;
- maintain records of fill movement, importation and placement across Site;
- the environmental consultant should inspect construction of the area where capping is to be placed, including a photographic record; and
- ensure the backfilling and capping meets the requirements of the SEA/Sydney Water, including a 1:1 batter.

The ongoing risks to human health and the environment associated with capping ACM impacted soil at the site would need to be managed by implementation of an Environmental Management Plan (EMP) and Asbestos Management Plan (AMP) prepared by a suitably qualified environmental consultant.

8 Remediation strategy implementation

The remediation scope of works includes the following stages:

1. stakeholder engagement;
2. site establishment;
3. soil remediation works including former UPSS tank removal and abandonment; and
4. validation.

8.1 Step 1: stakeholder consultation

Before the implementation of the RAP, it was necessary to secure all relevant approvals and licences and submit a notification of the works to Randwick City Council.

Sydney Water, the asset owner of Bunnerong Stormwater Channel No 11, approved the remediation works subject to conditions to ensure no interference with Sydney Water infrastructure adjacent to the Site. The remediation methodology was approved by Sydney Water (reference 20-000728) on 10 May 2021, presented in stamped SEA in Appendix A.

8.2 Step 2: site establishment

Initial activities at the Site included preparation of all health and safety documentation and the engagement of all contractors, plant and equipment required for the proposed remediation works. Before commencing any earthmoving activities, environmental protection safeguards and Site security measures were implemented in accordance with the Site Environmental Management Plan (SEMP) within the RAP (EMM 2021).

Site establishment activities included:

- revegetation and establishment of Site office and amenities;
- mobilise to the Site with a suitably sized excavator, equipment and personnel to undertake the works;
- installation of an exclusion zone around the works area (demarcated with bollards in addition to silt fencing along the western boundary adjacent to the canal);
- installation of Site safety requirements and warning signage; and
- installation of Site environmental controls as per the SEMP (ie silt fencing and vibration monitoring).

8.3 Step 3: remediation works

8.3.1 Tank removal and remediation

The removal of the USTs and associated infrastructure was undertaken by a suitably licenced contractor in accordance with NSW environmental and safety requirements and industry best practice, including:

- Australian Standard AS 4976 (2008): The removal and disposal of underground petroleum storage tanks;
- AS 1940–2004: Storage and handling of flammable and combustible liquids (AS, 2004);

- AS 4976–2008: The removal and disposal of underground petroleum storage tanks (AS, 2008); and
- Code of Practice: Storage and handling of dangerous goods (NSW WorkCover Authority, 2005).

The remediation of former USTs included the infrastructure identified in the September 2020 DSI (EMM, 2020) in addition to further infrastructure identified during the excavation works, namely T5, as outlined in Table 8.1 below.

Table 8.1 UPSS infrastructure remediation

Tank ID	Contents/description	Dimensions/ volume*	Photograph	Date pumped out/removed
T1	UST containing black degraded oil, medium to high viscosity. Steel tank.	3,000 gallons (11,356 L)		Pumped out 27/08/2021. Removed 30/08/2021.
T2	Vertically orientated UST exposed from the ground surface. Containing solid waste, top cut open, no liquid visible. Steel tank.	2 m ⌀		Contents excavated to max. depth of 2.6 m on 27/08/2021. Tank remained in-situ as per RAP following backfill with stabilised sand and VENM. The tank was then cut down to below the ground surface so that it was no longer visible on 5/10/2021.
T3	UST with small volume of liquid with oily sheen, mostly filled with solid waste. Concrete tank.	1 45 m ⌀		Removed 26/08/2021.
T4	UST full of black low viscosity oily water. Steel tank.	4 length (l) x 0.65 width (w) x 0.78 depth (d)		Pumped out 27/08/2021. Removed 27/08/2021.

Table 8.1 UPSS infrastructure remediation

Tank ID	Contents/description	Dimensions/ volume*	Photograph	Date pumped out/removed
T5	UST uncovered during remediation works adjacent to southern side of holding tank. Tank mostly filled with soil. Small amount of water with oily sheen observed. Concrete tank, similar to T3.	1.2 m ⌀		Removed 27/08/2021.
Holding Tank	Small volume of viscous black oily sludge and oily water. Partially filled with solid waste material including ACM. Concrete and brick tank with steel gatic cover.	4 l x 2 w x 2 d		Removed 26/08/2021.
Interceptor Pit	Filled with solid waste material (mostly glass fragments), no liquid visible. Mostly constructed of brick with steel gatic covers.	2.5 l x 0.55 w x 1 d		Removed 25/08/2021.

*Note all dimensions provided are approximate with all units in metres (m).

The following process outlined in the RAP (EMM 2021) was followed during the remediation works:

- any general solid waste (excluding soil), such as concrete or steel, across the former UPSS area was removed and disposed of at a licensed disposal facility;
- all USTs which contained predominantly liquids (T1 and T4) were decommissioned in accordance with UPSS Technical Note: Decommissioning, Abandonment and Removal of UPSS (DECCW, 2010). Vacuum extraction was completed before any disturbance to the in-situ position of each UST;
- tanks which contained predominantly solid waste and soil (T2, T3, T5, Interceptor Pit and Holding Tank) had their contents excavated, with waste material appropriately segregated and disposed of in accordance with the RAP;
- tanks were confirmed to be gas free, and as such, degassing was not required to be undertaken using applicable methodologies (ie compressed CO_2);

- T2 was filled with VENM which was imported to Site following review of classification documentation and visual confirmation;
- the use of an excavator hammer was used to cold cut the top of tanks and create an opening large enough to inspect the tanks' interior;
- the USTs were lifted from the subsurface under supervision of an EMM Site supervisor. Associated infrastructure (eg fuel lines) was removed;
- the walls and base of the excavations were validated by a suitably qualified EMM Site supervisor in accordance with the validation sampling presented in Section 9, subject to the requirements of the SEA/Sydney Water; and
- overburden material from each excavation was stockpiled on the impermeable concrete pad adjacent to the remediation area in an agreed location and clearly demarcated to avoid mixing of stockpiles pending classification/validation. Excluding hydrocarbon impacted material from the T1 excavation, the stockpiled soil/fill was sampled and reinstated in-situ after it was confirmed to meet the validation criteria (excluding asbestos);
- odorous and hydrocarbon impacted material from the T1 excavation was kept stockpiled with appropriate covering to prevent water ingress and mitigate odours, classified under the NSW EPA Waste Classification Guidelines Part 1: Classifying Waste and has been disposed off-Site to an appropriately licenced waste facility; and
- tanks were again be confirmed to be gas free and mechanically cut-up on site by an excavator using shears and/or rippers and disposed off-Site at an appropriately licensed recycling facility.

8.3.2 Pipework decommissioning

The following methodology was applied for fuel related infrastructure (excluding tanks):

- bulk product was not required to be removed from the supply lines as it was not observed to be present;
- there was no significant visible residual product observed in the lines which warranted flushing the lines with water;
- piping was drained and disconnected, with all fittings and internal tubes that are not specifically required for the selected purging method are removed and plugged;
- cut and remove fuel line infrastructure and dispose off-site at an appropriate recycling or disposal facility; and
- the remaining pipework excavation voids were contained within larger tank excavation voids, thus were validated as part of the surrounding tank excavation footprints.

8.3.3 Notification to SafeWork NSW

SafeWork NSW was notified within 7 days of the UPSS removal and abandonment.

A copy of the notification is provided in Appendix N.

8.3.4 Source removal validation/characterisation

Following removal of each of the USTs and related subsurface infrastructure, material beneath was sampled and analysed for CoPCs. Where sample results met the validation criteria, the material was considered validated, and where they did not meet validation criteria, the samples were used to characterise the material and inform further remediation/disposal options.

The approach adopted to validation and characterisation sampling, including sampling frequencies, is presented in Section 9.

8.3.5 Soil investigation – test pitting

It was originally proposed in the RAP (EMM 2021) that EMM would conduct an investigation by test pitting to close out identified data gaps in soil to the extent practicable which included:

- locations down gradient of the UPSS infrastructure. EMM notes that the Site slopes to the west and south-west and that a brick lined storm water wall lies immediately west of the former UPSS infrastructure. It is possible that impact may have migrated along the stormwater wall to the south and south-west; and
- any other area where the potential for contamination is identified after demolition which may include locations of staining, distressed plants or locations where filling is likely.

However, it was also noted in the RAP that based on the above criteria, the need to undertake test pitting may change dependent on the findings from the remediation works.

The extent of excavation works to the west were limited by the requirements of the SEA/Sydney Water to maintain the integrity of the stormwater channel. Notwithstanding, the results from the validation sampling undertaken indicated that further investigation was not warranted. As such, there was no requirement for additional test pitting following the remediation works.

8.3.6 Characterisation of excavated soils

Excavated soils were stockpiled and segregated according to the area they were removed from and based on observations (eg staining or visible ACM fragments), odour and PID readings during the remedial works. Stockpiles were then sampled and characterised. Where samples met the validation criteria, material was reinstated into the excavation voids. Where samples did not meet validation criteria (ie for asbestos), the analytical results were used to further inform alternative remediation options – namely the adoption of backfill and capping of ACM impacted material. The sampling and analysis requirements for excavated material is provided in Table 8.2 below.

Table 8.2 Excavated material characterisation

Item	Description
Sample collection	Samples were collected by the use of an excavator bucket. Disturbed samples were retrieved from the bulk sample within the bucket by direct hand grab. Larger “blocks” of soil were broken apart by hand in order to obtain a sample from the centre which has not been in contact with the bucket.
Field screening	Use of a calibrated PID and visual assessment.
Rate/frequency	Stockpiles were sampled at a ratio of at least one sample per 25 m^3 of material, in line with Table 4 within ASC NEPM (2013) Schedule B2; Guideline on Site Characterisation stockpile based on stockpile volume and homogeneity.
Analytical suite	All samples analysed for TRH, BTEXN, PAHs, 8 metals and asbestos.

8.3.7 Reinstatement of excavations

Excavated soils removed from around the tanks were replaced in the excavation voids after being suitably validated (noting residual ACM contamination) as the adopted remedial contingency (refer to Section 7).

Cement stabilised sand was used as backfill for the deepest 300 mm of the T1 excavation in line with SEA/Sydney Water requirements as this area has surpassed the depth of the channel wall invert.

Clean fill validated as virgin excavated natural material (VENM) was also used to reinstate the excavations over the backfill material, separated by a high density polyethylene (HDPE) plastic marker layer. The HDPE was perforated to facilitate surface water seepage and infiltration. Compaction was completed by track rolling.

Diagrams showing the capping layer construction are shown in Figure 8.1 (T1 excavation) and Figure 8.2 (all other excavations) below.

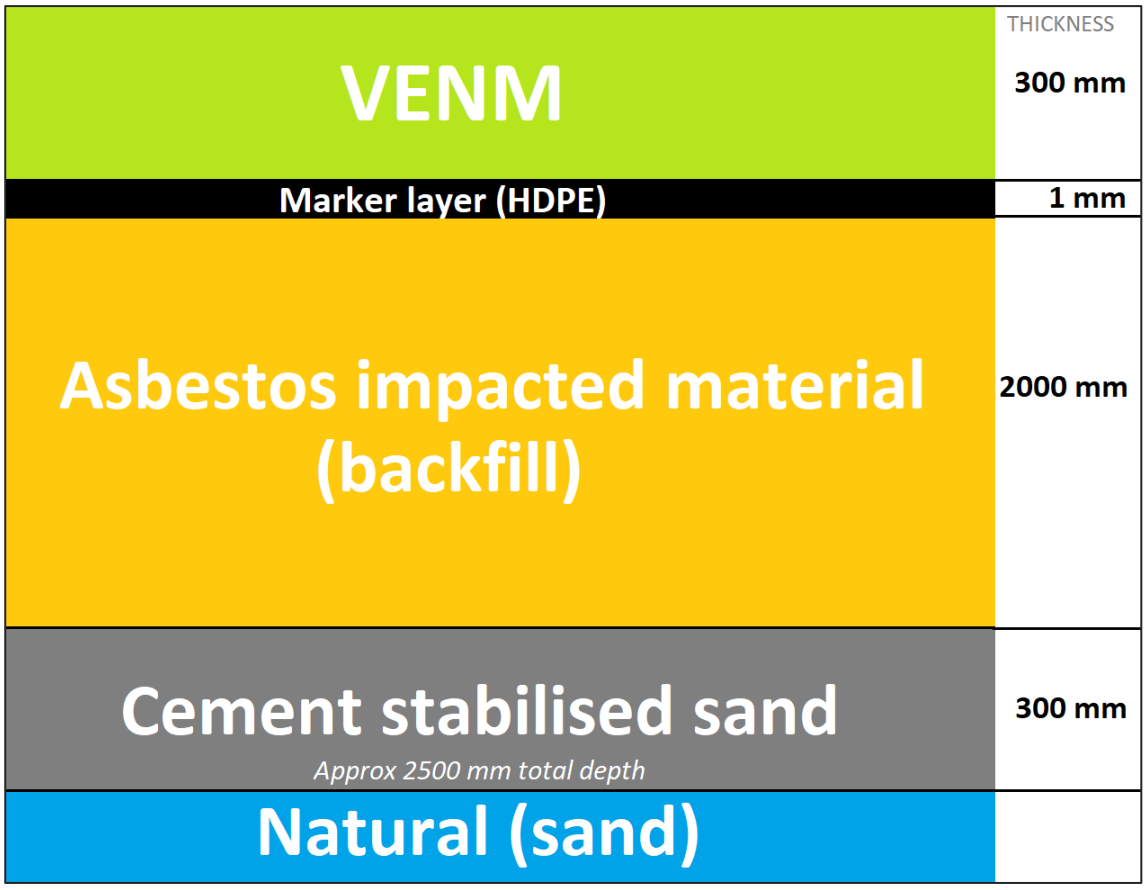

Figure 8.1 Backfill and capping layers – T1 excavation

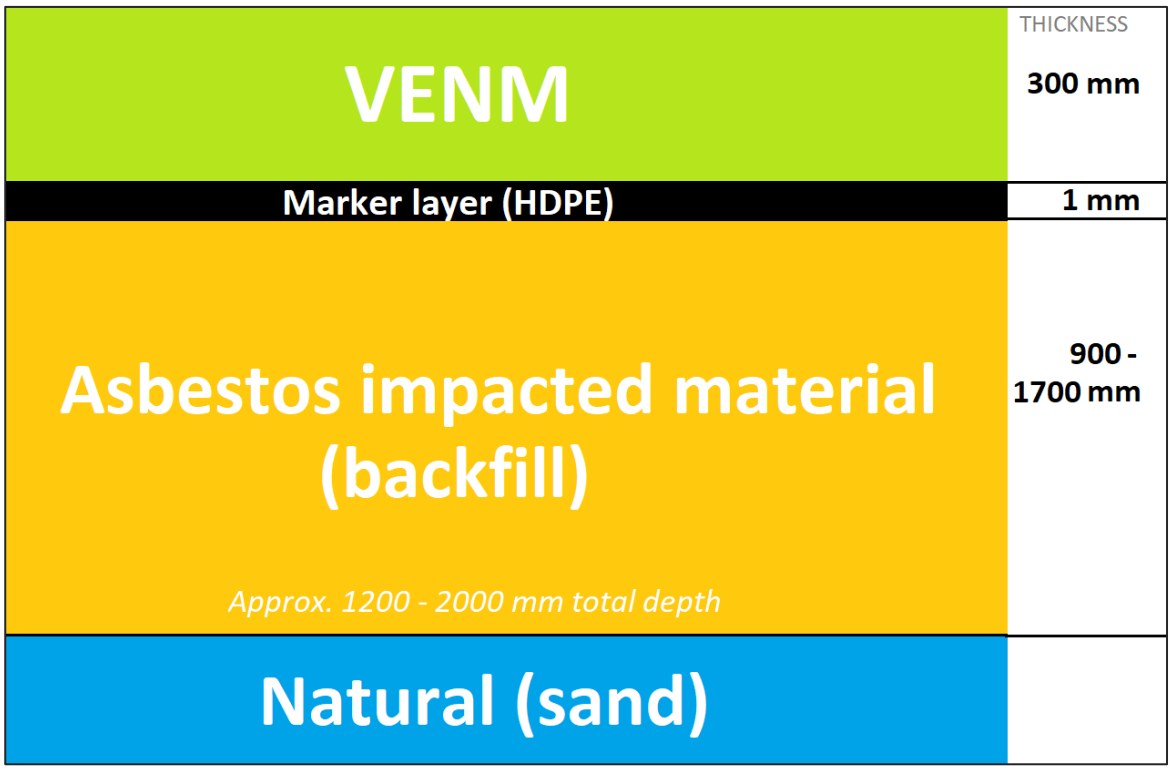

Figure 8.2 Backfill and capping layers – all other excavations

9 Validation approach

Validation sampling was undertaken for the following areas:

- UST pit excavations (which encompassed associated pipework footprints); and
- petroleum hydrocarbon impacted soil excavation area (within T1 excavation footprint).

Validation works were completed in accordance with the DQOs in Section 6.1.

9.1 Validation sampling and analysis

Validation sampling and visual inspections of the excavations created by removal of UPSS infrastructure, including the USTs and associated pipework were undertaken. Where applicable, visual indications of contamination (staining, odours or asbestos) were used to guide validation sampling.

Validation sampling methodology, frequency and analysis is summarised below in Table 9.1.

Table 9.1 Validation and characterisation sampling summary

Item	Description
Sample Collection	Samples were collected by the use of the excavator bucket and retrieved from the centre which had not been in contact with the bucket to avoid potential cross-contamination.
Field Screening	Using a calibrated PID, field screening was used to inform soil material segregation and stockpiling, with the following nominal categories: • 0–10 ppm (all other stockpiles) • >10 ppm (Stockpile SP04)
Rate/Frequency	Soil validation/characterisation samples were collected in accordance with the Technical Note: Investigation of Service Station Sites (NSW EPA, 2014) as follows: • UST excavations were sampled as follows: – UST <4 m long (T3, T4, T5): at least one sample from each wall and one from the floor in the centre of the tank; – UST 4–10 m long (T1, holding tank/interceptor pit): at least two samples from each long wall, at least one from each short wall, and one under each end of the tank; and – fuel lines - one sample every 5 m of line (note this was covered off by the surrounding tank excavation footprint sampling). Samples were also collected from depths in line with the soil validation criteria discussed in Section 9.2 to allow comparison of the analytical data to the depth appropriate criteria.
Analytical Suite	All samples were for TRH, BTEXN, PAHs, heavy metals and asbestos at a minimum.
Soil Sample Labelling, Storage and Transport	All samples were clearly labelled with unique sample identification numbers consisting of the date, sample location, depth of sample and sampler's initials. Field duplicates and triplicates were labelled so as to not reveal their purpose or sample location to the laboratory. All samples were kept chilled in an ice-filled cooler or dedicated site refrigerator prior to dispatch to a National Association of Testing Authorities (NATA) registered laboratory under standard chain of custody (COC) procedures.

Table 9.1 Validation and characterisation sampling summary

Item	Description
Field logging	The soil profile was logged in the field in accordance with AS1726-1993. Any soils sampled were classified in accordance with the Unified Soil Classification System (USCS) Procedure for Determining Unified Soil Classification (Visual Method), United States Department of the Interior, Bureau of Reclamation (USBR) 5005-86, including observation of any anthropogenic material (eg ACM or other inclusions such as brick, concrete) or olfactory evidence of contamination where observed.
Decontamination	At each sample location a new set of disposable nitrile gloves were used to directly collect soil samples from the re-useable sampling equipment for placement into the laboratory prepared glass sampling containers. No re-useable sampling tools or equipment (eg hand trowel) were required to be used during the remediation works. Thus, no rinsate samples were collected during the works. In lieu, field blank samples were collected for each day of sampling, involving pouring laboratory prepared deionised water directly into laboratory prepared sampling containers for analysis of select CoPC to check for potential airborne contaminants or cross contamination between laboratory containers during transport and storage. Further details on QA/QC sampling and procedures are described in Section 9.3.1.

9.2 Validation criteria

The primary reference for environmental site assessment in Australia is the ASC NEPM. This document includes criteria for use in evaluating potential risk to human health and ecosystems from chemical impacts, which are presented as generic investigation levels and screening levels appropriate to a Tier 1 risk-based assessment applicable to the first stage of site assessment. The application of these investigation levels and screening levels is subject to limitations, and their selection and use should be in the context of a CSM relating to the nature and distribution of impacts and potential exposure pathways (as summarised in Section 5).

Soil validation criteria adopted for the proposed remediation works are summarised below in Table 9.2. The criteria are primarily Tier 1 screening criteria and are not specifically designed to be remediation criteria. Therefore, exceedances of a criterion would trigger additional evaluation of the Site-specific circumstances, and not necessarily indicate that further remediation is required.

Table 9.2 Soil validation criteria

Adopted validation criteria	Rationale and selection
Health Investigation Levels (HILs), ASC NEPM (2013)	ASC NEPM (2013) HILs provide a framework for the use of investigation and screening levels. The framework is applicable for assessing human health risk via all relevant pathways of exposure and covers a broad range of metals and organic substances.

Table 9.2 Soil validation criteria

Adopted validation criteria	Rationale and selection
Health Screening Levels (HSLs), ASC NEPM (2013)	ASC NEPM (2013) presents HSLs for petroleum compounds which have been derived through consideration of risks to human health, with the main focus being on the vapour exposure pathway. The HSLs have been calculated using parameters that generally correspond to data available and as such aim to provide levels that are realistic rather than overly conservative. The Site is zoned as IN1: General industrial (Table 3.1) and it is assumed the land will be used for commercial or industrial purposes in future. **HSL D Commercial/Industrial are deemed to be suitable validation criteria.** Subsoil conditions surrounding the UPSS infrastructure are characterised by sand fill to a depth of at least 2.5 m bgl. Where the value is non-limiting (NL) for depth range 0 to <2 m, direct contact values have been adopted (CRC CARE #10, part 2, Friebel, E. and Nadebaum, P., 2011): **HSL D Direct Contact.**
Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs), ASC NEPM (2013)	ASC NEPM (2013): Ecological Investigation Levels (EILs) and ecological screening levels (ESLs) apply to the top 2 m of soil. EILs and ESLs protective of Areas of Ecological Significance have been selected for soil samples collected in the site. EILs and ESLs protective of **Commercial/Industrial** land use have been selected.
Intrusive Maintenance Worker (Shallow Trench) Health Screening Levels, CRC CARE Technical Report No. 10, Part 2	Health screening levels for intrusive maintenance workers are adopted for potential future intrusive work into shallow soil onsite. Adopted Validation Criteria: **Soil HSLs – Intrusive Maintenance Worker (Sand) 0−<2 m bgs.** Where the value is non-limiting (NL) for depth range 0 to <2 m, direct contact values have been adopted (the Friebel, E. and Nadebaum, P., 2011): HSL Intrusive Maintenance Worker Direct Contact.
Management Limits, Amended ASC NEPM (2013)	The ASC NEPM (2013) Management Limits for TRH are applied after the consideration of the relevant HSLs as there are a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons. There are Management Limits for specific soil types (coarse and fine) and land uses in the Amended ASC NEPM (NEPC, 2013). The Management Limits avoid or minimise the potential effects of the following and require consideration of site-specific factors to determine the maximum depth to which the limits should apply: • Formation of observable LNAPL. • Fire and explosive hazards. • Effects on buried infrastructure, eg penetration of, or damage to, in-ground services by hydrocarbons. This guideline is considered relevant for the upper 2 m of soil. As the Site geology is dominated by sandy fill, the soil texture 'coarse' has been adopted.
Soil Aesthetic Issues	In accordance with the Amended ASC NEPM (NEPC, 2013), the aesthetic state of sites is required to be taken into account. Aesthetic issues generally relate to the presence of materials with a negligible risk or non-hazardous inert foreign material in soil or fill resulting from human activity. Sites that have been assessed as being acceptable from a human health and environmental perspective may still contain such foreign material. An assessment of the Site aesthetics requires consideration of the natural state of soil on any given site, and a comparison between it and the soil encountered during investigation works. In particular, soils onsite should not exhibit discolouration (staining), a malodorous nature (odours) or abnormal consistency (rubble and asbestos). Both odours and staining were considered for future commercial/industrial land use.

9.3 Quality assurance and quality control

9.3.1 Field methods and quality control measures

The following QA/QC procedures were incorporated into the validation sampling and analysis program:

- intra-laboratory duplicates (at a rate one per 20 samples analysed) were submitted to the primary National Association of Testing Authorities (NATA) accredited external analytical laboratory (ALS/Envirolab) for analysis of CoPC;
- inter-laboratory duplicates (at a rate one per 20 samples analysed) were submitted to the secondary NATA accredited external analytical laboratory (Envirolab/ALS) for analysis of CoPC;
- collection and analysis of field blank samples at a rate of one per media, per day; and
- trip blank and trip spike samples were analysed at a rate of one per day.

It is noted that no rinsate blanks were collected as there was no reusable field sampling equipment used which required decontamination. All samples were collected via direct hand grab with single use nitrile gloves.

9.3.2 Laboratory QA/QC

Details of the specific analytical techniques utilised by Envirolab and ALS are provided in the laboratory reports issued for each batch of samples. CoC documentation accompanies all analytical data provided by Envirolab and ALS.

As part of the QA/QC programme, relative percent differences (RPD) between the duplicate and its primary sample were calculated. To be acceptable, the RPD must be within the limits detailed in Table 6.2, which is recommended in Australian Standard 4482.1-2005. The RPD results are included in Appendix C, with an EMM data QA/QC report are presented in Appendix D.

9.3.3 Analytical data validation

Analytical data validation is the process of assessing if data are in compliance with method requirements and Project specifications. The primary objectives of this process are to ensure that data of known quality are reported, and to identify if the data can be used to fulfil the overall project objectives.

Specific elements of data validation that were checked and assessed are:

- preservation and storage of samples upon collection and during transport to the laboratory;
- sample holding times;
- required limits of reporting;
- frequency of conducting quality control measurements;
- laboratory blanks;
- rinsate blanks;
- trip blanks;

- field duplicates;
- laboratory duplicates;
- inter-laboratory duplicates;
- laboratory control samples;
- surrogates; and
- the occurrence of apparently unusual or anomalous results, eg laboratory results that appear to be inconsistent with field observations or measurements.

The overall reliability of the analytical data was assessed against the DQIs as required by NSW EPA (refer to Appendix C). The data were considered sufficiently reliable for the purpose of validation and waste classification.

10 Results

10.1 Field observations

Encountered stratigraphic conditions at the Site were generally found to comprise gravelly silty sand fill material. Anthropogenic materials were observed in the fill material, including ceramic, brick, plastic, asphalt, concrete, glass and potential ACM fragments.

PID readings ranged from 0 ppm to 18 ppm, indicating low to moderate volatile contaminant concentrations in soil. Hydrocarbon staining and odours were noted in some areas as outlined in Section 10.2.

Descriptions of the material encountered in each excavation and stockpile is detailed in Section 10.2.

A photographic record of activities was taken each day during the remediation works as documented in Appendix F, with a summary provided in Table 10.1 below.

Table 10.1 Daily record of works summary (refer to Appendix F)

Date	Reference	Summary	Environmental incident
20 August 2021	Appendix F.1	Site establishment, install vibration monitor and devegetation.	Nil.
23 August 2021	Appendix F.2	Completion of Site establishment and scrape back topsoil (Stockpile SP01) to expose tanks.	Nil.
24 August 2021	N/A	Stand-down due to adverse weather.	Nil.
25 August 2021	Appendix F.3	Topsoil scrape completed and SP01 sampled for validation, new tank T5 uncovered adjacent to Holding Tank.	A bone fragment was found southwest of T1 during the topsoil scrape. Intrusive work was paused in the area and cordoned off until advice was sought from EMM archaeologists. It was determined that the fragment was likely to be cow vertebra and that work was ok to resume.
26 August 2021	Appendix F.4	Complete excavation and removal of Interceptor Pit and Holding Tank with the excavation (HT) sampled for validation. T3 and T2 were also excavated and T3 removed. Importation of VENM to Site (SP02) completed and visually inspected. Commencement of SP03 from material within and surrounding tanks.	A minor environmental incident occurred during excavation where a hydraulic hose on the smaller 5 tonne excavator came loose and spilled approximately 2-3 litres of hydraulic fluid near T2. A nearby spill kit was immediately deployed and the hydrocarbon impacted material was segregated and later combined into Stockpile SP04 before waste classification sampling was undertaken.

Table 10.1 Daily record of works summary (refer to Appendix F)

Date	Reference	Summary	Environmental incident
27 August 2021	Appendix F.5	Pump out of T1 and T4 both completed with T4 removed and excavation sampled for validation. T1 was cut open with absorbent material placed inside to soak up residual oils to be recovered on 30 August 2021. T5 tank removed and excavation sampled. T2 contents excavated to maximum depth and sampled for validation. SP03 sampled for validation.	Further bone fragments were discovered on the ground surface south of the remediation area. EMM archaeologists concluded the bones were likely non-human and no further action was required.
30 August 2021	Appendix F.6	T1 removed and excavation validation sampling undertaken. Material within T1 excavation surrounding/below the former tank was hydrocarbon odour and staining impacted and stockpiled in SP04 which was sampled for waste classification. SP04 was visually and laboratory tested not to contain ACM material (SP01 and SP03 were ACM impacted and segregated). **Conclusion of the excavation phase of the project.**	Nil.
31 August 2021	Appendix F.7	Repositioning and demarcation of stockpiles to enable safe access for backfill/disposal. Scrap metal from UPSS infrastructure was offloaded to a skip and truck. SP01 and SP03 material validated to meet validation criteria with the exception of asbestos.	Nil.
1 September 2021	Appendix F.8	Importation of concrete stabilised sand (temporarily stockpiled - SP05) and commence backfill of T1 excavation using SP05 where depth exceeded height of channel wall (as per SEA/Sydney Water requirements). Commenced backfill of T3-T5 and HT/IP excavations using SP01 material. Commenced backfill of T1 above stabilised sand using SP03 material.	Nil.
2 September 2021	Appendix F.9	Completed backfill of SP01 and SP03 material. Installed plastic marker layer over asbestos impacted fill from SP01 and SP03. Heavy duty plastic included incisions to ensure soil drainage. Backfill SP02 (VENM) over marker layer to approx. 300 mm depth. Jute mesh was placed over the embankment adjacent to the silt fencing as per SEA/Sydney Water requirements. **Completion of backfill phase of works.**	Nil.
3 September 2021	Appendix F.10	Completion of erosion and sediment (ErSed) controls and assessment of final Site condition following completion of backfill phase of works. SP04 (RSW) remained on Site and was covered pending off-Site disposal.	Nil.
5 October 2021	Appendix F.11	Load out of SP04 (RSW) for off-Site disposal and cut down of T2 below ground surface.	Nil.
6 October 2021	Appendix F.11	Float out excavator and reinstatement of ErSed controls (jute mesh and silt fencing).	Nil.

10.2 Validation results

Analytical results of for all validation sampling are tabulated in Appendix B and laboratory documentation is provided in Appendix M.

Descriptions of the excavations created during the remediation works are recorded in Table 10.2, including a summary of validation results. The excavation footprints are also shown on Figure 10.1.

Table 10.2 Excavation summary

ID	Area	Start	Finish	Placement	Sampled	Backfilled	Validated	Dimensions (l x w x d)	Description
HT	Holding Tank and Interceptor Pit	25/08/2021	26/08/2021	SP03	26/08/2021 2 base and 6 wall samples.	2/09/2021	Yes	9.5 x 4.5 x 2 m	Fill sand; minor gravels, mixed waste inclusions (brick, concrete, plastic, glass, metal) and abundant ACM fragments (particularly within both pits/tanks). HT contained small volume of sludgy liquid; interceptor pit was mostly dry.
T1	Tank 1	30/08/2021	30/08/2021	SP04	30/08/2021 2 base and 6 wall samples.	2/09/2021	Yes (laboratory results were less than the validation criteria), except for hydrocarbon odours and staining observed at both base sample locations.	10 x 4.5 x 2.5 m	Fill sand; fine-medium grain, grey to brown, loose to medium dense, moist, hydrocarbon odour and dark brown to black staining, no visible ACM. Excavation to max depth of 2.5 m, within channel wall invert (as per SEA/Sydney Water requirement).
T2	Tank 2	27/08/2021	27/08/2021	SP03	27/08/2021 1 base sample.	2/09/2021	Yes	1.5 x 1.5 x 2.6 m	Tank historically filled with gravelly silty sand (fill) with ACM fragments observed. Excavation of tank contents to max. depth of 2.6 m, within channel wall invert (as per SEA/Sydney Water requirement). Tank abandoned in-situ, filled with VENM and cut down to below the ground surface.
T3	Tank 3	25/08/2021	26/08/2021	SP03	26/08/2021 1 base and 4 wall samples.	2/09/2021	Yes	4 x 2.8 x 2 m	As per HT.
T4	Tank 4	26/08/2021	27/08/2021	SP03	27/08/2021 1 base and 4 wall samples.	2/09/2021	Base sample contained asbestos. Due to the adopted remedial approach (backfill of ACM material), this was considered acceptable.	5 x 1.5 x 1.2 m	Minor residual sediment/sludge at bottom of the tank. Surrounding excavation material as per HT (fill sand with visible ACM fragments).

Table 10.2 Excavation summary

ID	Area	Start	Finish	Placement	Sampled	Backfilled	Validated	Dimensions (l x w x d)	Description
T5	Tank 5	27/08/2021	27/08/2021	SP03	27/08/2021 1 base and 2 wall samples.	2/09/2021	Yes	1.5 x 1.5 x 2 m	An extension of the HT excavation in the southwestern corner, so there were no east or north excavation walls.

Descriptions of the stockpiles created during the remediation works, from both material excavated from the Site (refer to Table 10.2 above) and imported material to the Site are recorded in Table 10.3 below, including the outcome of sampling undertaken.

Table 10.3 Stockpile summary

ID	Source	Commenced	Completed	Removed	Fate	Sampled	Results	Volume	Description
SP01	Topsoil scraped from surface of remediation area	25/08/2021	27/08/2021	1/09/2021	Backfill below SP02 capping layer	25/08/2021 5 primary samples, 2 field duplicates	Meets validation criteria except for asbestos. Considered acceptable for revised remedial approach.	~100 m^3	Topsoil (0-0.5 m depth) - fill gravelly silty SAND with ACM fragments. No odour or staining.
SP02	Imported	26/08/2021	26/08/2021	2/09/2021	Backfill top (capping) layer	N/A	VENM (refer to Appendix I)	~50 m^3	Material was visually confirmed to be consistent with VENM classification documentation (refer to Appendix I).
SP03	Within, beside and beneath UPSS infrastructure	26/08/2021	27/08/2021	1/09/2021	Backfill T1 area above SP05 material (see below)	27/08/2021 5 primary samples	Meets validation criteria except for asbestos. Considered acceptable for revised remedial approach.	~40 m^3	As per SP01 but with slight hydrocarbon odour. Fill material from depth within/surrounding tanks.

Table 10.3 Stockpile summary

ID	Source	Commenced	Completed	Removed	Fate	Sampled	Results	Volume	Description
SP04	T1 area	26/08/2021	30/08/2021	5/10/2021	Off-site disposal	30/10/2021 5 primary samples, 2 field duplicates	RSW (refer to Section 0)	~100 m^3	Fill sand from depth (>0.5 m) with no visible ACM fragments, hydrocarbon odours and staining.
SP05	Imported	1/09/2021	1/09/2021	1/09/2021	Backfill bottom 300 mm layer of T1 area below channel wall invert	N/A	N/A	~16 m^3	Cement stabilised sand - refer to Appendix J.

Source: EMM (2021); MetroMap (2021); DFSI (2017)

0 5 10 m

GDA 1994 MGA Zone 56

N

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KEY

- Site boundary
- Excavation footprint
- Area with identified former UPSS infrastructure
- Approximate tank outline
- UPSS feature
- Watercourse/drainage line

Validation sampling results

- Excavation base sample - exceeds validation criteria for aesthetical considerations (hydrocarbon odour and staining)
- Excavation base sample - asbestos detected
- Excavation base sample - meets validation criteria
- Excavation wall sample - meets validation criteria

Validation sampling results

42-52 Raymond Avenue, Matraville NSW
Remediation validation report
Figure 10.1

EMM
creating opportunities

10.3 Waste classification results

The material placed in the stockpile identified as SP04 was assessed as requiring off-Site disposal due to the significant hydrocarbon odours and staining observed. The material was sourced from the T1 excavation, beneath and adjacent to where the tank was located and visibly leaking product.

On 30 August 2021, a total of five (5) primary soil samples plus QA/QC samples were collected from SP04. The total estimated volume of material excavated in the stockpile was approximately 100 m^3. Based on an assumed bulk density factor of 1.7 tonnes per cubic metre (t/m^3), this equated to the characterisation of approximately 170 tonnes of excavated material requiring disposal to a suitably licensed facility. The sampling density was equivalent to the collection of approximately 1 primary sample per 20 m^3 of material excavated.

The primary samples were analysed for the standard CoPC plus phenols, organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs). Sample results were compared against the NSW EPA (2014) Waste Classification Guidelines: Part 1 Classifying Waste threshold criteria and associated addendums, including:

- Contaminant Threshold criteria for General Solid Waste (GSW) (CT1).
- Contaminant Threshold criteria for Restricted Solid Waste (RSW) (CT2).

Observations of the sampled material including PID readings are recorded and summarised in Table 10.4 below.

Table 10.4 Summary of material observations and PID readings – SP04

Sample ID	Primary ID	Date	Method	PID (ppm)	Description
SP04_01_210830	-	30/08/21	Grab	15	FILL: SAND; fine-medium grain, grey to brown, loose to medium dense, moist, hydrocarbon odour and dark brown to black staining, no visible ACM.
SP04_02_210830	-	30/08/21	Grab	10	
SP04_03_210830	-	30/08/21	Grab	8	
SP04_04_210830	-	30/08/21	Grab	8	
SP04_05_210830	-	30/08/21	Grab	16	
QC102_210830	SP04_05_210830	30/08/21	Grab	-	
QC202_210830	SP04_05_210830	30/08/21	Grab	-	

Tabulated analytical results are presented in Appendix B. Laboratory analytical reports are provided in Appendix M.

All reported results were below the relevant contaminant threshold (CT), with the exception of:

- TRH C_{10}-C_{36} (Sum of total): concentrations exceeded GSW CT1 criteria (10,000 mg/kg) for samples SP04_02_210830 (19,000 mg/kg), SP04_05_210830 (23,000 mg/kg), QC102_210830 (22,000 mg/kg) and QC202 (30,400 mg/kg).

Based on the analysis conducted, material contained within Stockpile SP04 met the RSW – Restricted Solid Waste classification when compared with NSW EPA Waste Classification Guidelines (2014) – Part 1: classifying waste.

The waste classification report for stockpile SP04 is provided in Appendix G.

The stockpile was removed from Site on 5 October 2021. The licenced waste facility disposal dockets are provided in Appendix H.

10.4 Canal wall dilapidation monitoring

10.4.1 Vibration monitoring

In accordance with the requirements of the SEA/Sydney Water, vibration monitoring was undertaken over a period of 3 days prior to works commencing to establish baseline conditions, and subsequently for the duration of the remediation works. The monitor was positioned adjacent to the work area on top of the Bunnerong Stormwater Channel No 11 eastern brick wall (the canal wall). The vibration monitoring report is provided in Appendix K. A statement on compliance with the SEA conditions will be provided by Calibre (Sydney Water's WSC) following review of this document.

10.4.2 Survey data

In accordance with the requirements of the SEA/Sydney Water, the following survey monitoring work was undertaken by a registered surveyor to assess potential impacts to the structural integrity the canal wall:

- installation of 16 targets at approx. 5 m intervals from along the top (or along the side where vegetation obstructed the top) of the canal wall;
- the targets were survey quality reflective targets on small section aluminium angle glued to the top of the brickwork with an epoxy resin ("Araldite");
- whilst the glue set, survey control was established on Site prior to the first round of observations taken and recorded (2 faces with multiple rounds of arc and distance measurements);
- a second round of observations was taken prior to commencement of Site works to verify background conditions with regards to stability of the structure;
- additional rounds of observations during the course of remedial works and at conclusion of works were undertaken to assess potential changes, including after excavation (31 August 2021) and after reinstatement (7 September 2021);
- confirmation that the replacement batter was less than 1:1 gradient and depth of excavation during construction did not exceed the invert level of stormwater canal; and
- survey of the base of excavations to outline the areas which exceeded the depth of the top of the canal wall to inform the requirement for stabilised sand to be used as backfill, which occurred at the T1 area.

The survey monitoring data is provided in Appendix L.

10.5 Quality assurance and quality control

Data QA/QC procedures were adopted to provide a consistent approach in the evaluation of the DQIs as outlined in Section 6.1. The methodology outlined in this section was based upon data validation guidance provided in ASC NEPM. The process involved the checking of analytical procedure compliance and an assessment of the accuracy and precision of analytical data from a range of quality control measurements, generated from both the field sampling and analytical programs.

Based on the review of QA/QC information undertaken in Appendix D, it is considered that an acceptable degree of QA/QC information has been collected and reported in accordance with the DQOs and DQOs (refer to Section 6.1).

The following documentation is provided in the respective appendices:

- QA/QC report – Appendix D
- Trip blank, trip spike and field blank sample result tables – Appendix C.1
- RPD tables – Appendix C.2
- Equipment calibration certificates – Appendix E

The laboratory data are considered to provide an acceptable level of confidence in the precision, accuracy, representativeness, comparability and completeness of the analytical results.

11 Updated conceptual site model

Based on historical investigations and the intrusive investigation works completed by EMM, a CSM was developed to evaluate the nature and extent of contamination at the Site prior to remediation works. This original CSM is outlined in Section 5, which includes a detailed analysis of potential contamination sources, pathways and receptors.

Based on the results of the validation sampling, the following identified sources of contamination at the Site have been re-evaluated based on the original CSM.

Table 11.1 Summary of source-pathway-receptor evaluation following remediation works

Source and CoPC	Evaluation
Former UPSS TRH, BTEXN, PAHs, VOC, lead	Tanks were observed to contain oily water and product (primarily T1) and seepage was observed in the adjacent stormwater channel wall. Observations during previous soil and groundwater investigation did not indicate the presence of widespread contamination on the Site (EMM 2020). Due to limitations imposed by the requirements of the SEA/Sydney Water, investigations and excavation downgradient and below the former UPSS (adjacent to the stormwater canal) were necessarily limited. While all validation samples inferred to be downgradient (ie the western excavation wall samples) met the validation criteria, the T1 excavation base samples did not meet the validation criteria for aesthetical considerations as hydrocarbon odours and staining were observed (however, they did not exceed the criteria for laboratory analytical results). Deeper excavation and removal of impacted material during the remediation works was not permitted based on the SEA/Sydney Water requirements. Impacted material was removed from the T1 pit to the extent practicable and permissible, with residual hydrocarbons remaining at the base of the excavation. As such, it is considered possible that residual soil and/or groundwater hydrocarbon impacts associated with the former on-Site UPSS may be encountered at depth (below 2.5 m) within proximity to the former location of T1, including downgradient.
ACM in former buildings, utilities and pipework, and impacted soils Asbestos	ACM was previously identified in fill material at the Site, including outside of the remediation area. The distribution of ACM was not confined to any particular fill type or location. The remediation works confirmed that extensive subsurface ACM material was present in the remediation area. ACM fragments were observed at several walls of the excavation where the removal of hydrocarbon-impacted soil (the primary objective of the remediation works) was terminated. As a result, the remedial contingencies (as identified in the RAP) were applied. This involved reinstatement of ACM impacted material (validated a suitable for other CoPCs) to excavation voids as an interim management measure, followed by capping with VENM and compaction. This presents a residual contamination risk which can be managed in accordance with recommendations outlined in Section 12.

12 Recommendations and conclusions

12.1 Validation summary

The remediation works:

- were undertaken in accordance with legislative guidelines, Site-specific Sydney Water requirements and current industry best practice;
- executed the remediation strategy in accordance with the RAP (EMM 2021); and
- implemented contingency options in accordance with the RAP were considered warranted based on the subsurface conditions encountered during remediation works at the Site. Variations to the preferred remediation strategy have been documented in this Validation Report. This included excavated asbestos impacted material reinstated to excavation voids and then capped due to the greater extent of asbestos impacted material encountered.

EMM notes that SEA/Sydney Water requirements affected the remediation methodology proposed (as originally anticipated in the RAP), whereby the spatial limitations imposed on the extent of excavation that could be conducted adjacent to the heritage listed stormwater channel prevented lateral (to the west) and vertical remediation of residual hydrocarbon impacted soil at the Site.

Ongoing monitoring/management is required where contamination remains on-Site and should be undertaken after this validation report has been completed. The land use suitability (and associated statement in the validation report) for the remediated Site may be subject to the outcomes of an ongoing monitoring/management program.

12.2 Groundwater validation

As stated in the *UPSS Technical Note: Site Validation Reporting* (NSW DECCW 2010), groundwater assessment must be conducted where soil contamination has been encountered or identified, including the possibility of residual groundwater contamination at abandoned UPSS sites.

It is noted that the three monitoring wells on Site are located up or cross-hydraulic gradient of the former UPSS infrastructure and it is possible that groundwater impacts could exist within close proximity to, or down-hydraulic gradient from, the UPSS infrastructure. Without monitoring locations down-hydraulic gradient of the former UPSS infrastructure it is unclear if there are hydrocarbon impacts in groundwater.

In accordance with the RAP (EMM 2021), all efforts were made to install at least one (1) groundwater monitoring well within the UPSS source area or downgradient to assess conditions. This was not feasible during the detailed site investigation (DSI) or remediation and validation works due to the spatial constraints of working within close proximity to the Sydney Water canal along the western boundary of the Site, and due to slope stability/safety concerns in the location where installation of a groundwater well would be desirable. Based on current site redevelopment plans it is not expected that these constraints will be removed. Should redevelopment design plans change then the feasibility to assess post-remediation groundwater conditions should be reviewed.

EMM notes that, given the primary sources of hydrocarbon contamination (ie the UPSS) have been removed and extensive excavation and disposal of hydrocarbon contaminated soil has been completed during these remediation works, the residual contamination and potential source of groundwater impact has been significantly reduced so far as is reasonably practicable.

12.3 Management plans

The risks to human health and the environment associated with residual hydrocarbon impact in soil and capped ACM impacted soil at the Site must be managed by an EMP prepared by a suitably qualified environmental consultant. As the reinstatement of ACM impacted soil was an **interim measure** (to be addressed in conjunction with broader ACM contamination beyond the remediation area), an interim EMP is required to ensure that risks are managed during the development approvals and design phases.

A Site-specific AMP is also required under Part 8.4 of the NSW Work Health and Safety Regulation 2017 where there is potential for asbestos materials to be encountered. This will relate to works that may intersect, excavate or otherwise encounter any areas with potential, likely and confirmed asbestos. It is noted that this may include other areas of the Site beyond the scope of this validation report (ie outside of the UPSS remediation area). The AMP and associated Standard Work Procedures must satisfy the relevant requirements of:

- Work Health and Safety Act and Regulation 2017; and
- the Safe Work Australia Asbestos Codes of Practice and Guidance Notes.

All persons accessing the area(s) identified in the AMP will be required to undertake a suitable risk assessment and develop a Safe Work Method Statement (SWMS) prior to commencing work in potential or actual asbestos impacted areas.

Furthermore, all future bulk earthworks and construction works on the Site must be undertaken in accordance with other responsibilities under relevant Work Health and Safety legislation and industry guidelines. Therefore, any intrusive activities which may be required would be expected to be carried out under a Construction Environmental Management Plan (CEMP) and WHS Plan and as such, the potential risk of exposure to contaminants present on the Site, and appropriate mitigations, must be addressed accordingly. As well as typical environmental management measures, other components should include:

- an unexpected finds protocol, including procedures to identify and manage contamination, if encountered;
- procedures for the handling and storage of waste including contaminated materials;
- surface water management and sediment and erosion control;
- monitoring requirements;
- requirements for the storage of dangerous goods and other materials; and
- further remediation and rehabilitation if necessary.

Subject to completion of any further remediation works which may be undertaken during construction, a Long Term EMP (LTEMP) may be required to manage residual post-construction contamination risks. For any encapsulated ACM in soils, this would be primarily to ensure that capping material remains intact. The LTEMP should specify the monitoring requirements and procedures for future ground disturbance in the area of the Site where encapsulation has been undertaken.

The Site may be considered suitable for land use purposes under the current land zoning (IN1: General industrial) subject to appropriate recommendations outlined in this report being implemented in accordance with legislative guidelines.

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