NSW GOVERNMENT | sydney METRO

West

Westmead to The Bays and Sydney CBD

Environmental Impact Statement

Concept and Stage 1

Technical Paper 8
Contamination

Metro West - Stage 1

Technical Paper 8: Contamination

Final

Sydney Metro

Sydney Metro West – Stage 1

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Executive Summary

Jacobs Group (Australia) Pty Ltd have prepared a Stage 1 contamination investigation technical paper to support the Environmental Impact Statement for the Sydney Metro West Project. The purpose of this technical paper was to identify and assess the potential human health and ecological impacts from contamination as a result of Stage 1 (i.e. the potential for contamination to impact upon construction). In doing so it responds directly to the Secretary's Environmental Assessment Requirements.

The objective of the contamination investigation was to:

- Assess whether the land within and/or adjacent to the construction footprint and alignment (including power supply routes) could be contaminated
- Identify if management or remediation of the land may be required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses
- Identify if and where further investigations are required to better inform any required response (management or remediation) in accordance with current guidelines.

The methodology carried out for the contamination investigation is outlined below:

- Desktop review of available information sources and observations from site inspections to understand the existing environment and potential for contamination within the study area
- A high level prioritisation exercise including identification of areas of environmental interest (with respect to contamination) and assessment of potential impacts to construction from contamination (with no mitigation measures) to environmental and human receptors in the context of proposed construction activities
- Identification of appropriate mitigation and management responses for contamination, or where further investigation or remediation may be required.

Based on the findings of the desktop review and site inspections, a number of known and potential contamination sources (areas of environmental interest – AEIs) have been identified within and/or adjacent to the construction footprint and alignment (including power supply routes).

From the results of the prioritisation exercise, a number of sites have been identified as having moderate to high potential for construction to expose contamination to human and/or ecological receptors (without mitigation). Additional information would need to be obtained and reviewed (such as site-specific data) in order to determine most appropriate site-specific responses or controls, which may include remediation. Construction sites or parts of the alignment with moderate to high potential for construction to expose contamination to human and/or ecological receptors (without mitigation) are:

- Westmead metro station construction site and tunnel alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including mechanical workshop activities, dumping of construction wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Parramatta metro station construction site and tunnel alignment – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including possible commercial/industrial land use, dry cleaning operation and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Clyde stabling and maintenance facility construction site and tunnel alignment in Rosehill/Clyde – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been

assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including industrial land use, industrial land use on adjoining sites, vehicle maintenance at Sydney Speedway (location on NSW Government owned land), historical land reclamation around on-site waterways, heliport operations, known groundwater contamination on adjoining or nearby sites (James Hardie and Clyde Refinery), landfilling of asbestos and PFAS containing wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures

- Silverwater services facility construction site and tunnel alignment – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been assigned a **moderate to high potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including possible commercial/industrial land use, known VOC contamination on-site, dumping of construction wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Sydney Olympic Park metro station construction site and tunnel alignment – Groundwater and landfill gas within / beneath the construction site and above the alignment have been assigned a **high potential contamination impact** associated with historical burial of waste materials and potential firefighting activities adjacent to the site
- North Strathfield metro station construction site and tunnel alignment – Soils within the construction site or above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures and potential firefighting activities adjacent to the site
- Burwood North Station construction site and tunnel alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including mechanical workshop activities and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Five Dock Station construction site and tunnel alignment – Soils within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including the operation of funeral homes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- The Bays Station construction site and tunnel alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities (power station) carried out on and adjacent (industrial land use) to the site, historical land reclamation, potential firefighting activities (on and in the vicinity of the site) and the possible inappropriate management (during demolition) of hazardous building materials in former structures adjacent to the site.

Potential contamination may be present within the following power supply routes:

- Westmead metro station construction site: There is the potential for fill (material of unknown quality, construction wastes) within the railway corridor and in areas adjacent to waterways.
- Clyde stabling and maintenance facility construction site: It is possible that industrial wastes (potential asbestos wastes) may have been used in the construction of the roadways and used as fill in areas of the power supply route. Any construction activities for the power supply route which extend into groundwater could expose contamination known to be present in this general locality.
- The Bays Station construction site: It is possible that wastes associated with historical industry within the general locality or from harbourside industry (potential coal/coke wastes, ash and slag) may have been used in the construction of the roadways and used as fill in areas of the power supply route.

- All power supply routes will connect into existing sub-stations. Contamination associated with the use of these sites as sub-stations, including potential firefighting activities may be present.

Based on the assessed level of potential impact from construction to expose contamination to human and/or ecological receptors, a range of mitigation and management measures have been developed in order to manage potential contamination during construction in additional to the requirements of the Construction Environmental Management Framework. These mitigation and management measures include:

- Soil and water environmental management plans
- Additional data review
- Detailed site investigations
- Remedial action plans and remediation
- Site auditing, and as required, ongoing environmental management.

Glossary of terms and abbreviations

Acronym	Meaning
AEIs	Areas of environmental interest
AHD	Australian height datum
ASRIS	Australian Soil Resource Information System
ASS	Acid sulfate soil
ASSMAC	Acid Sulfate Soil Management Advisory Committee
BTEX	Benzene, toluene, ethylbenzene, xylenes
CLM Act	*Contaminated Land Management Act 1997*
CSIRO	Commonwealth Scientific and Industrial Research Organisation
der	Dermal
DIPNR	Department of Infrastructure, Planning and Natural Resources
DPI	Department of Primary Industries
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority
EPL	Environmental protection licence
GDE	Groundwater dependent ecosystem
HEPA	Heads of EPAs
ing	Ingestion
inh	Inhalation
ISCA	Infrastructure Sustainability Council of Australia
ISQG	Interim Sediment Quality Guidelines
LEP	Local Environmental Plan
LNAPL	Light Non-Aqueous Phase Liquid
LPI	Land and Property Information
mbgl	metres below ground level
NAGD	National Assessment Guidelines for Dredging

Acronym	Meaning
NEMP	National Environmental Management Plan
NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999, as revised 2013
OCP	Organochlorine pesticides
OPP	Organophosphate pesticides
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PFAS	Per- and poly-fluoroalkyl substances
PID	Photoionisation detector
PPE	Personnel protective equipment
RAP	Remedial action plan
REF	Review of environmental factors
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State environmental planning policy
TCLP	Toxicity characteristic leaching procedure
TfNSW	Transport for New South Wales
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
VOC	Volatile organic compounds

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1. Introduction

1.1 Sydney Metro West

Sydney Metro West is a critical step in the delivery of *Future Transport Strategy 2056*. It would provide fast, reliable and frequent rail service between Greater Parramatta and the Sydney CBD.

Sydney Metro (as 'the proponent') is seeking planning approvals as follows:

- Approval for the whole Sydney Metro West (at concept level) concurrent with Stage 1. Stage 1 involves the major civil construction works between Westmead and The Bays (and is the subject of this technical paper)
- Future stage(s) would include the remaining major civil construction works from The Bays to the Sydney CBD, rail systems fit-out, station fit-out and aboveground building construction, and operation of the metro line (future application(s)).

Sydney Metro is seeking a specific declaration for Sydney Metro West to be declared as State significant infrastructure and critical State significant infrastructure under sections 5.12(4) and 5.13 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), respectively.

1.1.1 Location

Sydney Metro West would mainly be located underground in twin tunnels. Stage 1, which is subject of this assessment, extends from Westmead to The Bays (refer to Figure 1-1).

1.1.2 Overview of Stage 1

The Stage 1 of Sydney Metro West (Stage 1) would involve the major civil construction work between Westmead and The Bays, including:

- Enabling works such as demolition, utility supply to construction sites, utility adjustments and modifications to the existing transport network
- Tunnel excavation including tunnel support activities
- Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays
- Shaft excavation for services facilities at Rosehill (within the Clyde stabling and maintenance facility construction site), Silverwater and between Five Dock Station and The Bays Station construction sites
- Civil work for the stabling and maintenance facility at Clyde including earthworks and structures for crossings of A'Becketts Creek and Duck Creek
- A concrete segment facility for use during construction located at the Clyde stabling and maintenance facility construction site
- Excavation of a tunnel dive structure and associated tunnels at Rosehill to support a connection between the stabling and maintenance facility and the mainline metro tunnels

The Stage 1 is further described in Chapter 9 (Stage 1 description) of the Environmental Impact Statement.

The location of the services facility between Five Dock Station and The Bays Station is currently being investigated, and is not assessed within this technical paper. Further detail on the locational and design criteria that would be used as part of determining the preferred location is detailed in Chapter 9 (Stage 1 description) of the Environmental Impact Statement.

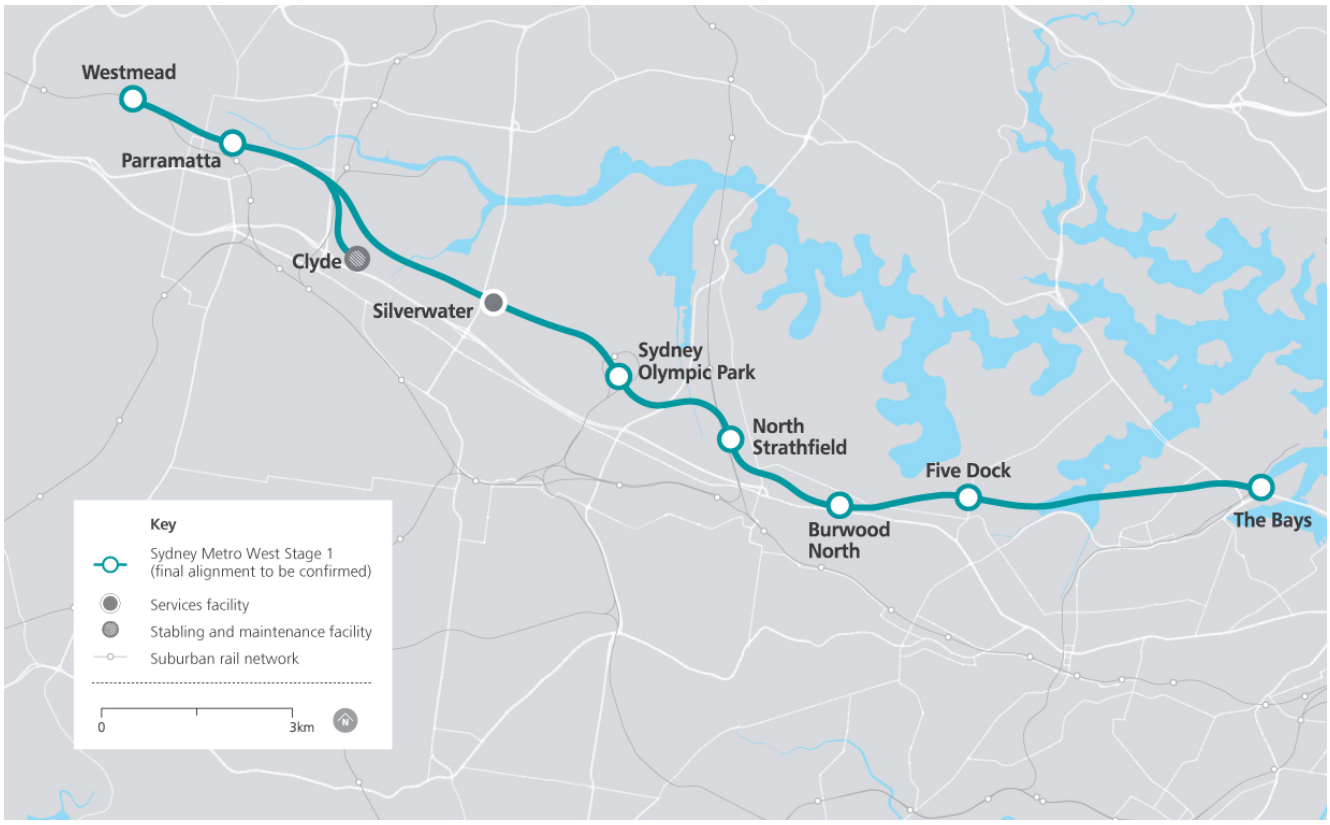

Figure 1-1: Sydney Metro West – Stage 1 overview

1.2 Purpose and scope of this report

This technical paper is one of several technical papers that form part of the Environmental Impact Statement. The purpose of this technical paper is to identify and assess the potential human and ecological health impacts from contamination to the construction of Stage 1. In doing so it responds directly to the Secretary's Environmental Assessment Requirements outlined in Section 1.3.

The objective of the contamination investigation was to:

- Assess whether the land within and/or adjacent to the construction footprint and alignment (including power supply routes) could be contaminated
- Identify if management or remediation of the land may be required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses
- Identify if and where further investigations are required to better inform any required response (management or remediation) in accordance with current guidelines.

It is acknowledged that contamination (if present) could impact upon receivers (e.g. commuters, workers and the general public) associated with the operation of Sydney Metro West. Contamination impacts to operational receivers would need to be further assessed and where required, remediated during the construction phase.

1.3 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements where issued for Stage 1 on 11 December 2019. The requirements specific to contamination and where these requirements are addressed in this technical paper are outlined in Table 1-1. The Secretary's Environmental Assessment Requirements also refer to the further investigations and assessments as identified in the Sydney Metro West Scoping Report – Westmead to The Bays

and Sydney CBD (Sydney Metro, 2019). Where these requirements are addressed in this technical paper are outlined in Table 1-2.

Table 1-1: Secretary's environmental assessment requirements – Contamination and soils

Secretary's environmental assessment requirements	Where addressed
1. Commitments made in Section 9.8.2 of the Scoping Report.	Refer to Table 1-2.
2. The risk of contamination and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with current guidelines.	Section 3.8, Section 3.9, Section 4 and Section 7.

Table 1-2: Further investigations and assessments as identified in the Sydney Metro West Scoping Report – Westmead to The Bays and Sydney CBD (Sydney Metro, 2019)

Further investigations and assessments	Where addressed
A review of previous contamination assessments (where available)	Refer to Section 3.9.7.
A review of historical aerial photography and plans to identify potential contamination sources along and/or adjacent to Stage 1 construction sites	Refer to Section 3.9.1.
A review of publicly available data (web-based information searches)	Refer to Section 3.9.
A site inspection to identify potential contamination sources and verify those potential areas of concern identified in the review of historical and available information	Refer to Section 3.8.
Recommendations for additional investigations and/or management of potentially contaminated sites which could be encountered during construction	Refer to Section 7.

2. Assessment methodology

The methodology for this Stage 1 contamination investigation is outlined in the following sections and has included:

- Desktop review of available information sources and observations from site inspections to understand the existing environment and potential for contamination within the study area
- A high level prioritisation exercise including identification of areas of environmental interest (with respect to contamination) and assessment of potential impacts to construction from contamination (with no mitigation measures) to environmental and human receptors in the context of proposed construction activities
- Identification of appropriate mitigation and management responses for contamination, or where further investigation or remediation may be required.

2.1 Study area

To account for potential soil, groundwater and vapour contamination that may be present as a result of historic and / or current activities carried out on and / or next to the construction footprint and alignment, the study area for this investigation is defined as follows:

- The Stage 1 construction sites and surrounding land within approximately 500 metres of the construction sites
- The Stage 1 tunnel alignment, and surrounding land within approximately 500 metres of the tunnel alignment
- With respect to per-and ploy-fluoroalkyl substances (PFAS), the Stage 1 construction sites and tunnel alignment and surrounding land within one kilometre of the respective construction elements
- A broad assessment of current and historical land use (with respect to potential contamination) within and immediately adjacent to the power supply routes
- The construction sites considered in this assessment are shown in Figure 2-1 to Figure 2-9. Excavation would occur at each site to facilitate the construction of future stations, services facilities or the tunnel portal
- Tunnel boring machines would be used to excavate twin tunnels which would be about 21 kilometres long. The tunnel alignment for Stage 1 is shown in Figure 1-1. The depth of the tunnels would vary from about 15 metres to 90 metres deep due to changes in the topography. The shallower tunnel sections would generally be near the tunnel portal at Rosehill and near the cut-and-cover stations. The tunnels would be lined with pre-cast concrete segments to ensure the long term life of the asset and minimise groundwater inflow into the tunnel.

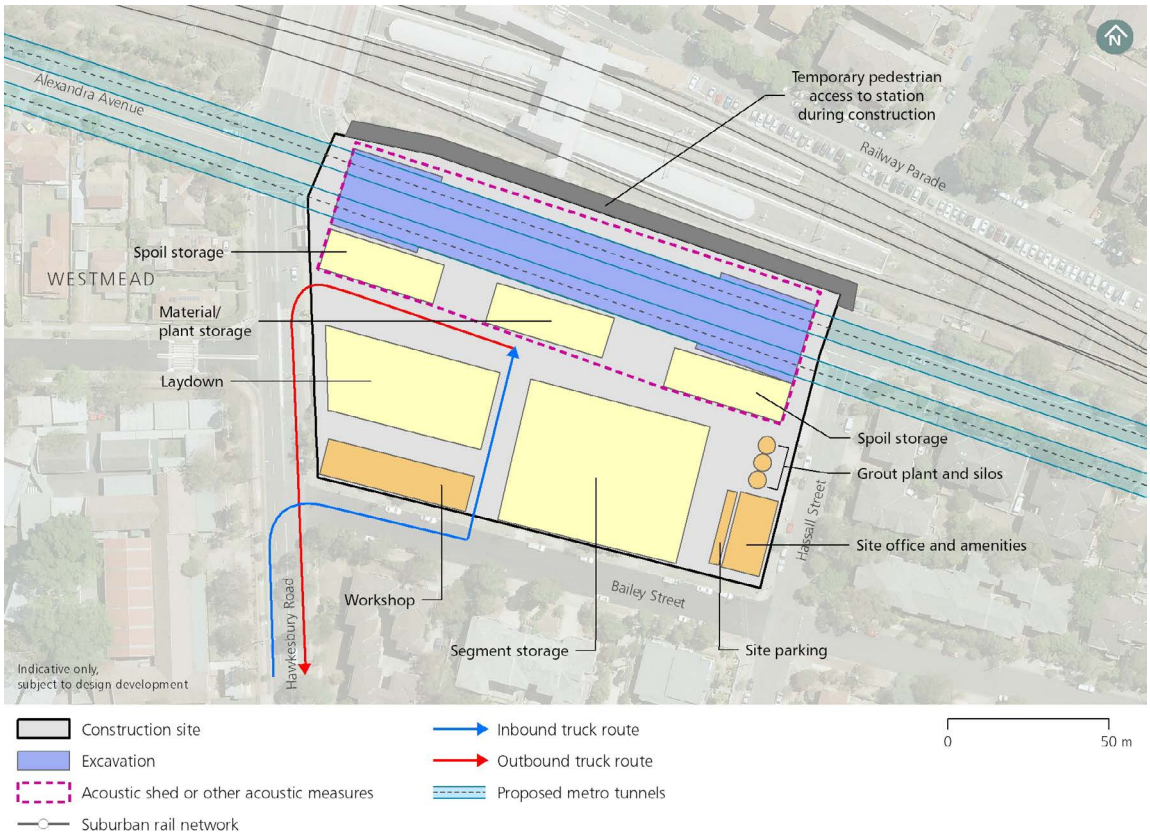

Figure 2-1: Westmead metro station construction site

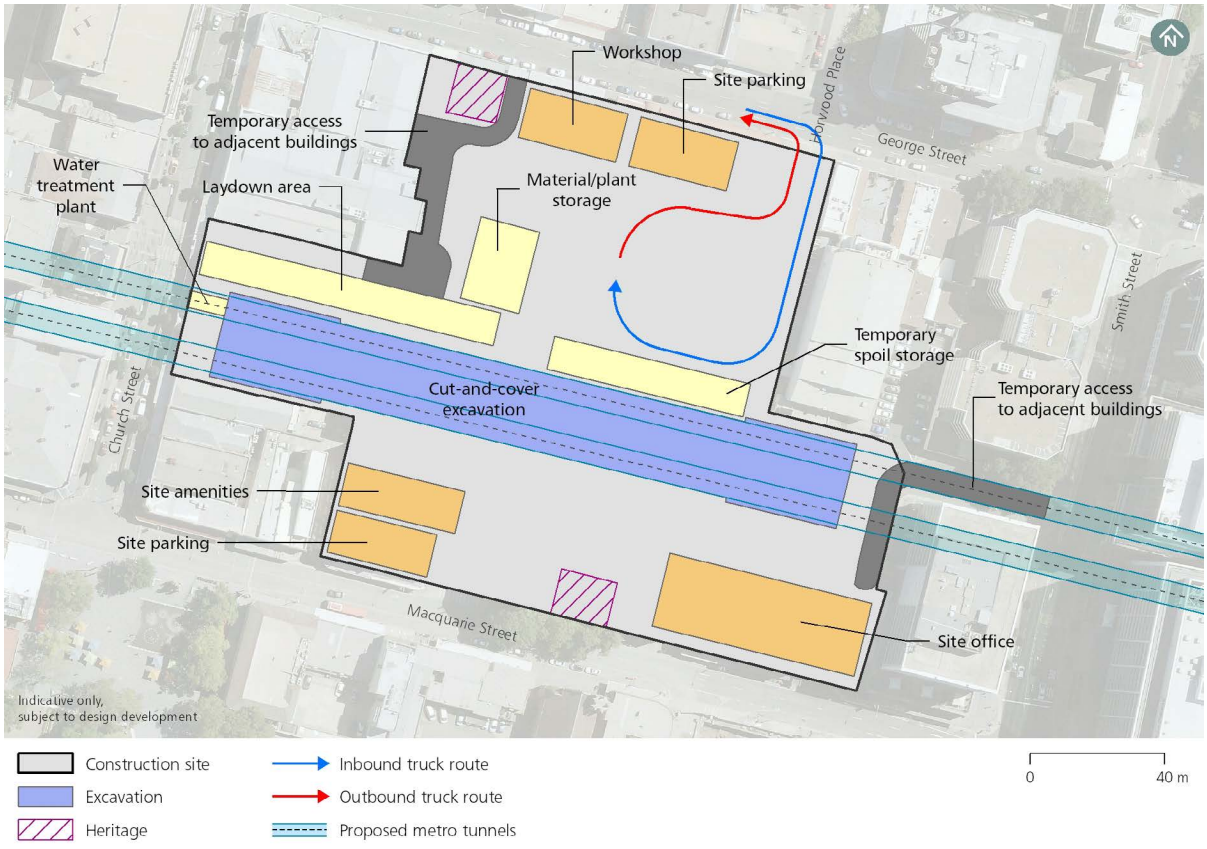

Figure 2-2: Parramatta metro station construction site

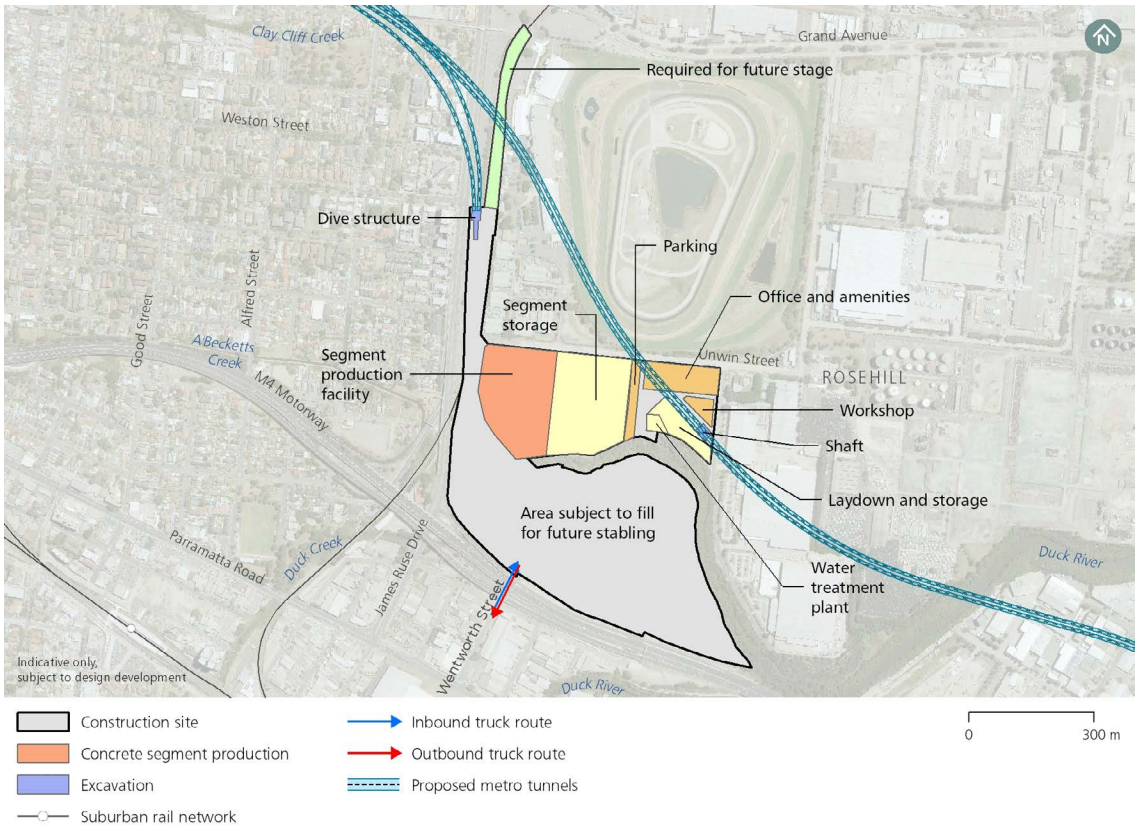

Figure 2-3: Clyde stabling and maintenance facility construction site

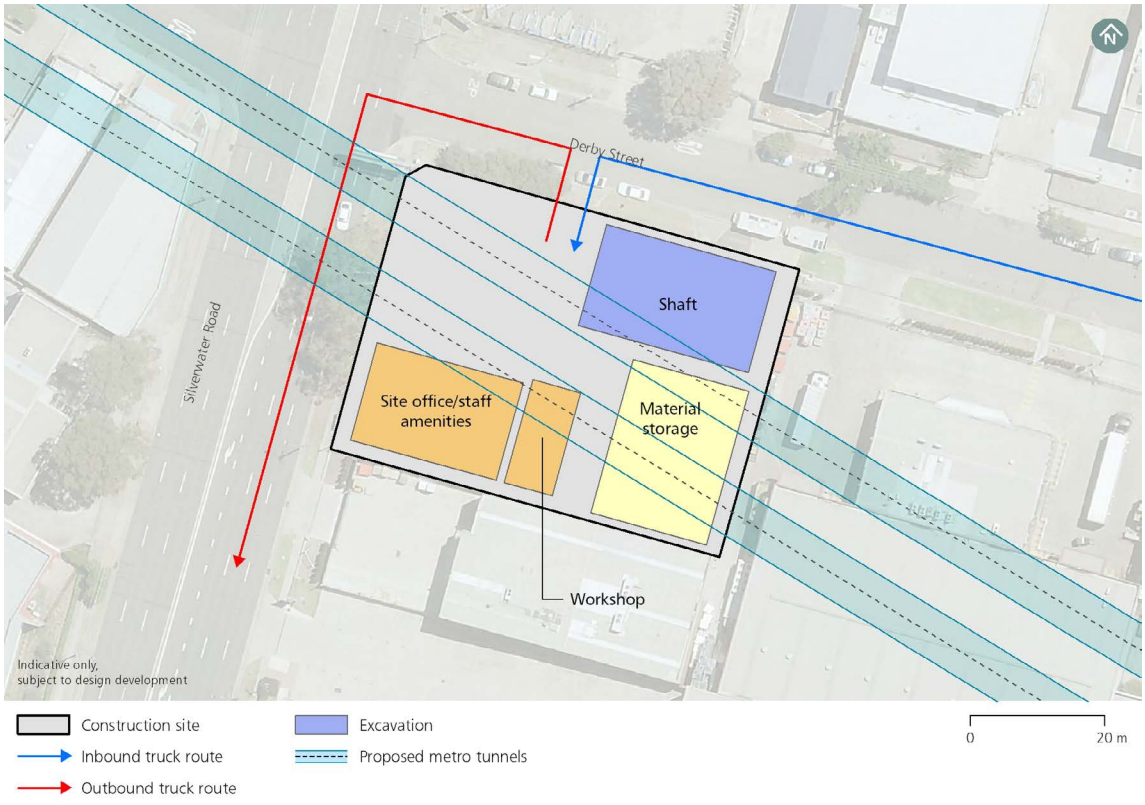

Figure 2-4: Silverwater services facility construction site

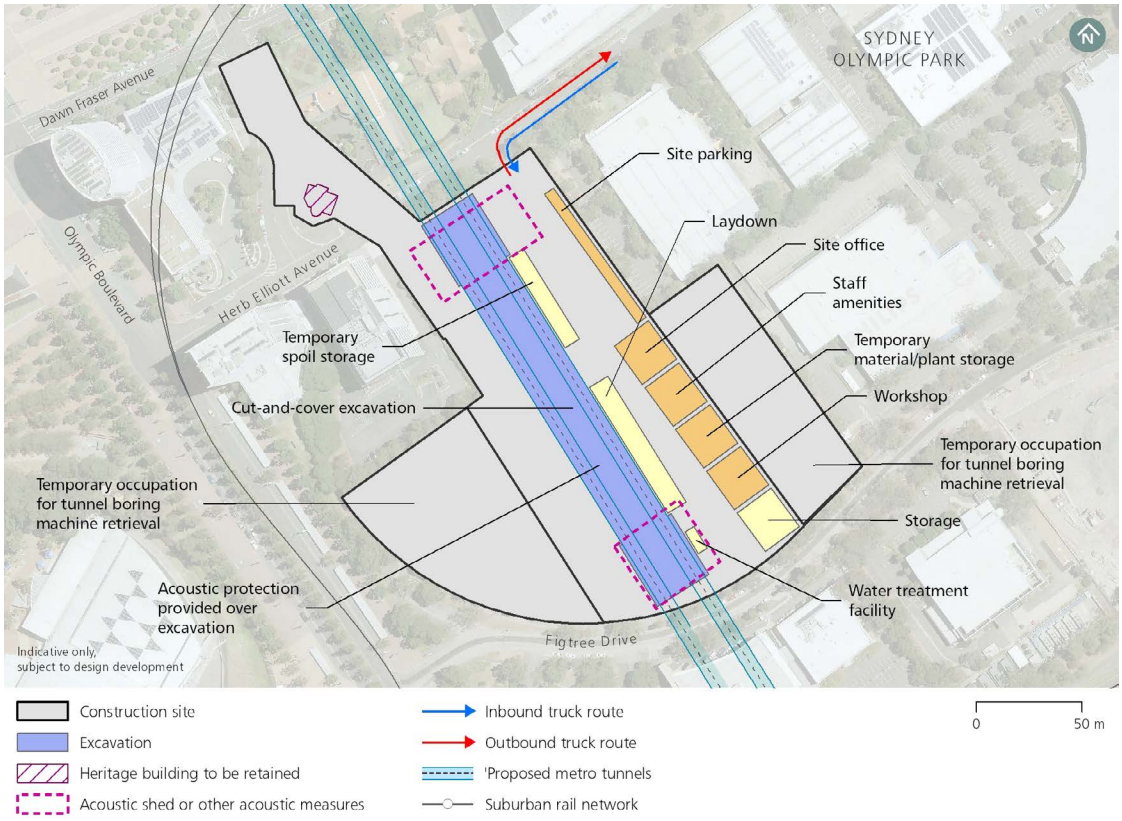

Figure 2-5: Sydney Olympic Park metro station construction site

Figure 2-6: North Strathfield metro station construction site

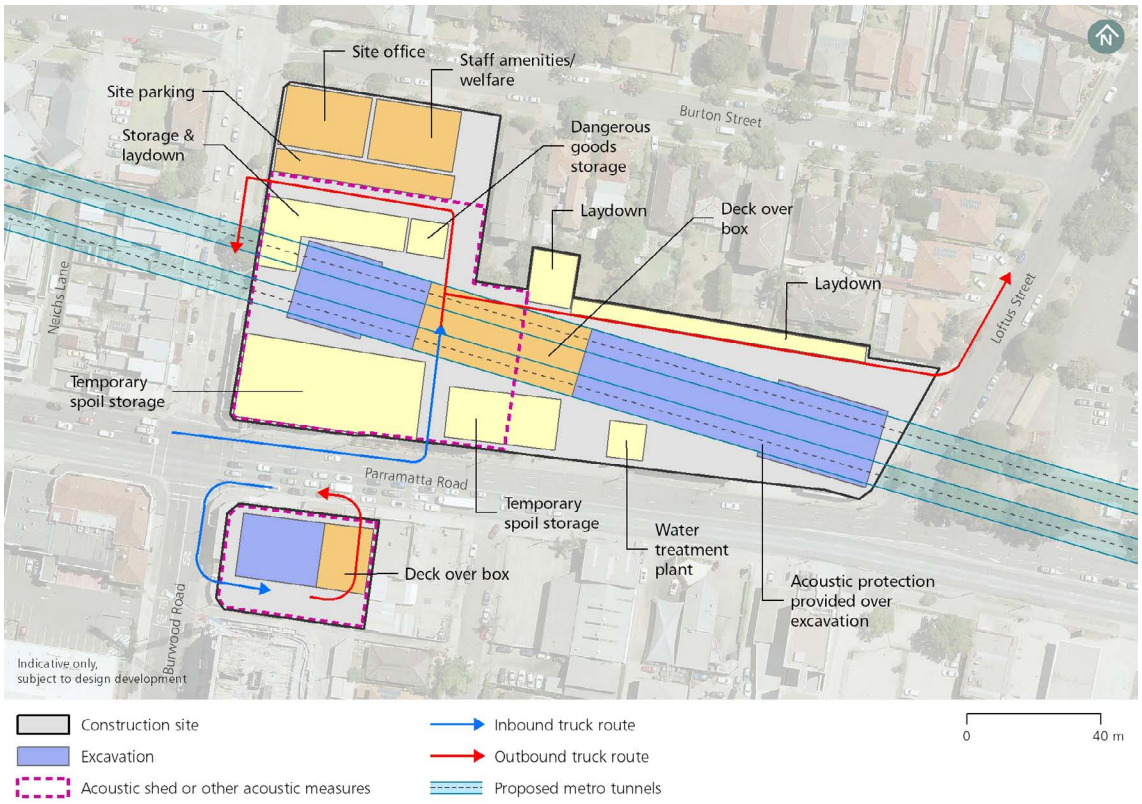

Figure 2-7: Burwood North Station construction site

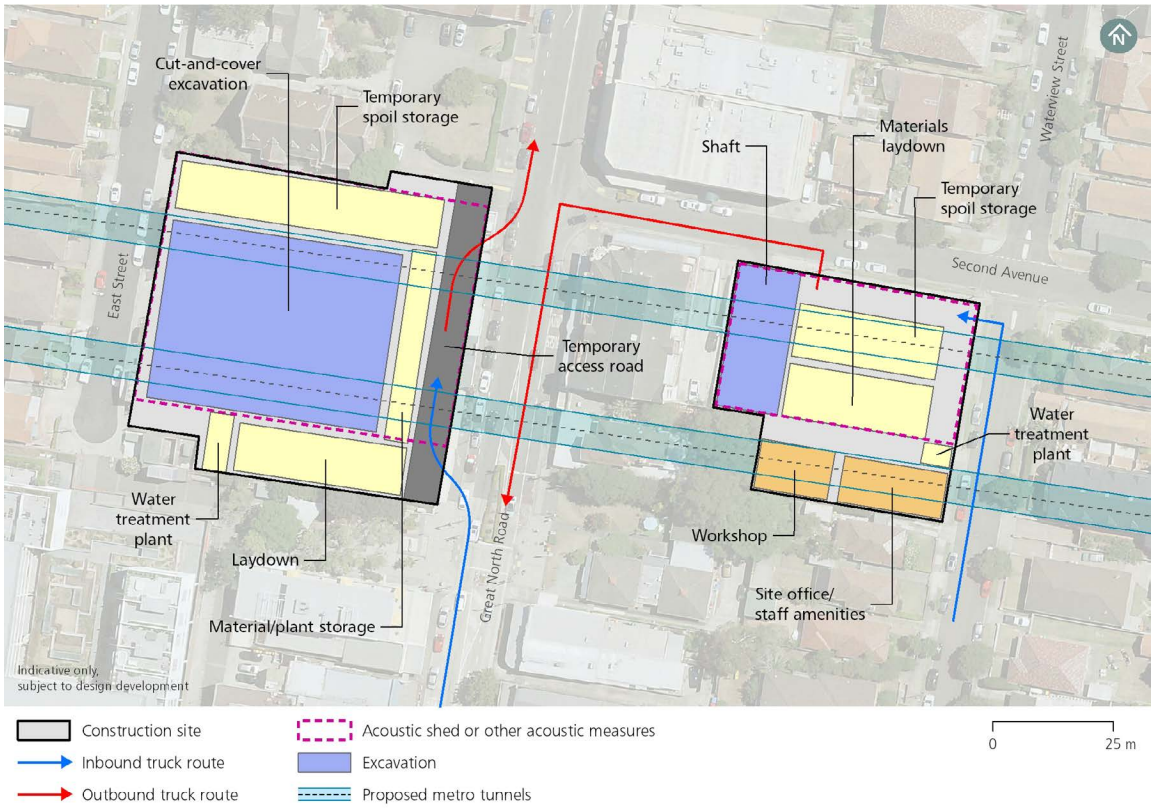

Figure 2-8: Five Dock Station construction site

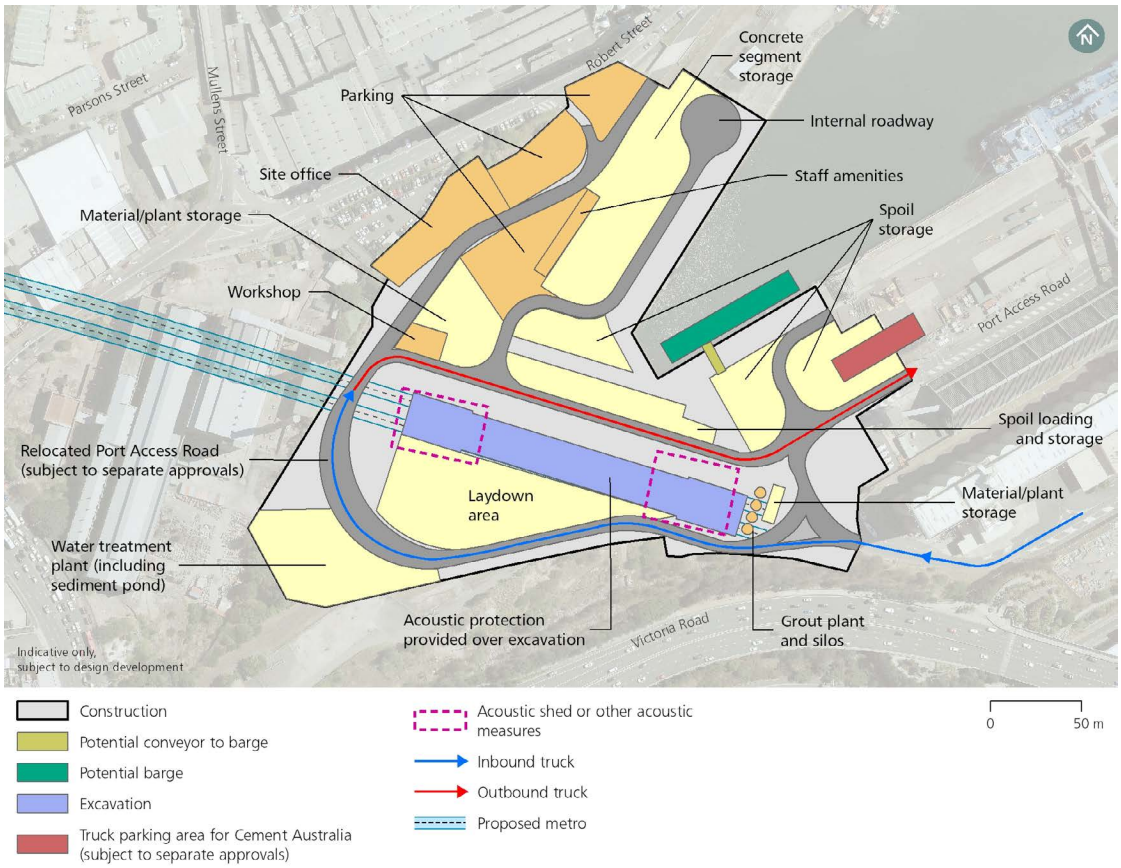

Figure 2-9: The Bays Station construction site

2.2 Desktop review

The desktop assessment involved a review of available information relevant to the study area to understand the existing environment, the potential risk for contamination and the potential impacts of Stage 1. The review of information included:

- Review of existing land uses along and in vicinity to the construction footprint and tunnel alignment and information on topography, drainage, geology, soils, hydrogeology and receiving environments
- Review of historical aerial photographs (1930 to 2005 (where available)), available aerial imagery services (*GoogleEarth* and SIX Maps)
- Publicly available information available via general internet searches for the key words (contamination, remediation and site investigation) for suburbs and major projects within and adjoining the construction footprint and alignment
- Review of publicly available information from the NSW Environment Protection Authority (EPA), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) ASRIS database and the former NSW Department of Primary Industries groundwater database
- Review of information provided by Sydney Metro

The information sources detailed above were not reviewed for the assessment of potential contamination impacts associated with construction of the power supply routes. A broad assessment of current and historical land use (based on an understanding of the information above) within and immediately adjacent to the power supply routes was undertaken to assess potential contamination impacts.

2.3 Site inspections

Areas located within construction sites, nearby land uses and potential areas of environmental interest (with respect to contamination) were visually inspected on 6 and 7 February 2019, and on 3 and 4 July 2019. This was conducted from publicly available areas, except at The Bays Station construction site where a site walkover was conducted. Inspections of the power supply routes were not undertaken.

2.4 High-level prioritisation exercise

A high-level prioritisation exercise was carried out to assist in assessing the potential impact from construction to expose contamination to human and/or ecological receptors. The exercise considered source-pathway-receptor relationships consistent with a conceptual site model as defined by the National Environment Protection (Assessment of Site Contamination) Measure 1999, as revised 2013 (NEPM, 2013). The prioritisation exercise considered the following:

Contamination severity and extent

- Known or potential sources of contamination and likely potential contaminants of concern
- The type of potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air)
- Approximate spatial distribution of potential contamination, and proximity to construction sites and the alignment (e.g. within the construction site, above the tunnel alignment, etc)
- The nature of construction activities proposed as part of Stage 1 (e.g. surface disturbance, cut-and-cover excavation or tunnelling at depth) and whether such activities would expose known or potential areas of contamination.

Pathways and receptors

- Assessment of potential pathways from a contamination source to a receptor without mitigation measures. Pathways were considered to include dust generation, vapour/gas emissions, excavation and disposal or reuse of soils, extraction and disposal or reuse of groundwater from dewatering or drainage, migration of groundwater via preferential pathways and surface water erosion. It was assumed that where construction activities would expose known or potential areas of contamination, the exposure pathways to construction workers could be complete. Where construction activities are located within and/or adjacent to sensitive environmental receptors, pathways could exist as a result of uncontrolled site discharges during construction
- Potential human and ecological receptors (including location, and potential for primary or secondary contact with contamination). Potential receptors were considered to comprise project construction workers and visitors, the general public and nearby residents and commercial workers in the surrounding land use, intrusive maintenance workers, receiving water bodies and ecological receptors. Exposure pathways to these receptors were considered to include direct dermal contact (der), ingestion (ing) or inhalation (inh) by human receptors and uptake by aquatic flora and intake by aquatic fauna.

Based on the limited information reviewed for the assessment of contamination potential associated with construction of the power supply routes, a high level prioritisation was not undertaken for the power supply routes.

Based on this prioritisation exercise, sites were categorised into five categories of contamination potential (very low, low, moderate, high and very high) representing potential impacts to construction without mitigation measures. The matrix used for categorising potential impacts from construction is provided in Table 2-1.

The categories of potential contamination impacts to construction represent a qualitative assessment. Although not definitive, examples of the contamination status represented by the categories is provided below:

- *Very low to low impact* could represent smaller volumes of contaminated materials, likely to be limited to surface soils, with pathways readily managed with typical soil and water controls and personnel protective equipment (PPE), and readily remediated by standard construction methods
- *Moderate impact* could represent larger volumes of contaminated materials, with pathways readily managed with typical soil and water controls and PPE and readily remediated by standard construction methods or smaller volumes of more complex contamination which may require specialised remediation methods and specialised management measures for pathways
- *High to very high impact* could represent more significant exposure risks, contaminated groundwater and gas/vapours, increased quantum of contaminated materials and wider contamination extent requiring remediation and specialised remediation methods. Pathways may require specialised management measures for example, positive pressure tents and odour control.

Table 2-1: Contamination potential matrix

		Contamination severity and extent				
		SE1 **Low potential for contamination to be present in the media of concern at concentrations above the relevant assessment criteria and limited in extent**	SE2 **Contamination possibly present in the media of concern at concentrations above the relevant assessment criteria and limited in extent**	SE3 **Contamination possibly present in the media of concern at concentrations above the relevant assessment criteria and potentially widespread**	SE4 **Known contamination present in the media of concern at concentrations above the relevant assessment criteria and limited in extent**	SE5 **Known contamination present in the media of concern at concentrations above the relevant assessment criteria and widespread**
Pathways and receptors	**PR1** Media of concern is unlikely to coincide with or otherwise impact on the construction scope *AND/OR* No or unlikely exposure pathway for human or ecological receptor's during construction	Very low	Low	Low	Moderate	Moderate
	PR2 Media of concern may intersect the construction scope. *AND* Exposure pathway for human or ecological receptors could be present and complete during construction	Low	Moderate	Moderate	High	High
	PR3 Media of concern would intersect the construction scope *AND* Exposure pathway for human or ecological receptors could be present and complete during construction	Moderate	Moderate	High	High	Very high

2.5 Relevant contamination guidelines

In preparing this technical paper, the following guidelines were considered (where relevant):

- Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land (Department of Urban Affairs and Planning and Environment Protection Authority (EPA), 1998)
- Guidelines for Consultants Reporting on Contaminated Sites (Office of Environment and Heritage, 2011)
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (as revised 2013)
- PFAS National Environmental Management Plan (HEPA, January 2018).

Should further investigations, remediation work and validation be carried out, these activities would be carried out in accordance with the following guidelines or other appropriate/endorsed guidelines available at that time:

- Guidelines made or approved under section 105 of the *Contaminated Land Management 1997*, including
  - Contaminated Sites: Sampling Design Guidelines (EPA, 1995)
  - Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (3rd Edition) (EPA, 2017)
  - Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination (DEC, 2007)
  - Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997 Environment Protection Authority, 2015
- Australian Standard (AS 4482.1-2005) Guide to the sampling and investigation of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds
- Australian Standard (AS 4482.2-1999) Guide to the sampling and investigation of potentially contaminated soils – Volatile substances
- Managing asbestos in or on soil (WorkCover NSW, 2014). [Online] Available at: http://www.safework.nsw.gov.au/__data/assets/pdf_file/0005/329171/Managing-asbestos-in-soil-guide.pdf
- Guidelines for the Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (Department of Environment, Climate Change and Water (DECCW), 2009)
- Technical Note: Investigation of Service Station Sites (EPA, 2014)
- Technical Note: Light Non-Aqueous Phase Liquid Assessment and Remediation (EPA, 2015)
- Information for the assessment of former gasworks sites (DEC, 2005)
- Vapour Intrusion: Technical Practice Note (DECW, 2010)
- Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases (EPA, 2012)
- Best Practice Note: Landfarming (EPA, 2014)
- Waste Classification Guidelines (EPA, 2014)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2018).

3. Existing environment

The information presented below is based on a review of publicly available information, and observations made during the visual inspections. The existing environment sections have been assessed in the context of the Stage 1 study area (not including the power supply routes) and where construction activities could potentially affect environmental conditions.

The existing environment section has been prepared to meet the reporting requirements (where applicable) detailed in the Guidelines for Consultants Reporting on Contaminated Sites (Office of Environment and Heritage, 2011).

3.1 Land use zones

Land use zones within and adjoining the Stage 1 construction sites and along the tunnel alignment are listed in Table 3-1. A number of current land use zones (based on permitted land use with or without consent) may represent a higher contamination risk and are present within the study area including:

- SP2 – Infrastructure: Rail Corridor
- SP2 – Infrastructure: Roads
- B4 – Mixed Use
- B5 – Business Development
- B6 – Enterprise Corridor
- IN1 – General Industrial
- IN2 – Light Industrial
- IN3 – Heavy Industrial.

Table 3-1: Land use zones within the study area

Location	Applicable instrument	Land use zones (higher risk land uses (with respect to contamination potential) are shown in bold)
Westmead to Homebush (Cumberland and Parramatta local government areas)		
Westmead metro station construction site	Holroyd Local Environmental Plan 2013 Parramatta Local Environmental Plan 2011	**B4 – Mixed Use**
		R2 – Low Density Residential
		R4 – High Density Residential
		SP2 – Infrastructure (rail)
Paramatta metro station construction site	Parramatta Local Environmental Plan 2011	B3 – Commercial Core
		B4 – Mixed Use

Location	Applicable instrument	Land use zones (higher risk land uses (with respect to contamination potential) are shown in bold)
Clyde stabling and maintenance facility (including the Rosehill dive structure and services facility shaft) construction site	Parramatta Local Environmental Plan 2011	**IN1 – General Industrial**
		IN3 – Heavy Industrial
		SP2 – Infrastructure (Road and rail)
		B5 – Business Development
		W1 – Natural Waterways
		RE2 – Private Recreation
Silverwater services facility construction site	Auburn Local Environmental Plan 2010	**IN1 – General Industrial**
		SP2 – Infrastructure
Sydney Olympic Park metro station construction site	State Environmental Planning Policy (State Significant Precincts) 2005	**B4 – Mixed Use**
Tunnel alignment – Westmead to Homebush	As per the above with the addition of: Strathfield Local Environmental Plan 2012	As per the above, with the addition of: - B2 – Local Centre - RE1 – Public Recreation - R4 – High Density Residential - E2 – Environment Conservation - SP1 – Special Activities - SP2 – Educational Establishment - SP2 – Infrastructure (stormwater management)

Location	Applicable instrument	Land use zones (higher risk land uses (with respect to contamination potential) are shown in bold)
North Strathfield to The Bays (Canada Bay, Burwood and Inner West local government areas)		
North Strathfield metro station construction site	Canada Bay Local Environmental Plan 2013	R2 – Low Density Residential
		R3 – Medium Density Residential
		SP2 – Infrastructure (rail)
		RE1 – Public Recreation
		B1 – Neighbourhood Centre
		B3 – Commercial Core
		B4 – Mixed Use
Burwood North Station construction site	Canada Bay Local Environmental Plan 2013	**B6 – Enterprise Corridor**
		SP2 – Infrastructure (road)
		B4 – Mixed Use
		R3 – Medium Density Residential
		R2 – Low Density Residential
		RE1 – Public Recreation
Five Dock Station construction site	Canada Bay Local Environmental Plan 2013	**B4 – Mixed Use**
		R3 – Medium Density Residential
		R2 – Low Density Residential
		RE1 – Public Recreation

Location	Applicable instrument	Land use zones (higher risk land uses (with respect to contamination potential) are shown in bold)
The Bays Station construction site	Sydney Regional Environmental Plan No. 26 – City West	Port and Employment
	Leichardt Local Environmental Plan 2013	**IN2 – Light Industrial**
	Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005	W1 – Maritime Waters
Alignment – North Strathfield to The Bays	As per the above with the addition of: Callan Park (Special Provisions) Act 2002	As per the above, with the addition of: - B2 – Local Centre - R1 – General Residential - E2 – Environment Conservation - **IN1 – General Industrial** - **IN2 – Light Industrial** - SP2 – Infrastructure (Education, place of public worship) - Public Purpose

3.2 Topography

The elevation varies across the proposed construction footprint and alignment. Based on an inspection of the site, and use of *GoogleEarth*, the gradient of land along the length of alignment is characterised by generally gentle undulating to flat topography.

Construction sites located at Parramatta, Silverwater and Rozelle (The Bays) were generally less than 15 metres Australian Height Datum (AHD) in elevation, and construction sites at Westmead, Sydney Olympic Park, North Strathfield, Burwood North and Five Dock were generally greater than 15 metres AHD in elevation. The depth of the tunnels would vary from about 15 metres to 90 metres deep due to changes in the topography. The shallower tunnel sections would generally be near the tunnel portal at Rosehill and near cut-and-cover stations.

The localised topography at each construction site is detailed in Table 3-2. The alignment and depth of the alignment is provided in Figure 3-1 to Figure 3-3.

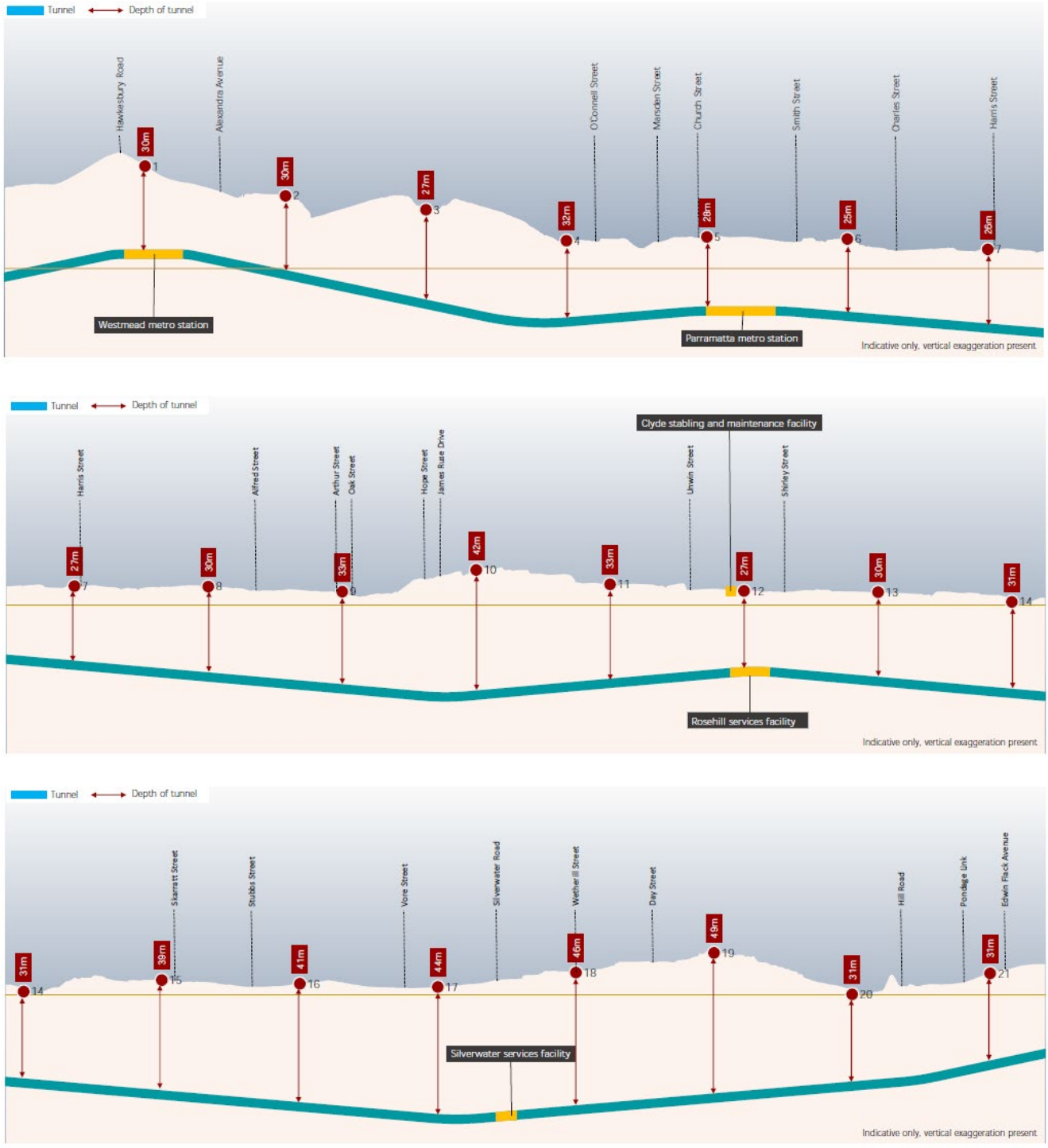

Figure 3-1: Tunnel alignment and depths – Westmead to Sydney Olympic Park

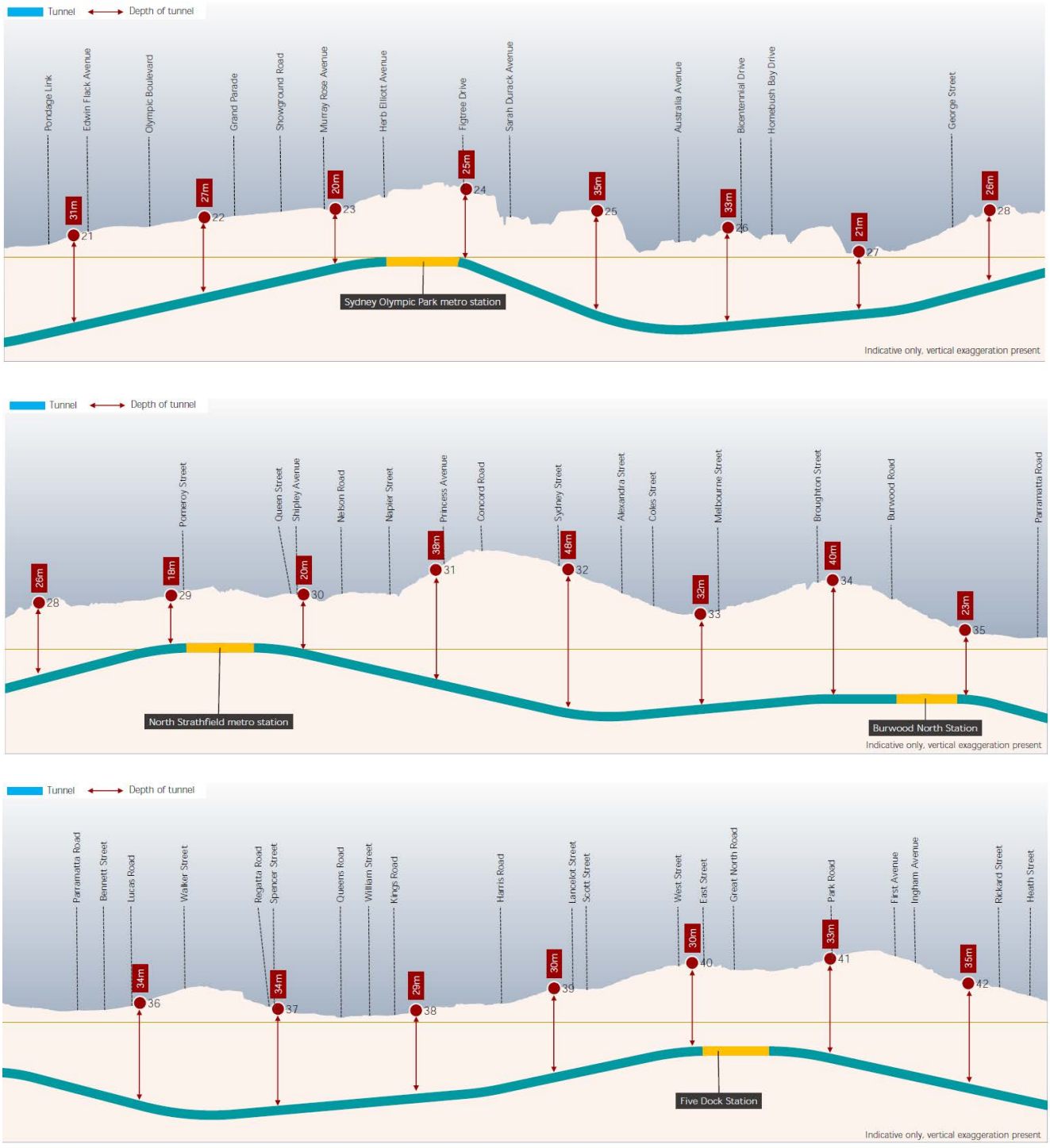

Figure 3-2: Tunnel alignment and depths – Sydney Olympic Park to Five Dock

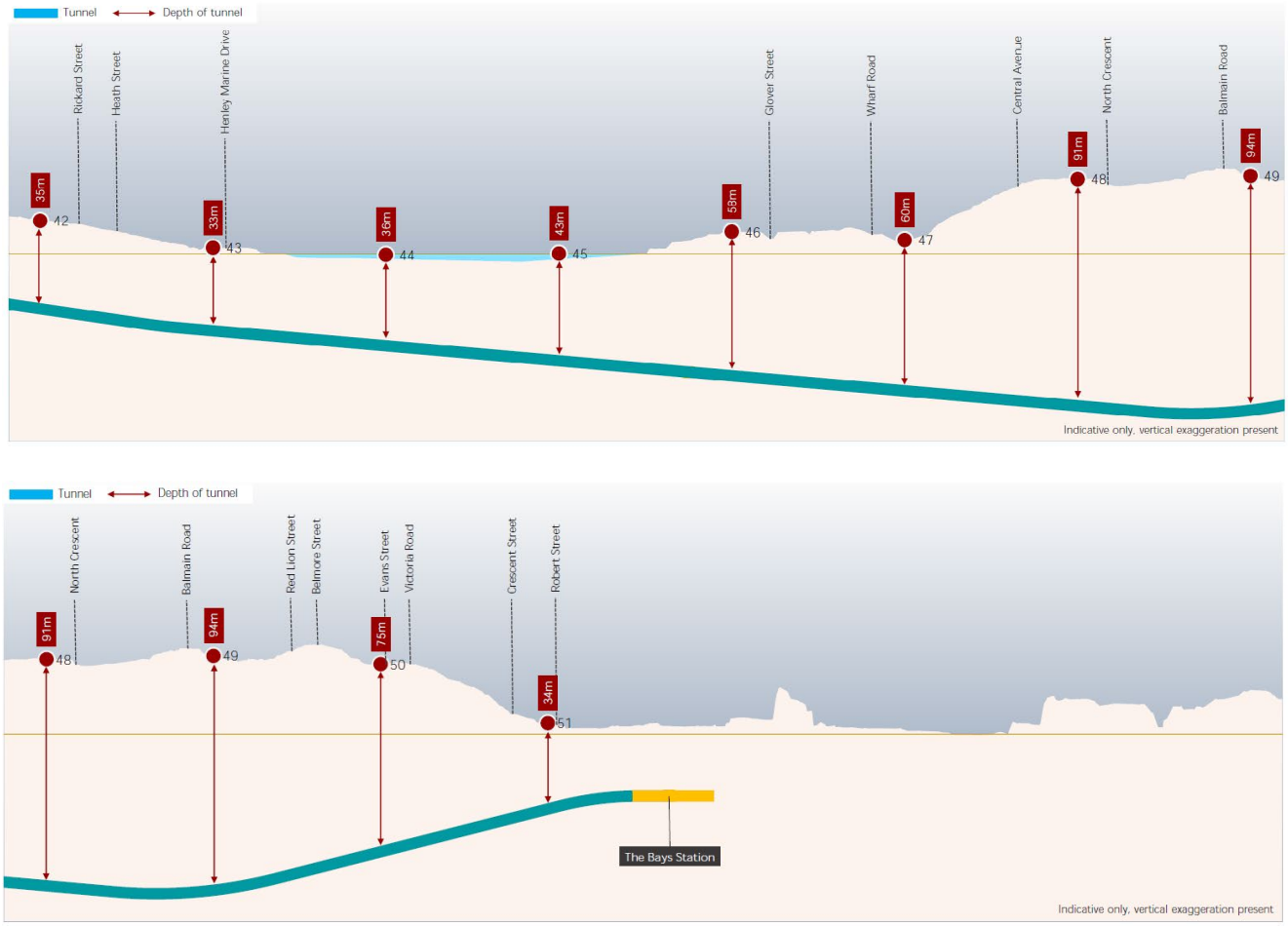

Figure 3-3: Tunnel alignment and depths – Five Dock to The Bays

Table 3-2: Localised topography

Construction site	Topography
Westmead metro station	Slight east decline across the construction site, with an embankment down to the rail corridor along the northern extent of the construction site
Parramatta metro station	Largely flat area with slight decline north towards Parramatta River
Clyde stabling and maintenance facility	Flat land with little to no incline or decline
Silverwater services facility	Slight south-western decline
Sydney Olympic Park metro station	South-easterly decline towards Bicentennial Park
North Strathfield metro station	Flat land with little to no incline or decline
Burwood North Station	Easterly decline in topography
Five Dock Station	Northerly decline in topography
The Bays Station	Sharp incline north-west towards Balmain. Flat land with little to no incline or decline around White Bay. Land could possibly be reclaimed land.

3.3 Geology

3.3.1 Geology units

Table 3-3 identifies the geological units underlying and adjacent to the construction footprint and alignment in order of youngest geology units to oldest. This is based on information provided by Sydney Metro and a review of the Department of Mineral Resources 1:100,000 Geological Sheet 9030 for Parramatta (Herbet and Smith, 1991) and the 1:100,000 Geological Sheet 9130 for Sydney (Herbet, 1983). Figure 3-4 illustrates the geological units relative to the tunnel. The geological long section is presented in Appendix A of Technical Paper 7 (Hydrogeology).

Table 3-3 Geology units in the study area

Unit	Description
Fill	Typically comprising waste, emplaced material and engineered fill. In general, a thin layer of fill (less than one metre thick) is commonly encountered in urban areas and is associated with minor modifications to the topography, landscaping and pavement construction. Such fill can be highly variable in composition and consistency. Thicker deposits of fill are expected towards the mouths of the infilled channels, associated with land reclamation generally located near waterways/harbours, back-filled quarries, landfills, stream capture and urban development (including parkland, residential, industrial, and open space areas) in these areas. Significant infilled areas are present at Rosehill, Silverwater, Sydney Olympic Park and White Bay

Unit	Description
Quaternary deposits	Alluvial and marine sediments. Undifferentiated, Holocene- and Pleistocene-age alluvial, estuarine and marine sediments have been deposited in gullies, valleys, and former drainage channels. These sediments comprise interbedded sands and clays with discontinuous "inter-fingered" lenses of the same material. Pleistocene-age, marine sediments comprise typically clayey sediments with intermittent sand lenses.
Ashfield Shale of the Wianamatta Group	Triassic claystone, mudstone, siltstone, laminites, and fine-grained lithic sandstone of four variably thick sub-units. The Middle-Triassic Ashfield Shale comprises black to dark grey shale and laminate of four variably thick sub-units. The thickness of the unit ranges between less than one metre and 50 metres. At some locations, the shale may become carbonaceous, with variable silt and clay particles present. The unit is laminated, although it retains bedding planes at some locations.
Mittagong Formation	Triassic interbedded dark siltstone and fine-grained sandstone beds and laminae of varying thickness. The Middle-Triassic Mittagong Formation consists of alternating siltstone and sandstone laminae. The shale beds are very similar to the Ashfield Shale; however, the unit is typically no more than 0.5 metres thick while the sandstone beds are up to five metres thick and are fine to medium grained. The Mittagong Formation consists of alternating siltstone and sandstone laminae. The shale beds are very similar to the Ashfield Shale, though it is typically no more than 0.5 metres thick while the sandstone beds are up to five metres thick and are fine to medium grained.
Hawkesbury Sandstone	Triassic medium- to coarse-grained quartz sandstone. It generally has a shallow weathering profile, but possesses increased defects in zones of faulting, shear and valley stress relief. The Middle-Triassic Hawkesbury Sandstone was deposited in a fluvial paleo-environment, likely to have been a braided river setting, and as such it is highly stratified. It is ubiquitous across the Sydney Basin and is up to some 300 metres thick. Hawkesbury Sandstone is often described as a medium to coarse grained and consists of three main depositional environments: massive sandstone facies, cross-bedded or sheet facies, and shale/siltstone interbedded facies.

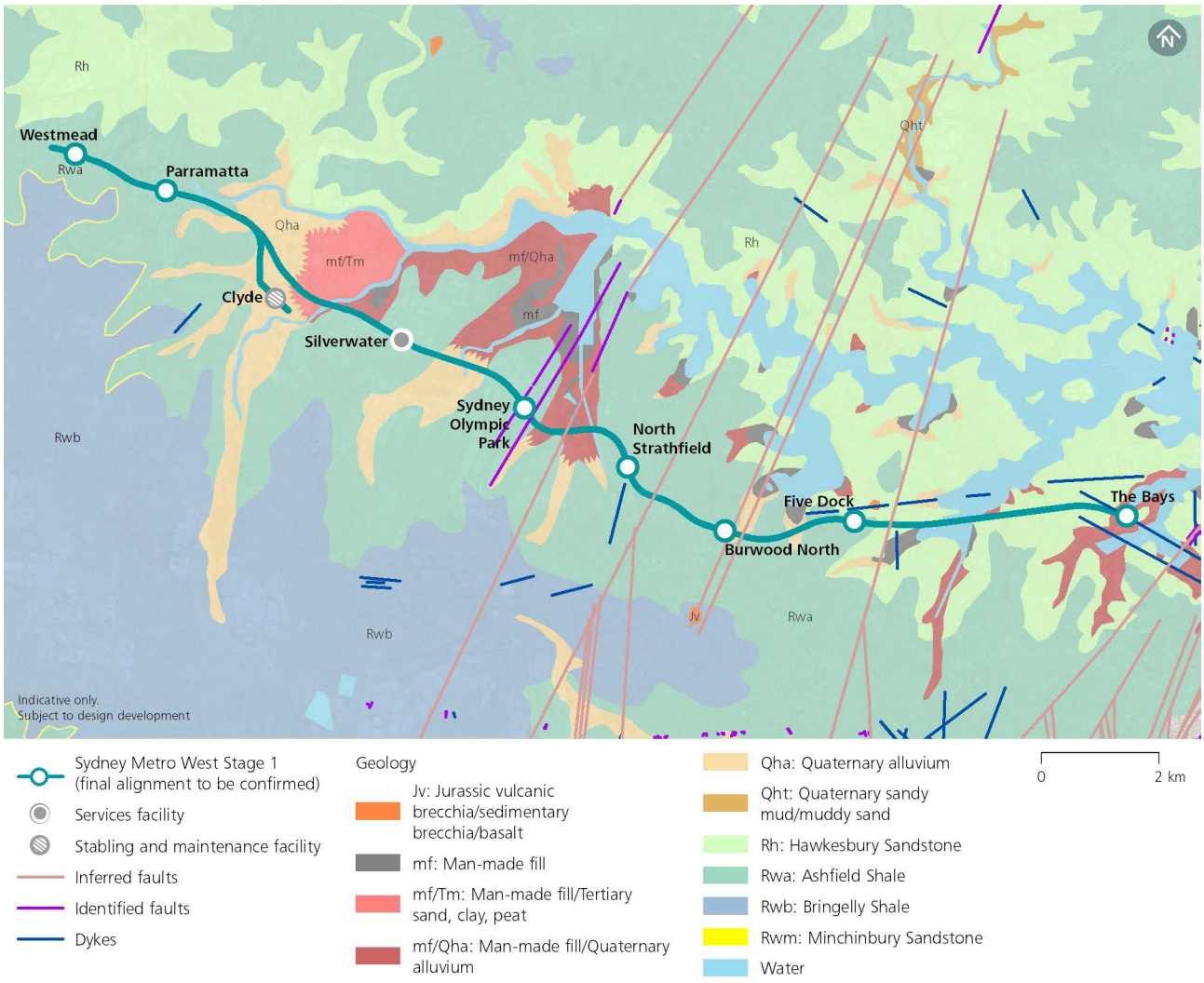

Figure 3-4: Geology along the Stage 1 alignment

3.3.2 Structural geology

The rock structures in the Ashfield Shale, Mittagong Formation and Hawkesbury Sandstone typically include:

- Sub-horizontal bedding
- Sub-vertical jointing or joint swarms
- Decomposed zones/seams
- Crushed zones/seams and shear zones
- Sub-vertical igneous intrusions (dykes) and associated jointing
- Buried valleys (palaeovalleys).

Both identified and inferred major sub-vertical faults, and identified dykes, are shown in Figure 3-4. Rock permeability may be higher in the vicinity of faults and therefore result in potentially higher groundwater inflows to Stage 1 excavations in their vicinity. Fault zones generally present as joint swarms or brecciated zones. These structural features have been recorded at numerous locations within the Sydney Basin and are generally continuous, mappable and relatively predictable, although not always uniformly linear across the Sydney region.

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Faults and joints can act as conduits to groundwater flow; however, faults may also act as barriers to groundwater flow. Increased groundwater inflows may be experienced during excavation where faults act as conduits to flow, with consequent depressurisation of the unit in the vicinity of the excavation. Excavation itself can enhance the inherent permeability of joints or brecciated zones through stress relief and dilation.

Identified and inferred faults cross the tunnel alignment to the south and east, respectively, of Sydney Olympic Park metro station construction site. An observed fault is interpreted to intersect the station box for the Sydney Olympic Park metro station. Inferred faults cross the tunnel alignment to the south of North Strathfield metro station and Burwood North Station construction sites, and is interpreted to intersect Burwood North Station construction site. It is possible that unidentified fault and joint swarms could be encountered during excavation. It is also possible that rock permeability in the vicinity of these (potential) faults and joints could be higher than elsewhere.

Dykes crossing the Stage 1 alignment and in proximity to the Stage 1 construction sites are typically doleritic intrusions through the shale and sandstone formations. The dykes are of variable dimensions, and typically range from less than three metres to over ten metres wide. The dyke rock type is susceptible to weathering and the dykes often possess a sub-vertical weathered zone, where the rock has degraded to soft clay (as well as exhibiting complete weathering to a white and green kaolinite clay near ground surface). Partly for this reason, dykes typically act as a hydraulic barrier perpendicular to their orientation, potentially acting as a groundwater flow divide. Dykes can also present a risk to tunnelling as they can also have elevated permeability. If unmanaged, tunnelling through a dyke can result in significant groundwater flow and depressurisation of the surrounding groundwater system. Dykes may also provide a conduit for higher groundwater inflows, especially when in proximity to open water bodies.

Inferred dykes may intersect North Strathfield metro station and The Bays Station construction sites. An inferred dyke comes in close proximity to the tunnel alignment to the east of Five Dock Station construction site. It is possible that unidentified dykes/dyke could be encountered during excavation. It is also possible that rock permeability in the vicinity of these (potential) dykes/dyke swarms could be higher than elsewhere.

The occurrence of infilled palaeochannels or palaeovalleys is generally limited to harbour areas and drainage channels in their vicinity. Experience from previous tunnel projects in Sydney indicates that identification of palaeovalleys is critical to tunnel design, because the rock mass beneath palaeovalleys is often more structurally complex, and rock permeability may be locally high due to valley stress relief and/or the presence of faults and dykes. Palaeovalley geometry along the Stage 1 alignment is variable and generally increases in width and depth towards the palaeovalley axes.

Further detail is available in Section 4 of Technical Paper 7 (Hydrogeology).

3.3.3 Summary of geology in the study area

The anticipated geological conditions and approximate depths at each of the construction sites is detailed in Table 3-4. Approximate depths are based on available geotechnical data supplied by Sydney Metro.

Table 3-4: Geological conditions at construction sites

Construction site	Geological conditions (in order of depth from surface metres Below Ground Level (m BGL))
Westmead metro station	Alluvial/residual clay (0 to 2 m BGL) Ashfield Shale (2 to 45 m BGL) Hawkesbury Sandstone (+45 m BGL)
Parramatta metro station	Alluvial/residual clay and fluvial sand (0 to 16 m BGL) Ashfield Shale (16 to 19 m BGL) Hawkesbury Sandstone (+19 m BGL)
Clyde stabling and maintenance facility	Fill (0 to 1 m BGL) Alluvial/residual clay and fluvial sand (1 to 13 m BGL) Ashfield Shale (13 to 28 m BGL) Hawkesbury Sandstone (+28 m BGL)
Silverwater services facility	Fill (0 to 1 m BGL) Alluvial/fluvial sand, clay, peat (1 to 5 m BGL) Ashfield Shale (5 to 30 m BGL) Hawkesbury Sandstone (+30 m BGL)
Sydney Olympic Park metro station	Fill/alluvial/residual clay (0 to 2 m BGL) Ashfield Shale (2 to 45 m BGL) Hawkesbury Sandstone (+45 m BGL) Inferred fault
North Strathfield metro station	Alluvial/residual clay (0 to 2 m BGL) Ashfield Shale (2 to 34 m BGL) Hawkesbury Sandstone (+34 m BGL) Possible dyke
Burwood North Station	Alluvial/residual clay (0 to 2 m BGL) Ashfield Shale (2 to 22 m BGL) Hawkesbury Sandstone (+22 m BGL) Inferred fault
Five Dock Station	Alluvial/residual clay (0 to 4 m BGL) Ashfield Shale (4 to 13 m BGL) Hawkesbury Sandstone (+13 m BGL)
The Bays Station	Alluvial/residual clay (0 to 2 m BGL) Ashfield Shale (2 to 45 m BGL) Hawkesbury Sandstone (+45 m BGL)

3.4 Soils

Soils within and adjacent to the construction footprint and the alignment have been identified from the NSW Department of Environment, Climate Change and Water's Soil Landscapes of Sydney 1:100,000 Sheet (Tille et al., 2009) and Penrith 1:100,000 Sheet (Hazelton et al., 2010). The characteristics of the major soil types identified along the alignment are summarised in Table 3-5 and depicted in Figure 3-5.

The soil landscape sheets indicate that the following soil landscape types are present within and adjacent to the construction footprint and the alignment:

- Residual soils associated with the Gymea and Blacktown soil landscape. These are derived from weathered siltstone and sandstone rock, except where formed by erosion. The residual soils derived from shale typically comprise stiff to hard clay of medium to high plasticity, gravelly clay, sandy clay and silt. The residual soils derived from sandstone typically comprise thin (less than 1.5 metres thick) medium plasticity silty clay to sandy clay
- Colluvial soils associated with the Hawkesbury soil landscape
- Erosional soils associated with the Glenorie soil landscape
- Alluvial/fluvial soils associated with the Birrong soil landscape
- Disturbed terrain.

Table 3-5: Soil landscape characteristics

Soil unit	Location	Description
Birrong	Present along the entire alignment and at all construction sites	Landscape: found on level to gently undulating alluvial floodplain draining Wianamatta Group shale, with slopes less than three per cent. Broad valley flats and extensively cleared tall open forest and woodland Soil: deep soils (less than 250 centimetres) on older alluvial terraces and current floodplain Limitations: localised flooding, high soil erosion hazard, saline subsoils, seasonal waterlogging, and very low soil fertility
Blacktown	Present along the entire alignment and at all construction sites	Landscape: found on gently undulating rises on Wianamatta Group shales, with slopes of less than five per cent and local reliefs of up to 30 metres Soils: strongly acidic and hard setting soils Limitations: low fertility, high aluminium toxicity, localised salinity and sodicity, low wet strength, low permeability, and low available water holding capacity

Soil unit	Location	Description
Disturbed terrain	Clyde stabling and maintenance facility Sydney Olympic Park metro station site The Bays Station site Tunnel alignment between Westmead and The Bays Station	Landscape: found on a variety of landscapes ranging from level plain to hummocky terrain that has been extensively disturbed by human activity. Slopes are typically less than five per cent and local reliefs of less than 10 metres Soils: the original soil has been completely disturbed, removed or buried. Landfill may include soil, rock, building and waste material with a cap of sandy loam. Soil may by strongly acidic to strongly alkaline Limitations: low fertility, low wet strength, low availability water capability, high permeability, localised toxicity/acidity and/or alkalinity, potential mass movement hazard
Glenorie	Present along the entire alignment and at all construction sites	Landscape: found on undulating to rolling low hills on Wianamatta Group shales, with slopes typically between five per cent and 20 per cent. Soils: shallow to moderately deep on crests (less than 100 centimetres) moderately deep on upper slopes (70 centimetres to 150 centimetres) and deep on lower slopes (greater than 200 centimetres Limitations: high soil erosion hazard, localised impermeable soil and moderate soil reactivity
Gymea	Present along the alignment from Burwood North Station site, eastwards to Five Dock Station and The Bays Station sites	Landscape: found on undulating to rolling rises and low hills on Hawkesbury Sandstone, with slopes between 10 per cent and 25 per cent and local relief up to 80 metres Soils: shallow to moderately deep (30 centimetres to 100 centimetres) Limitations: localised steep slopes, high soil erosion hazards, shallow highly permeable soil and very low soil fertility
Hawkesbury	Present along the alignment from Burwood North Station site to Five Dock Station and The Bays Station sites	Landscape: found on rugged, rolling to very steep hills on Hawkesbury Sandstone, with slopes greater than 25 per cent and local reliefs up to 200 metres Soils: Shallow (less than 50 centimetres) discontinuous lithosols/siliceous sands associated with rock outcrops, with earthy sands and some yellow podzolic soils on the inside of benches and along rock joints and fractures Limitations: extreme soil erosion hazard, mass movement hazard, steep slopes, high permeability soil and low soil fertility

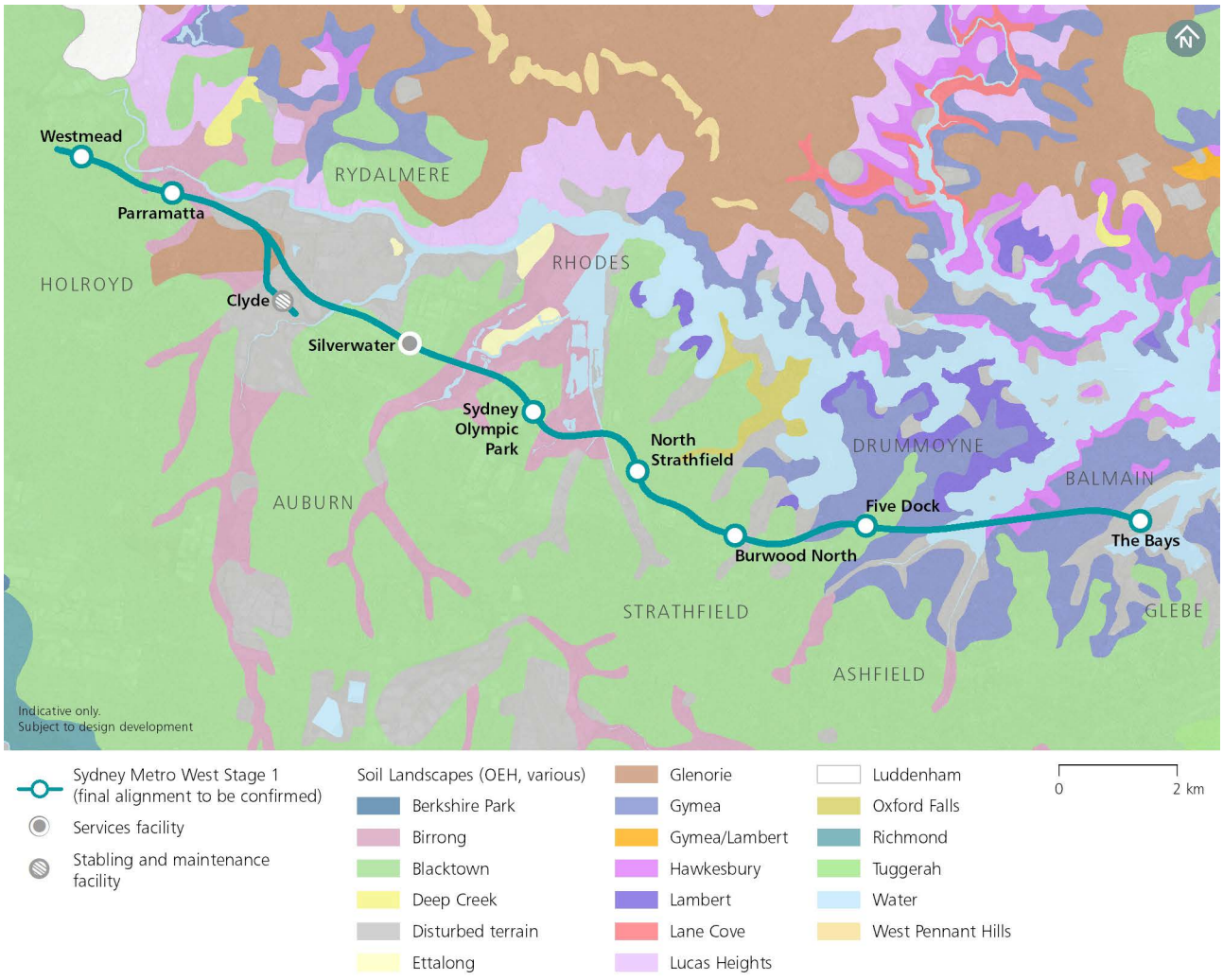

Figure 3-5: Soil landscapes along the alignment

3.5 Hydrogeology

3.5.1 Groundwater levels

Groundwater is known to occur in the soil profile and within the fractured/porous rock along the alignment. Available data from site investigations for Sydney Metro West indicate that groundwater levels in the soils along the alignment are generally shallow (typically between one metre and five metres below ground surface).

Where adjacent piezometers are screened separately in soil and rock horizons, the data indicates that there is generally hydraulic connection between the soil and rock aquifers. At some locations a perched watertable may be present within the soils, due to a separation caused by the low conductivity of the soil profile.

Table 3-6 presents typical groundwater levels in metres Australian Height Datum (AHD) in the vicinity of the alignment based on site investigation data obtained for Sydney Metro West. Data are limited at many locations, and the typical levels listed may not represent groundwater levels in the immediate vicinity of the station/facility structure.

Table 3-6: Groundwater levels in the vicinity of construction sites

Construction site	Typical groundwater level in the vicinity (m AHD)	Typical groundwater level in the vicinity of the construction site* (metres below ground surface)
Westmead metro station	33	3
Parramatta metro station	4	6
Clyde stabling and maintenance facility	3 (assumed at the shaft) 7 (assumed at the dive portal)	3 5
Silverwater services facility	5	1
Sydney Olympic Park metro station	12	12
North Strathfield metro station	15	5
Burwood North Station	4	12
Five Dock Station	16 to 18	2
The Bays Station	2	2

*Average/typical values based on available data and average ground surface elevation. Depth to groundwater will vary depending on topography.

3.5.2 Groundwater extraction

Groundwater supply bores recorded in WaterNSW's groundwater bore database (WaterNSW, 2019) were reviewed. Groundwater bores registered by WaterNSW along the Stage 1 alignment are shown in Figure 3-6. Further detail on bores located within the predicted groundwater level drawdown zone of influence in Section 4 of Technical Paper 7.

With the exception of groundwater bore GW305646 which is used for water supply in the vicinity of Burwood North Station construction site, licensed groundwater bores in the drawdown zone of influence are not being used for beneficial purposes (e.g. potable use, irrigation, stock watering etc.). Groundwater bore GW305646 is located over one kilometre to the north east of the construction site and alignment, is recorded as being six metres and is for private use. The estimated groundwater drawdown at its location is two metres at two years after excavation (refer to Technical Paper 7). This bore is not listed as active in the NSW Water Register. Site inspection is recommended to confirm the viability of this bore. This is further discussed in Technical Paper 7.

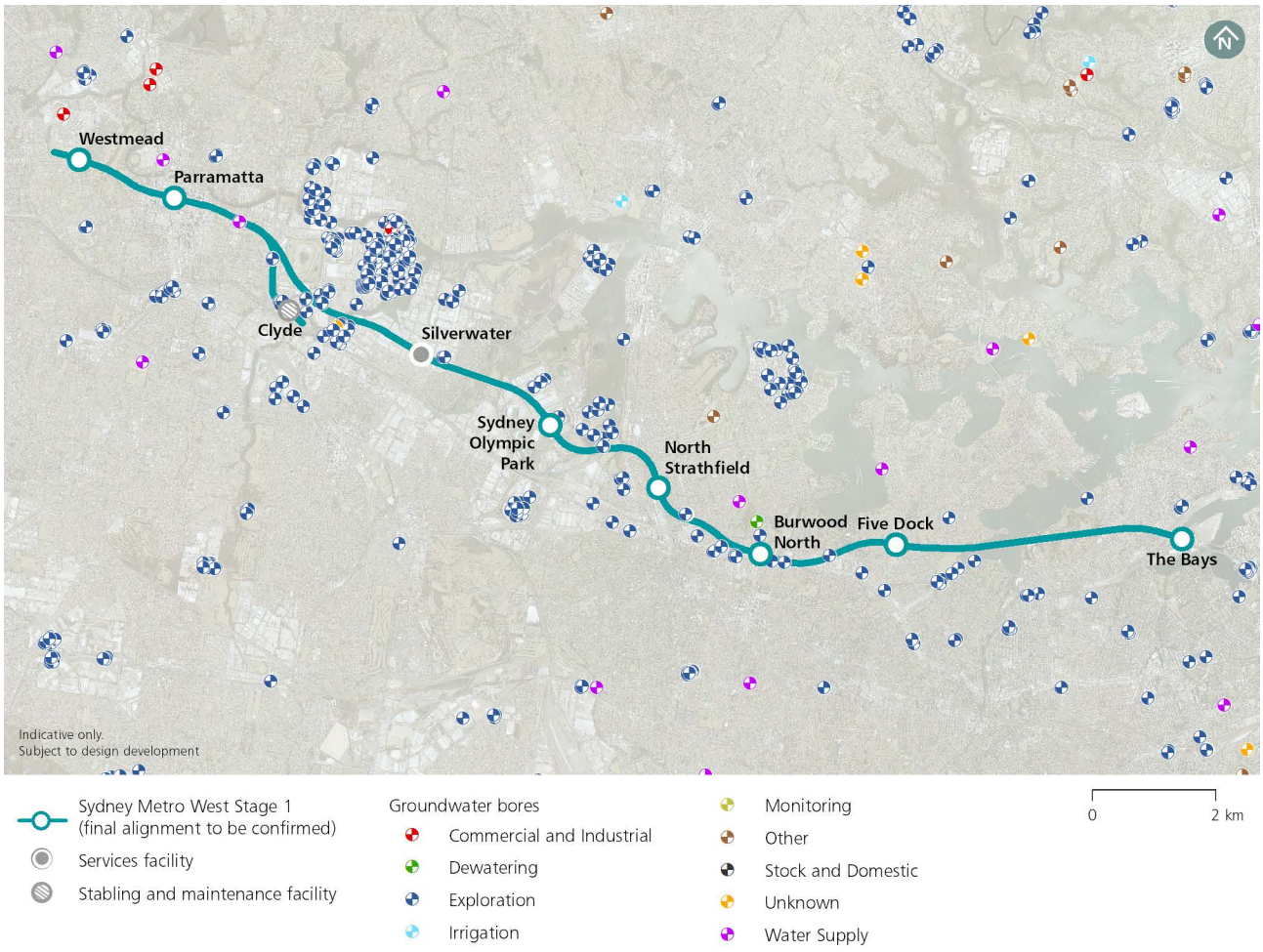

Figure 3-6: WaterNSW-registered groundwater bores along the Stage 1 alignment

3.5.3 Surface water-groundwater interaction

Interaction between groundwater and surface water along the alignment is generally expected to be limited to:

- Likely surface water infiltration that contributes to groundwater
- Discharge from groundwater to surface watercourses and waterbodies, especially in low lying areas or deeply incised channels
- Leakage from surface watercourses to groundwater.

There is potential for groundwater to contribute to streamflow (baseflow) and other surface water bodies in low lying areas or deeply incised channels. However, where the portions of these watercourses are lined, they would be unlikely to have a connection with the groundwater system.

3.5.4 Groundwater quality

The following is a summary of information contained in Technical Paper 7.

Typical quality

The quality of groundwater within the Ashfield Shale is typically brackish to saline, and acidic to near-neutral.

The quality of groundwater within the Ashfield Shale is typically brackish to saline, and acidic to near-neutral. The salinity typically ranges between about 2,000 milligrams per litre and 20,000 milligrams per litre as total dissolved solids, and pH ranges between about 4 and 8.

The quality of groundwater within the Mittagong Formation and Hawkesbury Sandstone is typically fresh to brackish with near-neutral pH and elevated metals concentrations, particularly for iron and manganese.

The salinity of the Mittagong Formation regionally is typically between about 250 milligrams per litre and 350 milligrams per litre as total dissolved solids, and pH ranges between about 4.5 and 8. Generally, groundwater from this unit is sodium-chloride or sodium-chloride-sulfate type water.

The quality of groundwater within the Hawkesbury Sandstone regionally is typically of low to moderate salinity, with electrical conductivity ranging between 500 microSiemens per centimetre and 2,000 microSiemens per centimetre (about 300 milligrams per litre to 1,400 milligrams per litre as total dissolved solids), and pH values generally range between 4.5 and 8. Generally, groundwater from this unit is a sodium-chloride type water, and high in iron.

Where Ashfield Shale overlies Hawkesbury Sandstone, the quality of groundwater within the Hawkesbury Sandstone is often influenced by the overlying unit and the groundwater is generally of a higher salinity leading to elevated salinity within the groundwater in the Hawkesbury Sandstone.

Organic compounds are not naturally associated with Ashfield Shale, Mittagong Formation or Hawkesbury Sandstone.

The quality of groundwater within the residual and alluvial soils that overlie the Ashfield Shale and Hawkesbury Sandstone is typically fresh to brackish, and may be saline in close proximity to salt water bodies. It typically has near-neutral to slightly acidic pH and metals concentrations generally lower than those in the underlying bedrock.

Project-specific quality

Sydney Metro West data

Groundwater samples were collected and analysed from the 50 monitoring bores installed along the alignment.

Laboratory analyses were carried out for various combinations of test parameters (depending on sample) for major ions, heavy metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethyl benzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAH), nutrients, hexavalent chromium, total and speciated phenols, per- and polyfluoroalkyl substances, volatile organic compounds (VOC), organochlorine (OCP) and organophosphate pesticides (OPP), and tributyltins.

The pH reported from these monitoring bores is consistent with the ranges noted in typical quality in the section above. The electrical conductivity (EC) is also generally consistent with the typical ranges encountered in similar geological settings in Sydney, with higher EC values recorded in piezometers that are in closer proximity to salt water bodies.

Data show that groundwater along the alignment exceeds the ANZECC (2018) trigger levels for 95 percent protection of freshwater aquatic ecosystems at numerous locations for ammonia and heavy metals. In particular, concentrations of ammonia, cobalt and manganese were above the trigger in 50 percent or more of the samples tested. Concentrations also exceeded the trigger levels for arsenic, copper, lead, nickel and zinc at some locations.

The freshwater aquatic ecosystems trigger levels are lower than those for marine waters, and therefore represent a more conservative metric for impact assessment.

ANZECC (2018) does not provide a 95 per cent protection of freshwater aquatic ecosystems trigger level for iron, but iron concentrations along the alignment are relatively high, ranging from less than 50 per litre to 556 milligrams per litre, and with a mean concentration of about 19 milligrams per litre.

Groundwater in the Sydney region that has not been impacted by anthropogenic activity can contain heavy metals concentrations above the ANZECC trigger levels, and elevated concentrations for some metals (e.g. iron and manganese) may be due to the leaching of natural metals from the host rock/soil.

TRH, BTEX, PAH, hexavalent chromium, total and speciated phenols, per- and polyfluoroalkyl substances, VOC, OCP, OPP, and tributyltins in groundwater samples along the alignment were below the trigger levels provided by ANZECC (2018) for 95 per cent protection of freshwater aquatic ecosystem.

A review of the analytical results from the groundwater investigation data (September 2018) has been undertaken in the context of bio-accumulative contaminants and guidelines for 99 per cent protection of aquatic ecosystems. Groundwater from selected monitoring locations reported nickel and PFAS concentrations above the guidelines for 99 per cent protection of aquatic ecosystems. It was also noted that the Limit of Reporting was above the guidelines for the 99 per cent protection of aquatic ecosystems for a number of contaminants (e.g. mercury, phenols, VOC, pesticides, PFAS). The risk to receiving aquatic ecosystems from bio-accumulative contaminants is not fully understood as sampling and analysis has not been undertaken from the receiving surface waters to establish background conditions.

Electrical conductivity values ranged between 20 microSiemens per centimetre and 20,500 microSiemens per centimetre (salinity of up to about 11,300 milligrams per litre as total dissolved solids), with the Ashfield Shale showing higher values than the Hawkesbury Sandstone.

Cobalt, manganese and zinc concentrations were above the ANZECC (2018) trigger for 95 per cent protection of freshwater aquatic ecosystems in 50 per cent or more of the samples tested. Groundwater quality also exceeded the freshwater trigger values for arsenic, copper, lead and nickel at some locations. Iron concentrations were relatively high, ranging from 50 micrograms per litre to 45 milligrams per litre, and with a mean concentration of about eight grams per litre.

Other project data

Data was also reviewed for groundwater samples collected from 40 piezometers along the M4 East alignment as part of the WestConnex M4 East monitoring programme (CPB-Samsung-JH JV, 2017). This alignment runs approximately parallel to the Stage 1 alignment between Sydney Olympic Park and Five Dock.

The pH measured in the alluvium, Ashfield Shale and Hawkesbury Sandstone units ranged from about 3.8 to 8.5 (higher values were observed in one piezometer screened in the Hawkesbury Sandstone but were likely associated with piezometer construction).

The WestConnex M4 East monitoring results are generally consistent with those for the Stage 1 groundwater monitoring.

Summary of potential groundwater impacts

The potential groundwater impacts discussed (see Technical Paper 7) associated with Stage 1 are summarised in Table 3-7 as relevant to contamination. Contaminated groundwater seeping into the excavation would be collected and treated during construction.

Table 3-7: Summary of potential groundwater impacts due to Stage 1, as relevant to contamination

Construction site	Summary of potential impacts due to Stage 1	Significance of potential impact
Westmead metro station	Contamination could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer.	Moderate
Parramatta metro station	Contamination could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer.	Moderate
Clyde stabling and maintenance facility	Some groundwater contamination sources could be the vicinity of Stage 1 but are unlikely to significantly impact upon construction. Contamination (from other sources in the vicinity of Stage 1) could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer.	Low to moderate

Construction site	Summary of potential impacts due to Stage 1	Significance of potential impact
Silverwater services facility	Contamination (possible and known) could be / is present in groundwater at concentrations above the relevant assessment criteria and could range from limited to widespread in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, excavation, posing a potential exposure risk to site users/workers and adjacent site users, and potentially reducing the beneficial use of the aquifer.	Moderate to high
Sydney Olympic Park metro station	Contamination (possible and known) could be / is present in groundwater at concentrations above the relevant assessment criteria and could range from limited to widespread in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, excavation, posing a potential exposure risk to site users/workers and adjacent site users, and potentially reducing the beneficial use of the aquifer.	High
North Strathfield metro station	Contamination could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer	Moderate
Burwood North Station	Contamination could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer	Moderate

Construction site	Summary of potential impacts due to Stage 1	Significance of potential impact
Five Dock Station	Some groundwater contamination sources could be in the vicinity of Stage 1 but are unlikely to significantly impact upon construction. Contamination (from other sources in the vicinity of Stage 1) could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer	Low to moderate
The Bays Station	Contamination could be present in groundwater at concentrations above the relevant assessment criteria and is likely to be limited in extent. Contaminated groundwater may intersect Stage 1, and the exposure pathways for human or ecological receptors could be present and fully reached during construction. Potential migration of contaminated groundwater towards, and into, station excavation, poses a potential exposure risk to site users/workers and adjacent site users, and could potentially reduce the beneficial use of the aquifer.	Moderate
Tunnels	If contaminants were expected to migrate towards the tunnel during construction, controls would be put in place to prevent the exposure of construction workers to contaminated groundwater. Groundwater collected in the tunnels would be treated prior to release to the environment.	Low
	Migration of contaminants in groundwater could reduce the beneficial use of the aquifer	Low

3.6 Groundwater dependent ecosystems

The Technical Paper 7 and Technical Paper 10 (Biodiversity Development and Assessment Report) identifies the potential groundwater dependent ecosystems (terrestrial vegetation) located in the vicinity of Stage 1.

Potential groundwater dependent ecosystems (terrestrial vegetation) located in proximity to (about one kilometre of) the Stage 1 construction sites and tunnel (the likelihood of being a groundwater dependent ecosystem is noted after each ecosystem) are follows:

- In the vicinity of Westmead metro station construction site:
    - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley (moderate to high likelihood) to the north and north-west of the construction site
    - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain (moderate to high likelihood) along Domain Creek to the east of the construction site and along Toongabbie Creek to the north-west of the construction site

  - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain (high likelihood) within the construction site footprint (these are not mapped) and to the east of the construction site

- In the vicinity of Parramatta metro station construction site:
  - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley (moderate to high likelihood) to the north-west along Parramatta River
  - Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain (moderate to high likelihood) to the north-west of the construction site along the Parramatta River
  - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain (high likelihood) to the north-west of the construction site along the Parramatta River
  - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (high likelihood) to the north-east along the Parramatta River
- In the vicinity of the Clyde stabling and maintenance facility construction site:
  - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (high likelihood) along Duck Creek
  - Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (moderate to high likelihood) along Duck Creek
  - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (low likelihood) along Duck Creek
- In the vicinity of the Silverwater services facility construction site:
  - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (high likelihood) along Duck River
- In the vicinity of Sydney Olympic Park metro station construction site, associated with the Bicentennial Park wetlands to the east and north-east:
  - Common Reed on the margins of estuaries and brackish lagoons (moderate to high likelihood) to the east and north-east
  - Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (moderate to high likelihood) to the east
  - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (high likelihood) to the east
  - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (low likelihood) to the east
- In the vicinity of North Strathfield metro station construction site:
  - Turpentine –– Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (moderate to high likelihood) at Concord Golf Club to the north-east
  - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (low likelihood) associated with the Bicentennial Park wetlands to the north-west
  - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley to the west (moderate to high likelihood) associated with the Bicentennial Park wetlands to the north-west

- In the vicinity of Burwood North Station construction site:
  - Turpentine –– Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (moderate to high likelihood) at Queen Elizabeth Park to the north
- In the vicinity of Five Dock Station construction site:
  - Turpentine –– Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (moderate to high likelihood) at Five Dock Park to the east.

High priority groundwater dependent ecosystems are listed in Schedule 4 of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (Department of Industry, 2011). The plan lists Cumberland Plain Woodland and Coastal Saltmarsh in the Sydney Basin Bioregion as high priority groundwater dependent ecosystems. Therefore, Grey Box - Forest Red Gum woodland on the flats of the Cumberland Plain in the vicinity of Westmead metro station and Parramatta metro station construction sites, and the Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion in the vicinity of Sydney Olympic Park metro station and North Strathfield metro station construction sites are classified as high priority groundwater dependent ecosystems.

3.7 Surface waterways and wetlands

Parramatta River, Sydney Harbour, Duck River, Haslams Creek, Powells Creek and Iron Cove Creek have been identified as receiving environments of high sensitivity predominantly due to the key fish habitat classifications (including those downstream) and/or proximity to coastal wetlands as defined by the Coastal Management SEPP. These watercourses have a high conservation or community value or supports ecosystems or human uses of water that are particularly sensitive to pollution or degradation of water quality. Further information is available in Chapter 18 (Soils and surface water quality) of the Environmental Impact Statement. These waterways have the potential to be impacted by Stage 1 due to groundwater drawdown or surface works.

Table 3-8 lists the waterways, their condition, and their sensitivity, and potential impact mechanism.

Table 3-8: Sensitive surface water receiving environments

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
Finlaysons Creek	First order waterway Concrete-lined channel	Highly disturbed	Low	Westmead metro station construction site	Groundwater drawdown
Toongabbie Creek	Type 2 Key Fish Habitat Third order waterway Some aquatic habitat present	Moderately disturbed	Moderate	Westmead metro station construction site	Groundwater drawdown
Domain Creek	Modified channel, with no SEPP Coastal Wetlands within 0.5 kilometres First order waterway	Highly disturbed	Low	Westmead metro station construction site	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Westmead metro station construction site.
Parramatta River	Numerous SEPP Coastal Wetlands. Potential habitat for threatened aquatic species and protected aquatic vegetation Type 1 Key Fish Habitat Fourth order waterway Permanently flowing	Moderately disturbed	High	Westmead metro station construction site Parramatta metro station construction site The Bays Station construction site Tunnels	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Parramatta metro station and The Bays construction sites

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
Clay Cliff Creek	Highly modified channel with limited aquatic habitat. SEPP Coastal Wetlands within 0.5 kilometres. Second order waterway Concrete-lined with no instream habitat	Highly disturbed	Moderate	Parramatta metro station construction site Tunnels	Groundwater drawdown
Duck River	Type 1 Key Fish Habitat SEPP Coastal Wetlands within 0.5 kilometres Third order estuarine waterway Concrete-lined in upper reaches	Moderately disturbed	High	Clyde stabling and maintenance facility construction site Silverwater services facility construction site Tunnels	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Clyde stabling and maintenance facility construction site
Duck Creek	Type 1 Key Fish Habitat Second order waterway Unlined	Moderately disturbed	High	Clyde stabling and maintenance facility construction site	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Clyde stabling and maintenance facility construction site

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
A'Becketts Creek	Type 1 Key Fish Habitat First order waterway Concrete-lined channels along long sections	Highly disturbed	Moderate	Clyde stabling and maintenance facility construction site	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Clyde stabling and maintenance facility construction site
Haslams Creek	Type 1 Key Fish Habitat SEPP Coastal Wetlands within 0.5 kilometres Third order waterway	Moderately disturbed	High	Sydney Olympic Park metro station construction site Tunnels	Groundwater drawdown
Newington Wetlands	Rehabilitated wetland/Nature Reserve SEPP Coastal Wetlands within 0.5 kilometres	Moderately disturbed	Low	Tunnels	Groundwater drawdown
Bicentennial Park Wetlands	Rehabilitated wetland/Nature Reserve SEPP Coastal Wetlands within 0.5 kilometres	Moderately disturbed	High	Sydney Olympic Park metro station construction site North Strathfield metro station construction site Tunnels	Groundwater drawdown

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
Saleyards Creek	Type 1 Key Fish Habitat SEPP Coastal Wetlands within 0.5 kilometres First order waterway Concrete-lined channel	Highly disturbed	Moderate	Sydney Olympic Park metro station construction site Tunnels	Groundwater drawdown
Powells Creek Mason Park Wetland	Highly modified channel with limited aquatic habitat SEPP Coastal wetlands within 0.5 kilometres First order waterway Permanently flowing Estuarine with tidal limit 0.1 kilometres upstream of Allen Street Bridge, Homebush	Moderately disturbed	High	Sydney Olympic Park metro station construction site North Strathfield metro station construction site Tunnels	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the North Strathfield metro station construction site

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
St Lukes Park Canal	Type 1 Key Fish Habitat SEPP Coastal Wetlands within 0.5 kilometres First order waterway Estuarine Predominantly concrete-lined No instream aquatic habitat Mapped seagrasses within 500 metres of the point of discharge of this canal into Iron Cove	Highly disturbed	Moderate	Burwood North Station construction site Tunnels	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Burwood North Station construction site
Sydney Harbour	Numerous SEPP Coastal Wetlands. Potential habitat for threatened aquatic species and protected aquatic vegetation Type 1 Key Fish Habitat Fourth order waterway Permanently flowing	Moderately disturbed	High	The Bays Station construction site Tunnels	Surface water (including sediment) and groundwater discharge to waterways from The Bays construction sites

Watercourse	Description of the surface water features	Condition	Sensitive receiving environment rating	Stage 1 component	Potential impact mechanism
Barnwell Park Canal	Highly modified channel with limited aquatic habitat SEPP Coastal Wetlands greater than 0.5 kilometres downstream Concrete lined channel No instream aquatic habitat	Highly disturbed	Moderate	Five Dock Station construction site Tunnels	Groundwater drawdown
Iron Cove Creek (also known as Dobroyd Canal)	Highly modified channel with limited aquatic habitat First order waterway Concrete-lined channel Mapped seagrasses within 500 metres of the point of discharge of this canal into Iron Cove	Moderately disturbed	High	Five Dock Station construction site	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from the Five Dock Station construction site
Iron Cove	Concrete lined, enclosed embayment. SEPP Coastal Wetlands within 0.5 kilometres.	Moderately disturbed	High	Tunnels	Groundwater drawdown
White Bay	Concrete-lined, enclosed embayment SEPP Coastal Wetlands within 0.5 kilometres	Highly disturbed	Low	The Bays Station construction site	Groundwater drawdown Surface water (including sediment) and groundwater discharge to waterways from The Bays construction sites

3.8 Results from inspection of construction sites

A site inspection was conducted on 6 and 7 February 2019 and on 3 and 4 July 2019 by Jacobs environmental scientists of the Stage 1 sites, from publicly accessible areas. The site inspection focused on construction sites, as well as nearby land uses and potential areas of environmental interest (AEIs). Observations made during the site inspection are detailed in Table 3-9.

Table 3-9: Observations from site inspections

Stage 1 construction site	Construction site description	Surrounding area description
Westmead metro station	The construction site consists of residential (low/medium), healthcare, commercial and railway land uses. The healthcare facility comprises of a medical centre on the corner of Alexandra Avenue and Hawkesbury Road. An automotive workshop is present on the corner of Alexandra Avenue and Hassall Street. A derelict house was observed within the proposed construction site on Hawkesbury Road.	The existing Westmead Station is located to the north of the construction site, within a cutting and lower than the surrounding roads. Further north of the station and railway line, land uses included medium to high density residential land uses and a small commercial area containing a variety of commercial businesses. To the north-east of the existing Westmead Station are several educational facilities including Western Sydney University, Parramatta Marist High School, and Mother Teresa Primary School. Westmead Hospital is located further to the north. To the east of the construction site, land uses comprise of low to medium density residential housing. Further east, moderately vegetated parklands are located within Parramatta Park, including West Domain, and Southern Domain and Domain Creek flows to the Parramatta River. To the south of the construction site, land uses comprise of low to medium density residential housing. Westmead Public School is located south-west of the construction site. Streets were observed to be landscaped with trees and low vegetation density. To the west of the construction site, land uses comprise of low to medium density residential land uses and railway uses. Some vegetation was observed in the residential areas.

Stage 1 construction site	Construction site description	Surrounding area description
Parramatta metro station	The construction site consists of commercial land uses. The area comprises of multiple buildings used for a variety of activities including, but not limited to, food, beauty, clothing, car parking, chemists, banks, convenience stores, offices, education buildings, dry cleaners. Minimal vegetation was observed, except for an occasional tree. The land was largely paved.	To the north, east, south and west of the construction site, land uses comprise of commercial buildings and adjacent roads. The land was largely paved, and minimal vegetation was observed.
Clyde stabling and maintenance facility	The construction site consists of commercial, industrial, railway and recreational land uses. Sydney Speedway is located in the southern portion of the construction site. Duck Creek was observed to be heavily vegetated. Minimal vegetation was observed in other areas of the construction site.	Land to the north of the construction site comprises of Rosehill Gardens racecourse, stables and entertainment facilities. Heavily industrial activities are located on land to the east of the construction site. The M4 Western Motorway is located along the southern boundary of the construction site. West of the construction site, land is occupied by major roadways (James Ruse Drive and M4 Western Motorway ramp), the T6 Carlingford Line, low density residential housing and some parklands.
Silverwater services facility	The construction site is a vacant lot. The vacant lot comprises of exposed, sandy soils on the north, eastern and southern portion of the construction site. A shipping container was observed on the north-eastern boundary and a soil stockpile was observed on the south-eastern corner of the proposed construction site. Vegetation consisting of overgrown grasses, shrubs and trees were present on the western area of the construction site. Litter and debris was present across the construction site including bottles, witches hats, plastics, cardboard, and tyres. Four PVC pipes protruding from the ground were observed on the western side of the proposed construction site.	The construction site is surrounded generally by commercial and industrial land use. Land uses to the north of the construction site are commercial, including construction machinery hire, mechanic, offices and storage facilities. A service station is located approximately 200 metres north of the construction site. Land uses to the east and south are occupied by commercial facilities including warehouses, offices, mechanics and retail facilities and associated carparking. Land uses to the west include Silverwater Road, a service station, mechanics, warehouses and storage buildings, plastic fabrications and metal works facility. Further west, a concrete recycling and a metal manufacturing facility is present.

Stage 1 construction site	Construction site description	Surrounding area description
Sydney Olympic Park metro station	The construction site is occupied by large commercial buildings (offices or businesses), with large, tree-bound carparking areas. The gardens and gatehouse associated with a federation-style building is located on the northern portion of the construction site. The area is largely paved with some small grassed areas.	Area of land to the north of the construction site comprises the existing Olympic Park Station, large paved areas, large buildings (offices), sporting stadiums and grassland areas. To the east of the construction site, the land was observed to be occupied by large buildings (offices), carparks, and commercial facilities. Land use to the south comprises an aquatic centre and other sporting facilities. ANZ Stadium is located to the west of the construction site
North Strathfield metro station	The construction site was observed to comprise the current North Strathfield Station rail yard and station upgrade construction. Some vegetation in the form of trees was observed across the area. The proposed construction site was not fully visible during site inspections due to the presence of tall fencing associated with the construction works.	Land uses to the north of the construction site comprise of low density residential housing with moderate vegetation. Land uses to the east of the construction site comprise of low residential housing areas with moderate vegetation. A small strip of commercial buildings further south along Queen Street includes a dry cleaner. Land uses to the south of the construction site comprise of low density residential housing and moderate vegetation. West of the construction site is the existing North Strathfield Station. Further west, the land uses comprise of education facilities, carparking, childcare, gym, café and low density residential housing. Further west is a concrete drainage channel (Powells Creek) adjacent to an open grass covered, treelined area.

Stage 1 construction site	Construction site description	Surrounding area description
Burwood North Station	Burwood North Station northern construction site: The northern construction site is occupied by commercial/industrial facilities and some low-density residential housing The commercial/industrial facilities consist of a variety of uses including car mechanics, vacant buildings and an automotive dealership which was present along Parramatta Road. Within the northern construction site are medium-density residential properties, located on Burwood Road between Burton Street and Parramatta Road. Parramatta Road is located between the north and south construction sites. Burwood Road is located adjacent to the northern construction site.	Burwood North Station northern construction site: Land uses to the north of the Burwood North Station north construction site consist of low- and medium density residential housing on medium sized residential blocks, with streetscaping and moderate vegetation. A service station is present north-west of the Burwood North Station north construction site. Land uses to the east of the Burwood North Station north construction site and directly above the tunnel alignment comprises of Concord Oval (with associated carparking and stadium buildings) and commercial/industrial land uses. This includes further to the east, a construction site for Westconnex (M4 East). Land uses to the west of the construction site comprises of commercial land uses, a service station, car dealership, hospitality venues and accommodation. Low and high density residential areas are also present.
	Burwood North Station southern construction site: The southern construction site is occupied by commercial/industrial facilities. The commercial/industrial facilities consist of a variety of uses including car mechanics and vacant buildings. Parramatta Road is located between the north and south construction sites. Burwood Road is located adjacent to the construction site.	Burwood North Station southern construction site: Land uses to the east of the Burwood North Station south construction site comprises of low density residential housing and a variety of businesses (including automotive mechanics, building and construction suppliers, carwash, car and motorcycle dealerships, service station and hospitality venues). A bus depot (Burwood Bus Depot) is located further east of the construction site, south of the alignment. Land uses to the south of the Burwood North Station south construction site comprise of commercial and low to high-density residential land uses. Land uses to the west of the construction site comprises of commercial land uses, a service station, car dealership, hospitality venues and accommodation. Low and high density residential areas are also present.

Stage 1 construction site	Construction site description	Surrounding area description
Five Dock Station	Five Dock Station western construction site: The construction site is occupied by commercial premises with external car parking areas. Some vegetation was present comprising grassed areas and tree-lined streets.	Five Dock Station western construction site: Land uses to the north of the construction site comprise a church, carparking, and commercial premises. Further north, land was observed to be occupied by low-density to medium density residential properties. Land uses to the east of the construction site consist of a main roadway (Great Northern Road), and commercial premises. Land uses to the south of the construction site include a substation, town centre plaza and a large commercial centre. Land to the west of the construction site comprises of low density residential properties. Further west, land uses include a school, low-density residential properties and public open spaces.
	Five Dock Station eastern construction site: The construction site is occupied by low-density residential properties and an external carpark. Some vegetation was present comprising grassed areas and tree-lined streets.	Five Dock Station eastern construction site: Commercial land uses occur to the immediate west and north-west of the construction site. To the north, south and east of the construction site, land uses comprise of low- to medium-density residential properties. Further east, the land was occupied by parkland (Five Dock Park), including a skatepark, school (Domremy Catholic College), and tennis courts.

Stage 1 construction site	Construction site description	Surrounding area description
The Bays Station	The construction site is within part of the White Bay Power Station site and is vacant, mostly paved (asphalt), with some grassed areas. Minimal infrastructure has been built on the site and includes a bus stop, a driveway, and two historical railway lines which extended from the south-west of the site to the northeast. Within the site boundary there is also a large fenced-off stockpile which appears to consist predominately of soil and ballast. The stockpile at the time of inspection was approximately 27 metres long by 15 metres wide by seven metres high. Several historical groundwater wells were observed within the site. No information was provided about these wells. A historical pond associated with the power station is located along the north-western boundary of the site. This pond and surrounding vegetated area is a known area of historical contamination. A storage area (on top of the existing asphalt) of old timber and electrical infrastructure is located in the south-western portion of the site. No asbestos containing materials (ACM) were observed on site surfaces.	Land uses to the north consist of commercial/industrial facilities including but not limited to automotive mechanics, plumbing/glass suppliers, and timber manufacturers. Further north, land uses consist of low density residential areas. To the east of the construction site are port-related land uses including ship docks, paved carparking, warehouses, silos and sheds. The foreshore of the bay has the potential for historical land reclamation and land filling. Land uses to the south of the construction site consist of a major roadway (James Craig Road) and heavy industry/port facilities. Land to the west of the construction site is occupied by the White Bay Power Station. The land contains a large, unoccupied warehouse, historical power station infrastructure such as a coal hopper and smoke stacks, and surrounding, unkept land. The White Bay Power Station contains known legacy contamination issues and hazardous materials such as asbestos and lead paint. Further west, the land is occupied by a busy roadway (Victoria Road), commercial/industrial warehouses containing automotive mechanics, and low density residential housing.

3.9 Information review

Several information sources were investigated to determine the history of land use within and next to the construction footprint and alignment. The following sections list details of the sources of historical information and a summary of information provided by each source.

3.9.1 Historical aerial photography

Historical aerial photographs from the land and property information (LPI) were reviewed for the years: 1930, 1943, 1955, 1970, 1989, 1994 and 2005 (where available). The aerial photography review focused on the construction sites (detailed in Section 2.1) and the tunnel alignment (in the vicinity of the construction sites), and general land use that could represent a source of potential contamination to construction.

A summary of the historical aerial review of the construction sites is presented as Table 3-10 to Table 3-18.

Table 3-10: Historical aerial photography review – Westmead metro station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	No aerial imagery coverage available.	
1943	The construction site appears to comprise of several low-density residential premises. A roadway appears to exist along the northern boundary of the construction site. Scattered trees and vegetation exist along the roadway	• A railway line, station platform (the existing Westmead Station) and overpass (road and pedestrian) is located to the immediate north of the construction site. Some train carriages are visible on the aerial imagery • Wider surrounding land use to the north, south and south-west of the construction site and alignment appear to comprise predominantly low-density residential • Larger buildings (potentially educational) and air raid trenches are visible in a property located to the south-west of the construction site • Large areas of open space exist to the north and east of the construction site and within and adjacent to the alignment • Land to the east appears to consist of open space areas and the Parramatta River.
1955	The construction site does not appear to have undergone any significant changes since the 1943 imagery.	• Long, rectangular buildings (possibly commercial/industrial or accommodation) are present to the north-west of the construction site. Further to the north-west, a large, circular track (possibly a racecourse/track) exists. Long and smaller rectangular buildings (possibly commercial/industrial or accommodation) are situated nearby to the racecourse/track • Two round grassed ovals are present to the north of the alignment.

Date	Within the construction site	Surrounding area (including alignment)
1970	• The construction site does not appear to have undergone any significant changes since the 1955 imagery with the exception of widening of the roadway immediately north of the construction site.	• Some development (primarily low-density residential) appears to have occurred to the north-east, south and south-west of the construction site • Land to the north-west of the construction site has undergone some development with some of the structures identified in the 1955 imagery no longer present and multiple large buildings (possible school buildings) are now present within this area • Further north-west, the large circular track (possibly a racecourse/track) appears to have been widened • No major development appears to have occurred to the land to the east of the site since the 1955 imagery.
1989	• The construction site does not appear to have undergone any significant changes since the 1970 imagery with the exception of a roadway which has been constructed across the railway line to the north-west of the construction site.	• Large developments appear to have occurred to the north-west of the alignment. This is likely to be associated with the construction of Westmead Hospital. Surrounding vacant land use (as identified in the 1970 imagery) appears to have been developed as ovals, carparks and buildings • Increased vegetation is observed along Domain Creek within Parramatta Park • No major development appears to have occurred to the north, east, south and west of the construction site since the 1970 imagery.
1994	• The construction site does not appear to have undergone any significant changes since the 1989 imagery.	• The land to the north, east, south and west of the construction site does not appear to have undergone any significant changes • Some minor residential development appears to have occurred north-east of the construction site • Some land to the north-west of the construction site, surrounding Westmead Hospital, appears to have undergone some minor development with increased sealed carparks visible.

Date	Within the construction site	Surrounding area (including alignment)
2005	• Some changes (i.e. extension, subdivision) appears to have occurred to some of the properties within the construction site, however the land use appears largely unchanged.	• The land to the north, east, south and west of the construction site does not appear to have undergone any significant changes since the 1994 imagery.

Table 3-11: Historical aerial photography review – Parramatta metro station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	No aerial imagery coverage available.	
1943	• The land within the construction site appears to consist of multiple large buildings (possibly commercial/industrial) and associated yards. Potential low density residential is present within the south eastern corner of the construction site.	• The land to the north, east, south and west of the construction site appears to contain a combination of large (commercial/industrial) and small (low-density residential) buildings • The Parramatta River is situated north of the construction site. A railway line and station (the existing Parramatta Station) are located further south of the construction site and alignment • Parkland/open space appears to exist to the west of the construction site and above the alignment • The land within and adjacent to the alignment appears to be a combination of residential, commercial/industrial, vacant land and open space.
1955	• The construction site does not appear to have undergone any significant changes since the 1943 imagery	• Surrounding land use to the north, east, south and west of the construction site does not appear to have undergone significant changes since the 1943 imagery.
1970	• Some development has occurred within the construction site. Buildings appear to have undergone some extensions/modifications • A paved area appears to have been constructed in the centre of the construction site.	• Some development appears to have occurred to the north, east, south and west of the construction site. Buildings appear to have undergone some extensions/modifications • Land surrounding the Parramatta River appears to have undergone reclamation. The banks of the river appear to be uniform and landscaped. Two large buildings appear on the river bank (possible warehouse/commercial buildings) north of the construction site • Large buildings (possible Parramatta RSL Club) have been constructed to the west of the construction site.

Date	Within the construction site	Surrounding area (including alignment)
1989	• Development appears to have occurred within the construction site and surrounding parcels of land. • Buildings appear to have undergone extension/modifications and appear to be multiple storeys high. • A multiple-storey carpark is evident within the construction site.	• Surrounding land use to the north, east, south and west of the proposed footprint does not appear to have undergone significant changes since the 1970 imagery with the exception of the construction of a vehicle bridge across Parramatta River.
1994	• The areas within and surrounding the construction site does not appear to have undergone any significant changes since the 1989 imagery with the exception of moderate streetscaping in the form of increased treelined streets and small gardens.	• Surrounding land use to the north, east, south and west of the construction site does not appear to have undergone any significant development since the 1989 imagery.
2005	• The construction site appears to have undergone some changes. Former car parks are not apparent, potentially now covered carparks, underground, or removed and replaced by a building.	• Surrounding land use to the north, east, south and west of the construction site does not appear to have undergone any significant development since the 1994 imagery, with the exception of increased paved surfaces, likely carparks.

Table 3-12: Historical aerial photography review – Clyde stabling and maintenance facility construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	• The area beneath the construction site appears to consist of land occupied by small square structures and railway (north), vacant land (central), and oval and multiple small possible residential buildings (south).	• Land surrounding the construction site comprises low-density residential (west), low-density residential and commercial/industrial, the Duck River and Clyde stabling yards (central and south), vacant land (east) and Rosehill Racecourse (north).
1943	• The construction site appears to have undergone some changes. Land uses include railway line (north-eastern portion), low-density residential (south-western portion) and race track, possibly Sydney Speedway (southern portion) • A number of surface water features are located with the construction site footprint including A'Becketts and Duck Creeks. Areas of riparian vegetation appear to be present within the north-eastern portion of the construction site.	• Land surrounding the construction site comprises low-density residential (west), low-density residential and commercial/industrial, the Duck River and Clyde stabling yards (south), commercial/industrial namely the Camellia refinery (east) and Rosehill Gardens racecourse (north).

Date	Within the construction site	Surrounding area (including alignment)
1955	• The construction site appears to have undergone some changes. Land uses include commercial/industrial development (central western portion) • Commercial/industrial activities are operating in the eastern portion of the construction site.	• Areas surrounding the construction site do not appear to have undergone significant development since the 1943 imagery.
1970	• The construction site appears to have undergone some development. Areas of reclaimed land (previously waterways) appear to have been paved, containing multiple small structures (cars). • Some additional warehouse-like structures are apparent on the construction site. The waterway to the south of the construction site appears to be more landscaped and uniform.	• Some development appears to have occurred to areas to the immediate east of the construction site. Additional structures are located in the vicinity of the proposed construction site including pipelines and bulk above ground storage tanks (likely to be associated with the adjacent refinery site). • Areas surrounding the construction site appear to have undergone some development, with additional buildings and landscaping observed. The racecourse to the north-west of the construction site appears to have undergone development with additional tracks within the oval-shaped course.
1989	• The construction site does not appear to have undergone significant development since the 1970 imagery. Existing structures appear to have extended/modified, whilst others have been demolished and replaced by larger rectangular buildings (possible warehouses) or have remained undeveloped vacant land.	• Areas surrounding the construction site do not appear to have undergone significant development since the 1970 imagery. • Vegetation along the Parramatta River appears to have increased in density. • The waterbody within the racecourse appears to have been expanded.
1994	• The construction site does not appear to have undergone significant development since the 1989 imagery, with the exception of a few additional pipelines and carparks observed within the centre of the construction site.	• Areas surrounding the construction site do not appear to have undergone significant development since the 1989 imagery, with the exception of some additional buildings constructed at the racecourse to the north of the construction site and additional landscaping.

Date	Within the construction site	Surrounding area (including alignment)
2005	• The construction site does not appear to have undergone significant development since the 1994 imagery with the exception of some changes/modification to on-site buildings.	• Structures directly east of the construction site and alignment have been demolished and replaced by three large buildings (possible warehouses). • Areas to the north, east, south and west of the construction site do not appear to have undergone significant changes since the 1994 imagery.

Table 3-13: Historical aerial photography review – Silverwater services facility construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	No aerial imagery coverage available.	
1943	• The construction site is vacant, cleared open space.	• Areas surrounding the construction site are vacant, cleared open space with isolated scatterings of low-density residential properties.
1955	• The construction site contains two long rectangular buildings located along the southern boundary, one small structure/building on the north-eastern boundary and car parking. The northern portion appears to consist of vacant land, and unsealed surfaces.	• Areas to the north, east and west of the construction site appear to be occupied by long rectangular buildings on medium sized lots. Further north-west, vacant land is present. • Areas to the south the construction site appear to be occupied by long rectangular buildings. Further south, the land appears to be generally occupied by low density residential housing.
1970	• The construction site appears to have undergone some development. Multiple long rectangular buildings occupy the entire site. A long carpark appears to exist on the eastern boundary.	• Areas to the north, east, and west of the construction site appear to have undergone significant structural development. Lots with previously vacant land are now occupied by long rectangular buildings (likely warehouses) and car parks. • Previously vacant land to the far north-east is now occupied by a large building (possible warehouse). • Areas to the south of the construction site remains largely low-density residential.

Date	Within the construction site	Surrounding area (including alignment)
1989	• The construction site does not appear to have undergone significant changes since the 1970 imagery.	• Areas to the north, east and west does not appear to have undergone significant development since the 1970 imagery. • Buildings to the south of the construction site have been demolished and replaced with a large warehouse type building. • Some development appears to have occurred to previously vacant land to the far north-east if the site.
1994	• The construction site does not appear to have undergone significant changes since the 1989 imagery.	• Areas to the north, west and south of the construction site do not appear to have undergone significant development since the 1989 imagery, with the exception of minor structural changes/modifications to existing buildings. • Areas to the east appear to have undergone some changes. Buildings present on the area to the east of the construction site have been demolished and is now vacant.
2005	• The construction site does not appear to have undergone significant changes since the 1994 imagery.	• Areas to the north, west and south of the construction site do not appear to have undergone significant development, since the 1994 imagery with the exception of minor structural changes/modifications to existing buildings and increased paved surfaces. • Land to the east is now comprised of a large T-shaped building (likely warehouse), and paved surfaces.

Table 3-14: Historical aerial photography review – Sydney Olympic Park metro station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	No aerial imagery coverage available.	
1943	• The construction site appears to comprise areas of open space (possible paddocks), roadways and a small scattering of buildings (northern portion).	• Areas to the north of the construction site and above the alignment comprise a large commercial/industrial premises (possible abattoir) and associated holding yards and paddocks. • The land use surrounding the construction site and above the alignment comprises primarily paddocks and holding yards. • A brick pit and vegetated areas (possible mangroves) are located to the north-east and east respectively of the construction site and alignment.
1955	• The construction site does not appear to have undergone significant development since the 1943 imagery.	• Areas to the north, west and south of the construction site do not appear to have undergone significant development since the 1943 imagery.
1970	• The construction site does not appear to have undergone significant development since the 1955 imagery with the exception of more established roads and streets. Development of the railway line on the south-east corner of the construction site appears to have taken place.	• Areas to the north of the construction site do not appear to have undergone significant development since the 1955 imagery. • Areas to the south-west of the construction site have developed into small, fenced off areas of land and large rectangular structures (likely cattle pens), and paddocks. • Land to the south of the construction site appears to have less subdivision, with roads separating the land into large vacant lots. Land within the area appears to comprise disturbed terrain, where previously observed vegetation is no longer present. • Areas to the east of the construction site and north of the proposed alignment appear to be subject to landfilling.

Date	Within the construction site	Surrounding area (including alignment)
1989	• The construction site appears to have undergone development. Three large buildings now occupy portions of the construction site. • The rail line observed previously within the south-east corner of the construction site does not appear to exist.	• Areas to the north-east appear to have undergone development. Four large buildings, paved surfaces and car parks are apparent on previously vacant land. • Areas to the north and south-west of the construction site do not appear to have undergone significant development since the 1970 imagery. • Areas to the south of the construction footprint appear to have undergone development. Land that was previously occupied by paddocks and yards now is occupied by a large building. • Areas to the east of the construction site previously subject to landfilling now appear to be landscaped open space.
1994	• The construction site appears to have undergone development. Additional buildings, streetscaping work appears to have taken place, with the addition of paved surfaces and carparks.	• Buildings and structures on areas to the north of the construction site (ie. former abattoir) have been demolished. These areas of land now appear to consist of disturbed soils and stockpiles on vacant lots. • South-west, adjacent to the construction site, two field and track stadiums and the Sydney Olympic Park Aquatic Centre have been constructed. South of the proposed station alignment, a number of sporting fields and associated stadiums have been constructed, surrounded by carparking and landscaped areas. • West of the corridor, the structures associated with the former abattoir and yards have been demolished/removed. • Land to the east of the construction site and beneath the proposed alignment, does not appear to have undergone any significant changes since the 1989 imagery with the exception of landscaping/streetscaping works.

Date	Within the construction site	Surrounding area (including alignment)
2005	• The construction site does not appear to have undergone significant development since the 1994 imagery with the exception of the extension/modifications of one building and further streetscaping work including additional paved surfaces and carparks.	• Areas surrounding the construction site appear to have undergone significant landscaping work including additional paved surfaces, car parking, increased vegetation and additional green spaces between buildings. A large stadium (ANZ Stadium) appears to have been constructed to the west of the proposed construction site. Multiple large buildings (including the current Olympic Park Station) appear to have been constructed to the north of the corridor including another stadium. • Additional sporting fields/courts and facilities have been constructed to the south of the construction site. • Roads within and around this area appear to have undergone streetscaping and widening works.

Table 3-15: Historical aerial photography review – North Strathfield metro station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	No aerial imagery coverage available.	
1943	• The area within the construction site appears to be vacant land located between the main northern railway line and areas of low-density residential development.	• Areas to the west of the construction site and adjacent/above the alignment comprise stands of large buildings (possible commercial/industrial) and open space. • Areas to the east and south of the construction site and adjacent to/above the alignment comprise low density residential development. • Areas to the north of the construction site and adjacent to/above the alignment comprise low density residential and commercial/industrial land use.
1955	• The construction site does not appear to have undergone significant development since the 1943 imagery.	• Areas to the north, east and south of the construction site do not appear to have undergone significant changes or development since the 1943 imagery.

Date	Within the construction site	Surrounding area (including alignment)
1970	• The area within the construction site does not appear to have undergone significant changes or development since the 1955 imagery.	• Areas to the north, east and south of the construction site do not appear to have undergone significant changes or development since the 1955 imagery. • Areas to the west of the construction site have undergone some development with additional buildings constructed since the 1955 imagery.
1989	• A number of small buildings/structures have been constructed across the construction site.	• Areas to the north, east and south of the construction site do not appear to have undergone significant changes or development since the 1970 imagery. • Areas to the west of the construction site have undergone some changes with a number of buildings/structures demolished since the 1970 imagery.
1994	• The area within the construction site does not appear to have undergone significant changes or development since the 1989 imagery.	• Areas to the north, east and south of the construction site and alignment do not appear to have undergone any significant changes or development since the 1989 imagery. • Buildings (potentially large industrial buildings) previously located to the north-west of the construction site have been demolished and the land appears to be generally vacant. • Areas to the west of the construction site appear to have undergone some development with the areas now occupied by large buildings and carparking.
2005	• The area construction site does not appear to have undergone significant changes or development since the 1994 imagery with the exception of changes to buildings footprints previously identified within the site.	• Land to the north-west of the construction site has been developed for residential land use (possible medium density residential). • Buildings previously located to the south-west of the construction site have been demolished and new buildings constructed (possible medium-density residential). • Other areas surrounding the construction site and alignment does not appear to have undergone any significant changes or development since the 1994 imagery.

Table 3-16: Historical aerial photography review – Burwood North Station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	• The area within the construction site was not clearly visible in the imagery.	• Only the areas to the south and east of the construction site were visible in this imagery. • Areas to the south of the construction site appear to consist of multiple small to medium sized buildings (possible residential). • Areas to the east of the construction site appear to consist of open space land.
1943	• The area within the construction site consists of multiple small to medium sized buildings (possible small scale commercia/industrial and/or retail, motor dealerships) and potential yard areas (this includes areas to the south of Parramatta Road). • The northern portion of the construction site appears to comprise low-density residential premises. • Wide roadways (Burwood and Parramatta Roads) are apparent bordering the site boundaries.	• Areas surrounding the construction site comprise low-density residential (north), open space (east), mixed commercia/industrial and/or retail and low-density residential (south and west) • Areas above the alignment comprise open space (east) and mixed commercia/industrial and/or retail and low-density residential (west) • Areas adjacent to the alignment comprise low density residential and open space (north) and mixed commercia/industrial and/or retail and low-density residential (south) • A large commercial/industrial operation is present to the south of the construction site (possible scrapyard).
1955	• The area within the construction site does not appear to have undergone significant changes or development since the 1943 imagery.	Areas to the north, east and south of the construction site do not appear to have undergone significant changes or development since the 1943 imagery with the exception of the construction of possible commercial/retail building in the vicinity of Frankie Lane and Parramatta Road and the western most scrap yard (south of the construction site) has been developed (possible commercial/industrial building).

Date	Within the construction site	Surrounding area (including alignment)
1970	• The area within the construction site does not appear to have undergone significant changes or development since the 1955 imagery with the exception of additional paved areas. There are a number of small rectangular objects (possible caravans or trailers) within the eastern portion of the northern construction site which were not observed in the 1955 imagery.	• Areas to the north of the construction site appear to have undergone some development with additional structures present on previously vacant lots. A major roadway (Burwood Road) has been formalised • Areas of land to the east, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1955 imagery. • The large building to the south-east of the construction site has been demolished and a large L-shaped building has been constructed (potential bus depot).
1989	• The area within the construction site does not appear to have undergone significant changes or development since the 1970 imagery with the exception of small structural extensions/modifications to existing buildings.	• Areas to the north, east, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1970 imagery with the exception of some development (likely residential) on previous vacant land to the north of the construction site. • The oval to the east of the proposed station alignment appears to have been developed with the addition of two large rectangular structures on the west and east sides of the oval (likely to be grandstands). Additional landscaping works also appear to have occurred
1994	• The area within the construction site does not appear to have undergone significant changes or development since the 1989 imagery.	• Areas to the north, east, south and west of the construction site and alignment does not appear to have undergone significant changes since the 1989 imagery with the exception of small structural extensions/modifications to existing buildings, and additional landscaping works to the oval to the east of the construction site.
2005	• The area within the construction site does not appear to have undergone significant changes or development since the 1994 imagery with the exception of small structural extensions/modifications and to existing buildings and some minor demolition.	• Areas to the north, east, south and west of the construction site and alignment does not appear to have undergone significant changes since the 1989 imagery with the exception of the development of what appears to be a sporting field east of the existing oval.

Table 3-17: Historical aerial photography review – Five Dock Station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	• The areas within the eastern and western construction sites appears to consist of predominantly low-density residential dwellings and a small to medium sized building (possible small scale commercia/industrial and/or retail) fronting Great North Road.	• Areas surrounding the construction sites comprise predominantly low-density residential with minor mixed commercia/industrial and/or retail (north and south), low density residential and open space (east) and low-density residential (west).
1943	• The areas within the eastern construction site appear to consist of predominantly low-density residential dwellings and a small to medium sized building (possible small scale commercia/industrial and/or retail) fronting Great North Road • The areas within the western construction site appears to consist of small to medium sized buildings (possible small scale commercia/industrial and/or retail) fronting Great North Road • Air raid trenches are visible within the southern portion of the western construction site.	• Areas surrounding the construction sites do not appear to have undergone significant development since the 1930 imagery. • Areas above the alignment generally comprise low-density residential (east and west). Five Dock Park is located above the alignment to the east of the proposed construction site. • Areas adjacent to the alignment comprise mixed commercia/industrial and/or retail and low-density residential (north and south).
1955	• The areas within the eastern and western construction sites do not appear to have undergone significant changes or development since the 1943 imagery.	• The area surrounding the construction site do not appear to have undergone significant development since the 1943 imagery.
1970	• The area within the western construction site does not appear to have undergone significant changes since the 1955 imagery. A building located within the north-western corner of the eastern construction site has been demolished. This land is now occupied by paved areas and a carpark.	• Areas of land to the north, east, south and west of the construction site do not appear to have undergone significant changes since the 1955 imagery with the exception of demolition of buildings in an area to the west of the construction site (possible school) and additional buildings (possible retail) to the south of the construction site. • A building located adjacent to the western boundary of the eastern construction site has been demolished and a new structure/building (possible service station) has been constructed. • Surrounding areas of land appear to be largely low-density residential.

Date	Within the construction site	Surrounding area (including alignment)
1989	• The areas within the eastern and western construction sites do not appear to have undergone significant changes or development since the 1970 imagery.	• Areas to the north, east, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1970 imagery. • Surrounding areas of land appear to be largely low-density residential.
1994	• The areas within the eastern and western construction sites do not appear to have undergone significant changes or development since the 1989 imagery.	• Areas to the north, east, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1989 imagery. • Surrounding areas of land appear to be largely low-density residential.
2005	• The area within the western construction site appears to have undergone significant changes since the 1994 imagery with demolition of buildings (possibly residential) and construction of larger buildings (possible commercial/retail/residential land use). • The area within the eastern construction site does not appear to have undergone significant changes or development since the 1994 imagery.	• Areas to the north, east, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1994 imagery with the exception of the demolition of the possible service station and new building constructed adjacent to western boundary of the eastern construction site and possible commercial/retail/residential development to the south of the construction sites. • Surrounding areas of land appear to be largely low-density residential.

Table 3-18: Historical aerial photography review – The Bays Station construction site

Date	Within the construction site	Surrounding area (including alignment)
1930	• The area within the construction site appears to be being used for heavy industrial purposes associated with the former White Bay power station. Activities include operation of the power station, stockpiling activities (possibly coal and/or ash), rail yard and wharf operations.	• Areas surrounding the construction site appear to comprise residential (north), wharf and White Bay (east), commercial/industrial (south).
1943	• The area within the proposed construction site does not appear to have undergone significant changes since the 1930 imagery with the exception of construction of two large warehouse/factory type buildings within the western portion of the construction site.	• Areas surrounding the construction site and alignment appear to remain as commercial/industrial (north), wharf and White Bay (east), commercial/industrial (south) including possible bulk above ground storage tanks (south east) and the White Bay Power Station (west).

Date	Within the construction site	Surrounding area (including alignment)
1955	• The area within the construction site does not appear to have undergone significant changes, and land use appears to be the same as in the 1943 imagery with the exception of the demolition and removal of two large warehouse/factory type buildings within the western portion of the construction site.	• Areas to the north, east, south and west of the alignment does not appear to have undergone significant changes since the 1943 imagery.
1970	• The area within the construction site does not appear to have undergone significant changes since the 1955 imagery. Large stockpiles of materials (possibly coal) are present adjacent to the western boundary of the construction site.	• Land to the north of the construction site and alignment appears to have undergone development including potential reclamation • Construction on land to the south and east of the construction site and beneath the alignment appears to have occurred. Additional buildings, disturbed terrain and earth works are apparent. The bulk above ground storage tanks have been removed. • Land to the west of the construction site and alignment does not appear to have undergone significant changes or development since the 1955 imagery.
1989	• The area within the construction site appears to have undergone significant development. The western side of the construction site is now vacant land. Some structures exist on the eastern side of the proposed construction site.	• Areas to the north of the construction site and alignment appear to have undergone some changes. Existing buildings appear to have been extended/modified, and increased vegetation is apparent in residential areas. • Areas to the west of the construction site and alignment do not appear to have undergone significant changes since the 1970 imagery with the exception of increased vegetation grown along streets and in residential areas. • Areas to the south of the construction site and alignment appear to have undergone some changes with modifications observed to buildings. • Surrounding areas to appear to be largely low-density residential.

Date	Within the construction site	Surrounding area (including alignment)
1994	• The area within the construction site appears to have undergone some minor changes. A roadway or rail line is present, running diagonally across the construction site.	• Areas to the north, south and west of the construction site and alignment do not appear to have undergone significant changes since the 1989 imagery. • Areas of land to the east of the construction site and alignment appears to have undergone some changes in land use including the storage of motor vehicles • Surrounding areas to appear to be largely low-density residential.
2005	• The area within the construction site does not appear to have undergone significant changes since the 1994 imagery.	• Areas to the north and west of the construction site and alignment appear largely unchanged since the 1994 imagery. Some minor development (possible residential) appears to have occurred. • Areas to the east of the construction site and alignment appear largely unchanged since the 1994 imagery. • Areas to the south of the construction site and alignment appear to have undergone some changes. Buildings previously observed in this area no longer exist. The area comprises paved, vacant lots. • Surrounding areas to appear to be largely low-density residential.

3.9.2 Review of aerial imagery services

Jacobs undertook a review of available aerial imagery services (*GoogleEarth*) to ascertain current above ground activities and/or operations which could potentially represent contamination sources. The results of the aerial imagery review are presented in Table 3-19.

Table 3-19: Potential contamination sources (aerial imagery review)

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
Westmead metro station construction site and alignment					
Existing Westmead Station	Within and adjacent to construction footprint	Westmead metro station (surface and depth)	Residuals from historical and current railway use	Surface	Heavy metals, hydrocarbons, pesticides, phenols, asbestos
Mechanical workshop 3 Hassall St, Westmead	Within the construction footprint	Westmead metro station (surface and depth)	Leaks and spills from underground petroleum storage infrastructure / automotive repair work	Surface and depth	Hydrocarbons, heavy metals, solvents
Vacant land 133 Hawkesbury Rd, Westmead	Within the construction footprint	Westmead metro station (surface and depth)	Dumping of construction waste and demolition of former structures	Surface	Heavy metals, hydrocarbons, pesticides, asbestos
Existing buildings within Westmead metro station construction site	Within construction footprint	Westmead metro station (surface and depth)	Hazardous building materials within or from on-site buildings / structures	Surface	Heavy metals, hydrocarbons, pesticides, asbestos

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
Parramatta metro station construction site and alignment					
Existing buildings within Parramatta metro Station construction site	Within construction footprint	Parramatta metro station (surface and depth)	Hazardous building materials within or from on-site buildings / structures	Surface	Heavy metals, hydrocarbons, pesticides, asbestos
Clyde stabling and maintenance facility construction site and alignment					
Rosehill Gardens racecourse	Adjacent to construction footprint	Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Rosehill dive structure and tunnel portal (depth)	Equestrian-related activities	Surface	Pesticides, nutrients, disinfectants
Sydney Speedway	Within construction footprint	Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure)	Leaks and spills from vehicle maintenance and use	Surface	Hydrocarbons, heavy metals, solvents
Existing buildings within Clyde stabling and maintenance facility construction site	Within construction footprint	Clyde stabling and maintenance facility (surface and depth)	Hazardous building materials within or from on-site buildings / structures	Surface	Heavy metals, hydrocarbons, pesticides, asbestos

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
Rosehill Helipad Wentworth Street, Rosehill	Within construction footprint	Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Tunnel (depth)	Leaks and spills from petroleum storage infrastructure, maintenance and refuelling PFAS from hydraulic fluids	Surface and depth	Hydrocarbons, heavy metals, solvents, PFAS
Rapid Oil Distributors Deniehy Street, Rosehill	Within construction footprint	Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Tunnel (depth)	Leaks and spills from petroleum storage infrastructure	Surface and depth	Hydrocarbons
Silverwater services facility construction site and alignment					
Existing buildings within Silverwater services facility construction site	Within construction footprint	Silverwater services facility (surface and depth)	Hazardous building materials within or from on-site buildings / structures	Surface	Heavy metals, hydrocarbons, pesticides, asbestos

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
North Strathfield metro station construction site and alignment					
Existing North Strathfield Station	Adjacent to construction footprint	North Strathfield metro station (surface and depth)	Residuals from historical and current railway use	Surface	Heavy metals, hydrocarbons, pesticides, herbicides, asbestos
Funeral Home 115 Wellbank Street, North Strathfield	Adjacent to construction footprint	North Strathfield metro station (surface and depth)	Embalming chemicals	Surface and depth (Depth distribution associated with potential underground tanks and sewer)	Hydrocarbons, solvents (namely formaldehyde)
Laundry and dry cleaning 93 Queen St, North Strathfield	Adjacent to construction footprint	North Strathfield metro station (surface and depth)	Residuals from current dry-cleaning activities	Surface and depth. (Depth distribution associated with potential underground tanks)	Chlorinated hydrocarbons, Volatile Organic Compounds (VOCs)
Existing buildings within North Strathfield Metro Station construction site	Within construction footprint	North Strathfield metro station (surface and depth)	Hazardous building materials within or from on-site buildings / structures.	Surface	Heavy metals, hydrocarbons, pesticides, asbestos

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
Burwood North Station construction site and alignment					
Mechanical workshop 1 Parramatta Road, Concord Mechanical Workshop 318 Parramatta Road, Burwood Smash Repairers 342 Great Western Highway, Burwood Bus Depot 282 Parramatta Road, Burwood Mechanical Workshop 1/240 Parramatta Road, Burwood	Within and adjacent to construction footprint	Burwood North Station (surface and depth)	Leaks and spills from automotive facilities, car dealerships and bus depot	Surface and depth	Solvents, hydrocarbons, heavy metal.
Car wash 11 Parramatta Road, Concord Car Wash 320 Parramatta Road, Burwood	Adjacent to construction footprint	Burwood North Station (surface and depth)	Chemical use and waxes	Surface and depth (Depth distribution associated with sewer)	Solvents, surfactants, PFAS
Existing buildings within Burwood North Station construction site	Within construction footprint	Burwood North Station (surface and depth)	Hazardous building materials within or from on-site buildings / structures.	Surface	Heavy metals, hydrocarbons, pesticides, asbestos
High volume traffic flow on Parramatta Road	Adjacent to construction footprint	Burwood North Station (surface and depth)	Vehicle particulate deposition	Surface	Lead, PAHs, asbestos

Land use	Relative location to construction footprint	Construction element and anticipated depth	Potential contamination source	Potential contamination distribution	Potential contaminants
Five Dock Station construction site and alignment					
Funeral home 177 First Avenue, Five Dock	Adjacent to construction footprint	Five Dock Station (surface and depth)	Embalming chemicals	Surface and depth (Depth distribution associated with potential underground tanks and sewer)	Hydrocarbons, solvents (namely formaldehyde).
Existing buildings within Five Dock Station construction site	Within construction footprint	Five Dock Station (surface and depth)	Hazardous building materials within or from on-site buildings / structures.	Surface	Heavy metals, hydrocarbons, pesticides, asbestos
The Bays Station construction site and alignment					
Mechanical workshop 2 Mansfield Street, Rozelle Mechanical workshop 16 Mansfield Street, Rozelle Smash Repairers Robert Street, Rozelle Mechanical Workshop Robert Street, Rozelle	Adjacent to construction footprint	The Bays Station (surface and depth)	Leaks and spills from underground petroleum storage infrastructure / automotive repair work	Surface and depth. (Depth distribution associated with potential underground storage tanks)	Heavy metals, hydrocarbons, solvents
The former White Bay Power Station 28 Robert Street, Rozelle	Within construction footprint	The Bays Station (surface and depth)	Former White Bay Power Station activities (with substation) and structures	Surface	Heavy metals, hydrocarbons, PCB, asbestos

3.9.3 NSW EPA Contaminated Sites Register

A search conducted on 18 February 2019 of the NSW EPA Contaminated Sites Record of Notices (under section 58 of the *Contaminated Land Management Act 1997*) and the list of contaminated sites notified to the NSW EPA (under section 60 of the *Contaminated Land Management Act 1997)* indicated that there were 30 sites registered with the NSW EPA within 500 metres of the construction footprint and the alignment that were either regulated, formerly regulated or had been notified. The sites are summarised in Table 3-20 and shown in Figure 3-7 to Figure 3-10.

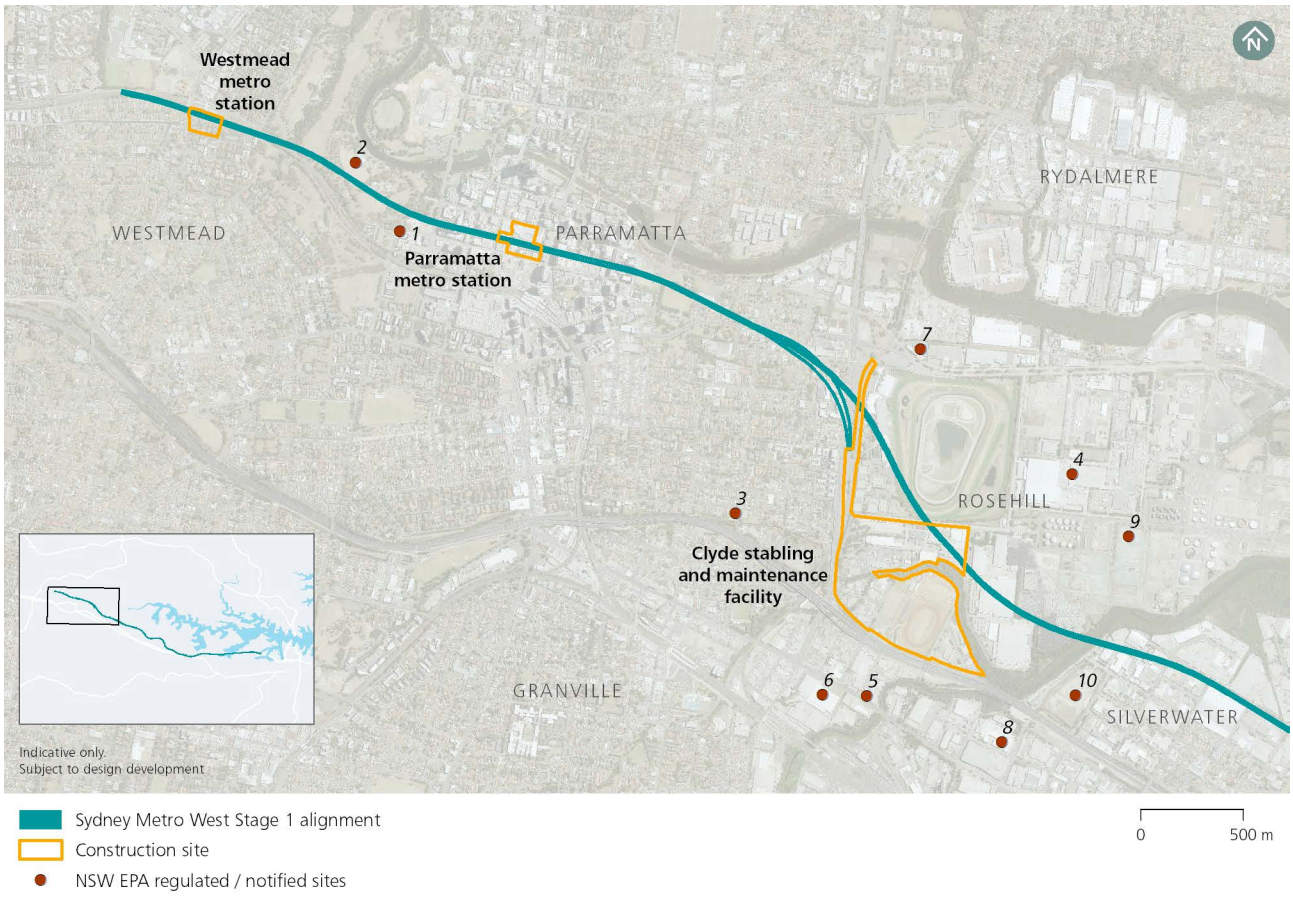

Figure 3-7: NSW EPA regulated / formerly regulated / notified sites within 500 metres of the construction footprint and alignment – Map 1

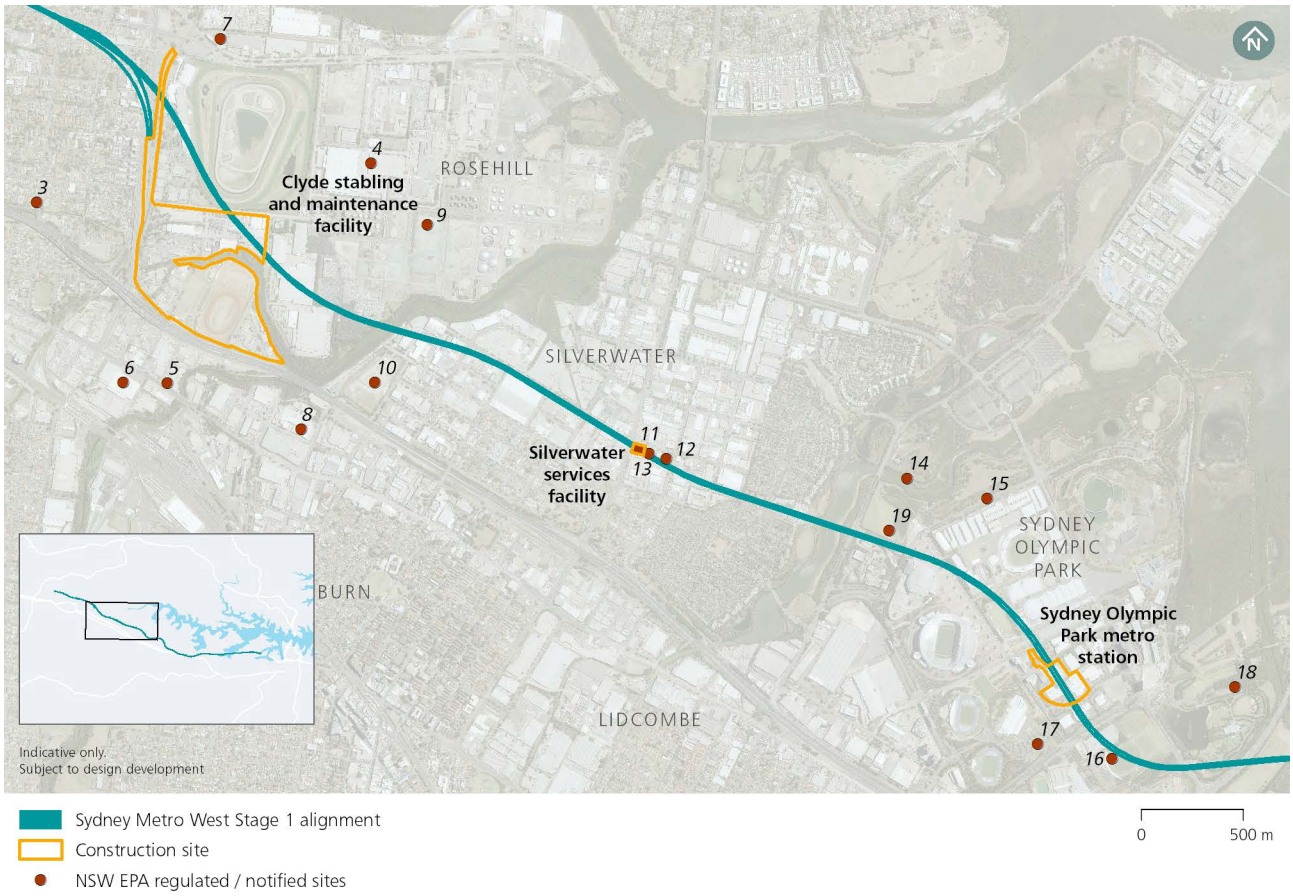

Figure 3-8: NSW EPA regulated / formerly regulated / notified sites within 500 metres of the construction footprint and alignment – Map 2

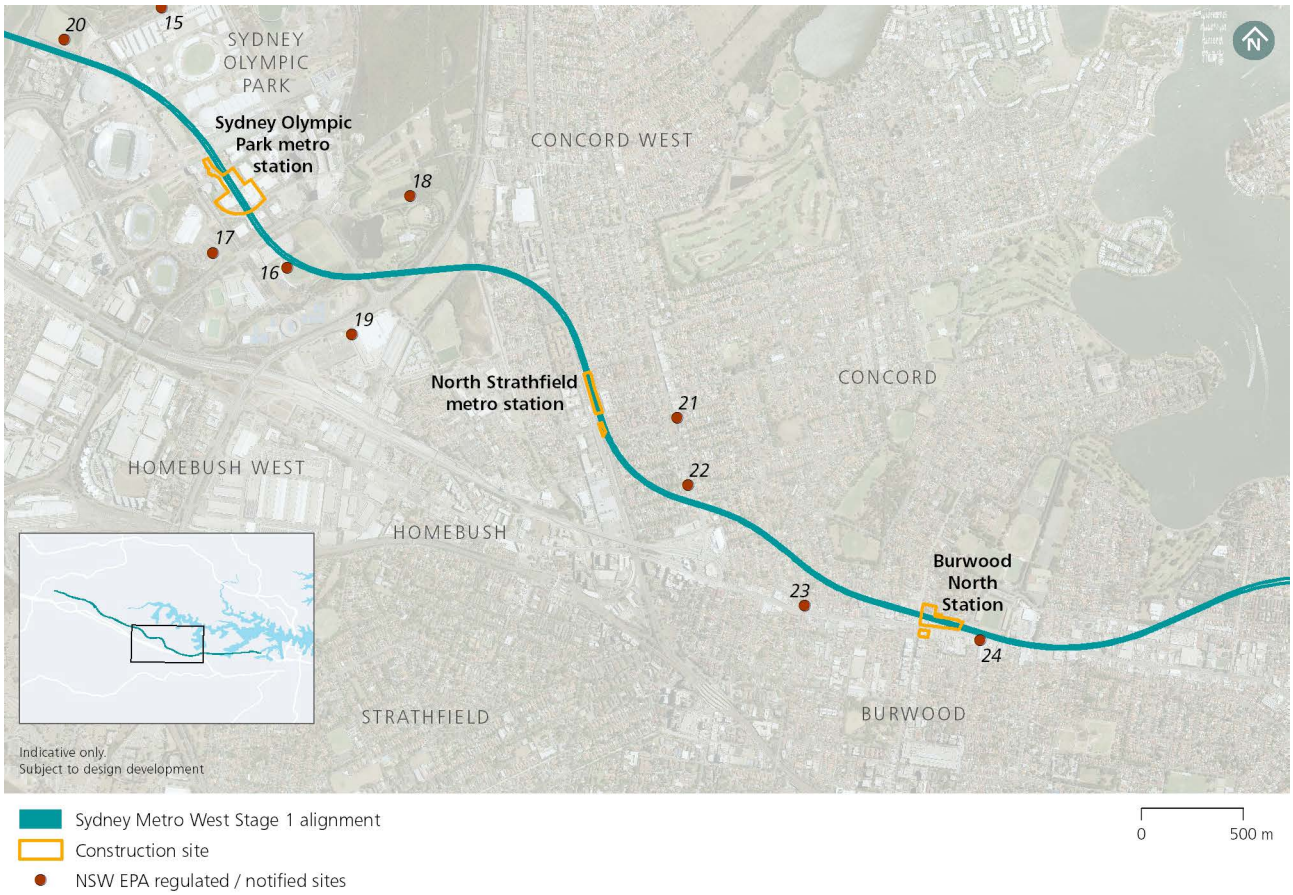

Figure 3-9: NSW EPA regulated / formerly regulated / notified sites within 500 metres of the construction footprint and alignment – Map 3

Figure 3-10: NSW EPA regulated / formerly regulated / notified sites within 500 metres of the construction footprint and alignment – Map 4

Table 3-20: NSW EPA regulated / formerly regulated / notified sites within 500 metres of the construction footprint and alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
Parramatta metro station construction site and alignment						
1	Parramatta	Notified	Corner of Pitt Street and Macquarie Street	Unclassified	Regulation under CLM Act not required	Approximately 500 metres south west of construction site and 100 metres south of alignment
2	Parramatta	Notified	Parramatta Park Toilet Block Demolition	Unclassified	Regulation under CLM Act not required	Approximately 250 metres north of alignment between Westmead and Parramatta metro station construction sites
Clyde stabling and maintenance facility construction site and alignment						
3	Rosehill	Formerly regulated	2 Ritchie Street	Unclassified	Contamination formerly regulated under the CLM Act. Asbestos contamination.	Approximately 500 metres west of construction site (Rosehill dive and Clyde stabling and maintenance facility) and alignment
4	Rosehill	Regulated	Devon Street	Landfill (James Hardie Australia and former James Hardie lands)	Ongoing maintenance required to manage residual contamination (CLM Act). Buried asbestos waste.	Approximately 500 metres north-east of construction site (closest to Rosehill services facility) and alignment
5	Clyde	Notified	3 Parramatta (corner Harbord Street) Road	Service station	Regulation under CLM Act not required	Approximately 250 metres south of construction site (stabling and maintenance facility) and alignment
6	Granville	-	15-17 Berry Street	Other industry	Contamination being managed via the planning process (EP&A Act)	Approximately 500 metres south of construction site (stabling and maintenance facility) and alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
7	Camellia	Regulated	1 Grand Avenue	Other industry activities (former James Hardie factory)	Ongoing maintenance required to manage residual contamination (CLM Act). Asbestos contamination in the fill material throughout most of the site. Arsenic contamination in fill in a localised area on the site. Zinc, phenol and PAH contamination of groundwater at the site.	Approximately 500 metres north-east of alignment
8	Auburn	Regulated	9 Short Street	Other industry (former Ajax chemical factory)	Contamination currently regulated under the CLM Act. Phthalate esters, xylenes, chlorinated hydrocarbons and heavy metals in groundwater on the north and north eastern site boundaries.	Approximately 300 metres southeast of construction site (stabling and maintenance facility) and 500 metres south of alignment
9	Rosehill	Regulated	Durham Street	Other industry (Former Shell Clyde Refinery)	Contamination currently regulated under POEO Act. Groundwater is contaminated with light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH), lead, chromium and perfluoroctane sulfonate.	Approximately 200 metres north-east of construction site (Rosehill services facility and stabling and maintenance facility) and within alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
10	Silverwater	Notified	Carnarvon Road	Landfill	Regulation under CLM Act not required	Approximately 300 metres east of construction site (stabling and maintenance facility) and 200 metres south of alignment
Silverwater services facility construction site and alignment						
11	Silverwater	Notified	103 -105 Silverwater Road	Other industry	Regulation under CLM Act not required	Within construction site and above alignment
12	Silverwater	Notified	46-58 Derby Street	Unclassified (Former printing facility)	Under assessment	Adjacent to construction site and above alignment
13	Silverwater	Regulated	54-58 Derby Street	Unclassified (Storage facility)	Under assessment Trichloroethene in groundwater.	Adjacent to construction site and above alignment
Sydney Olympic Park construction site and alignment						
14	Sydney Olympic Park	Formerly regulated	Kevin Coombes Drive	Landfill (Haslams Creek South Area 3)	Contamination formerly regulated under the CLM Act. Uncontrolled landfilling.	Approximately 500 metres north of the alignment
15	Sydney Olympic Park	Regulated	Kevin Coombes Drive	Landfill (Kronos Hill Landfill)	Ongoing maintenance required to manage residual contamination (CLM Act). Uncontrolled landfilling.	Approximately 500 metres north of the alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
16	Sydney Olympic Park	Regulated	Sarah Durack Avenue	Landfill (Former Golf Driving Range Landfill)	Ongoing maintenance required to manage residual contamination (CLM Act). Uncontrolled landfilling.	Approximately 400 metres south-east of construction site and above the alignment
17	Sydney Olympic Park	Regulated	Shane Gould Avenue	Landfill (Aquatic Centre)	Ongoing maintenance required to manage residual contamination (CLM Act). Uncontrolled landfilling.	Approximately 100 metres south-west of construction site and alignment
18	Sydney Olympic Park	Regulated	Bicentennial Drive	Landfill (Bicentennial Park)	Ongoing maintenance required to manage residual contamination (CLM Act). Uncontrolled landfilling.	Approximately 400 metres east of construction site and adjacent to alignment
19	Homebush	Notified	1 Underwood Road	Other Industry (Mason park Substation)	Regulation under CLM Act not required	Approximately 400 metres south of the alignment
20	Homebush Bay	Notified	Corner Pondage Link and Hill Road	Landfill	Regulation under CLM Act not required	Adjacent (north) to the alignment
North Strathfield metro station construction site and alignment						
21	North Strathfield	Notified	143 Concord Road	Service station	Regulation under CLM Act not required	Approximately 340 metres south-east from the construction site and alignment
22	North Strathfield	Notified	92A Concord Road	Service station (former)	Regulation under CLM Act not required	Approximately 450 metres south-east from the construction site and 50 metres north of alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
Burwood North Station construction site and alignment						
23	Concord	Notified	89 Parramatta Road	Service station	Regulation under CLM Act not required	Approximately 100 metres south-west of alignment
24	Burwood	Formerly regulated	Corner Shaftesbury and Parramatta Road	Other industry (Burwood STA Depot)	Contamination formerly regulated under the CLM Act. Soil and groundwater was contaminated with hydrocarbon compounds (site remediated)	Approximately 100 metres south of construction site and alignment
Five Dock Station construction site and alignment						
25	Five Dock	Notified	231-235 Great North Road	Service Station	Regulation under CLM Act not required	Approximately 200 metres north of construction site and alignment
26	Five Dock	Notified	47 Ramsay Road, corner Fairlight Street	Service Station	Regulation under CLM Act not required	Approximately 120 metres south of construction site and alignment
The Bays Station construction site and alignment						
27	Rozelle	Formerly regulated	Robert Street	Other Industry (White Bay Power Station)	EHC Act Revocation Notice (Former). Asbestos and PCB contamination.	Within construction site and above alignment

Site	Suburb	Regulated / formerly regulated / notified	Site address	Site activity	Contamination status	Location relative to construction footprint and alignment
28	Rozelle	Formerly regulated	Reynolds Street	Former Unilever Sulphonation Plant	EHC Act Revocation Notice (Former). Heavy metals, polycyclic aromatic hydrocarbons, linear alkylbenzene and linear alkylbenzene sulphonate compound contamination.	Approximately 400 metres north-west of construction site and alignment
29	Rozelle	Notified	178-180 Victoria Road	Service station	Regulation under CLM Act not required	Approximately 300 metres north of alignment
30	Rozelle	Notified	121 Victoria Road	Service station	Regulation under CLM Act not required	Approximately 350 metres north of alignment
31	Rozelle	Notified	15-39 Wellington Street	Other petroleum	Regulation under CLM Act not required	Approximately 450 metres north of alignment

Based on the review of the NSW EPA contaminated sites register (specifically related to regulated sites – i.e. where the regulator has deemed that contamination is significant enough to require regulation), there are a number of Stage 1 elements which could be impacted by contamination (in consideration of contamination type, media, migration pathway potential and lateral/horizontal extent of construction) as detailed in Table 3-21.

Table 3-21: Potential contamination to Stage 1 elements (NSW EPA contaminated sites register)

Site	Site address	Stage 1 element	Mechanism	Contamination	Comment
Clyde stabling and maintenance facility construction site and alignment					
7	1 Grand Avenue, Camellia	Tunnels	Groundwater ingress, dewatering	Zinc, phenol and PAH	
9	Durham Street, Rosehill	Clyde stabling and maintenance facility (including Rosehill services facility shaft) and tunnels	Groundwater ingress, dewatering	Light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH), lead, chromium and perfluoroctane sulfonate.	Groundwater ingress risk to services facility shaft
			Vapour ingress	Volatile hydrocarbons (TPH, BTEX).	Vapour ingress risk to services facility shaft
Silverwater services facility construction site and alignment					
13	54-58 Derby Street	Silverwater services facility and tunnels	Groundwater ingress, dewatering	Trichloroethene in groundwater	
			Vapour ingress	VOC	Vapour ingress
Sydney Olympic Park metro station construction site and alignment					
14	Sydney Olympic Park (Haslams Creek South Area 3)	Tunnels	Groundwater ingress, dewatering	Nutrients, metals, hydrocarbons (TRH, BTEX, PAH), VHC, PFAS	
			Vapour and gas ingress	Methane, hydrogen sulphide, VHC	

Site	Site address	Stage 1 element	Mechanism	Contamination	Comment
15	Sydney Olympic Park (Kronos Hill Landfill)	Tunnels	Groundwater ingress, dewatering	Nutrients, metals, hydrocarbons (TRH, BTEX, PAH), VHC, PFAS	
			Vapour and gas ingress	Methane, hydrogen sulphide, VHC	
16	Sydney Olympic Park (Former Golf Driving Range Landfill)	Sydney Olympic Park metro station and tunnels	Groundwater ingress, dewatering	Nutrients, metals, hydrocarbons (TRH, BTEX, PAH), VHC, PFAS	
			Vapour and gas ingress	Methane, hydrogen sulphide, VHC	
17	Sydney Olympic Park (Aquatic Centre Landfill)	Sydney Olympic Park metro station and tunnels	Groundwater ingress, dewatering	Nutrients, metals, hydrocarbons (TRH, BTEX, PAH), VHC, PFAS	
			Vapour and gas ingress	Methane, hydrogen sulphide, VHC	
18	Sydney Olympic Park (Bicentennial Park Landfill)	Sydney Olympic Park metro station and tunnels	Groundwater ingress, dewatering	Nutrients, metals, hydrocarbons (TRH, BTEX, PAH), VHC, PFAS	
			Vapour and gas ingress	Methane, hydrogen sulphide, VHC	

3.9.4 Environmental Protection Licences

A search conducted on 4 December 2019 of the NSW EPA Protection of the Environment Operations (POEO) Act public register (under section 308 of the *POEO Act 1997*) indicated there were 22 sites within 500 metres of the construction footprint and the alignment that have current environmental protection licences (EPL). The sites are summarised in Table 3-22. EPLs no longer in force or surrendered have not been included in Table 3-22 as it has been assumed that potential contamination risk is only associated with current licensed activities.

Table 3-22: Site with current EPL within 500 metres of the construction footprint and alignment

Site	Site address	Licence holder	Activity	Location relative to construction footprint and alignment (approximately)
Clyde stabling and maintenance facility construction site and alignment				
1	322 Parramatta Road, Clyde	Boral Cement Ltd	Cement of lime handling	• 360 metres from construction site
2	Parramatta Road, Clyde	Veolia Environmental Services (Australia) Pty Ltd	Non-thermal treatment of general waste Waste storage - other types of waste	• 400 metres from construction site
3	1A Unwin Street, Rosehill	Downer EDI Works Pty Ltd	Recovery of general waste Waste storage - other types of waste	• Within construction site • 200 metres from alignment
4	10 Colqhoun Street, Rosehill	James Hardie Australia Pty Ltd	Cement or lime handling Crushing, grinding or separating Concrete works	• 300 metres from construction site • 400 metres from alignment
5	Durham Street, Camellia	Viva Energy Australia Pty Ltd	Non-thermal treatment of hazardous and other waste Petroleum products storage	• 240 metres from alignment
6	181 James Ruse Drive, Camellia	Statewide Planning Pty Ltd	Contaminated soil treatment	• 360 metres from alignment
7	25 Wentworth Street, Granville	Heliport Developers Pty Ltd	Helicopter-related activity	• Within construction footprint

Site	Site address	Licence holder	Activity	Location relative to construction footprint and alignment (approximately)
8	Corner of Newton Street North and Carnarvon Street, Silverwater	MET Recycling Pty Ltd	Recovery of general waste Waste storage - other types of waste	• 130 metres from alignment
Silverwater services facility and alignment				
9	2-16 Wiblen Street, Silverwater	Cleanaway Daniels NSW Pty Ltd	Thermal treatment of hazardous and other waste Non-thermal treatment of hazardous and other waste Waste storage - hazardous, restricted solid, liquid, clinical and related waste and asbestos waste	• 150 metres from construction site • 60 metres from alignment
10	19-23 Fariola Street, Silverwater	Silverwater Recycling Pty Ltd	Waste storage - other types of waste Recovery of general waste	• 480 metres from alignment
Sydney Olympic Park metro station construction site and alignment				
11	Corner of Pondage Link and Hill Roads, Homebush Bay	Cleanaway Operations Pty Ltd	Waste storage - hazardous, restricted solid, liquid, clinical and related waste and asbestos waste Non-thermal treatment of hazardous and other waste	• Above alignment
12	Hill Road, Homebush Bay	Suez Recycling and Recovery Pty Ltd	Recovery of general waste Non-thermal treatment of general waste Waste storage - waste tyres Waste storage - hazardous, restricted solid, liquid, clinical and related waste and asbestos waste Waste storage - other types of waste	• 70 metres from alignment

Site	Site address	Licence holder	Activity	Location relative to construction footprint and alignment (approximately)
North Strathfield metro station construction site and alignment				
13	25-27 Pomeroy Street, Homebush	Ausgrid Operator Partnership	Waste storage - hazardous, restricted solid, liquid, clinical and related waste and asbestos waste	• 460 metres from alignment
The Bays metro station construction site and alignment				
14	Sommerville Road, Rozelle	Cement Australia Holdings Pty Ltd	Shipping in bulk Cement or lime handling	• Adjacent to construction site • 50 metres from alignment
15	Sommerville Road, Rozelle	Gypsum Resources Australia Pty Ltd	Shipping in bulk	• Adjacent to construction site • 50 metres from alignment
16	WestConnex between the M4-M5 Mainline Tunnels and Rozelle, Rozelle	John Holland Pty Ltd	Road construction (WestConnex)	• Adjacent to construction site
17	Sommerville Road, Rozelle	Newcastle Port Corporation	Shipping in bulk	• Adjacent to construction site
18	James Craig Road, Rozelle	Roads and Maritime Services	Boat construction/maintenance (general)	• 150 metres from construction site • 200 metres from alignment
19	Lot 1 Sommerville Road, Rozelle	Sugar Australia Pty Ltd	General agricultural processing Shipping in bulk	• Adjacent to construction site • 50 metres from alignment
20	James Craig Road, Rozelle	Sydney Boathouse Holdings Pty Ltd	Boat mooring and storage	• 130 metres from construction site • 160 metres from alignment

Site	Site address	Licence holder	Activity	Location relative to construction footprint and alignment (approximately)
21	37 James Craig Road, Rozelle	Sydney City Marine Pty Ltd	Boat construction/maintenance (general)	• 210 metres from construction site • 200 metres from alignment
22	Berth 4 White Bay Robert Street, Balmain	Port Authority of NSW	Shipping in bulk	• Adjacent to construction site • 50 metres from alignment

The majority of the EPL issued to activities within 500 metres of the construction footprint and alignment are associated with waste management and cement related operations. EPLs generally detail requirements for the management of pollution risks associated with the licenced activities. As such, if activities are operating in accordance with their respective EPL, the risk of those activities causing contamination would be reduced. Potential contamination impacts to construction would likely be associated with those licenced activities relating to waste management and which store/use chemicals undertaken within the construction footprint (localised contamination attributed to the on-site activities) and activities which could cause groundwater contamination (bulk chemical storage/use and liquid waste management) directly above or adjacent to the construction footprint and/or the alignment.

Based on the review of the POEO register, there are a number of Stage 1 elements which could be impacted by contamination (in consideration of contamination type, media, migration pathway potential and lateral/horizontal extent of construction) from licenced activities as detailed in Table 3-23 and shown on Figure 3-11.

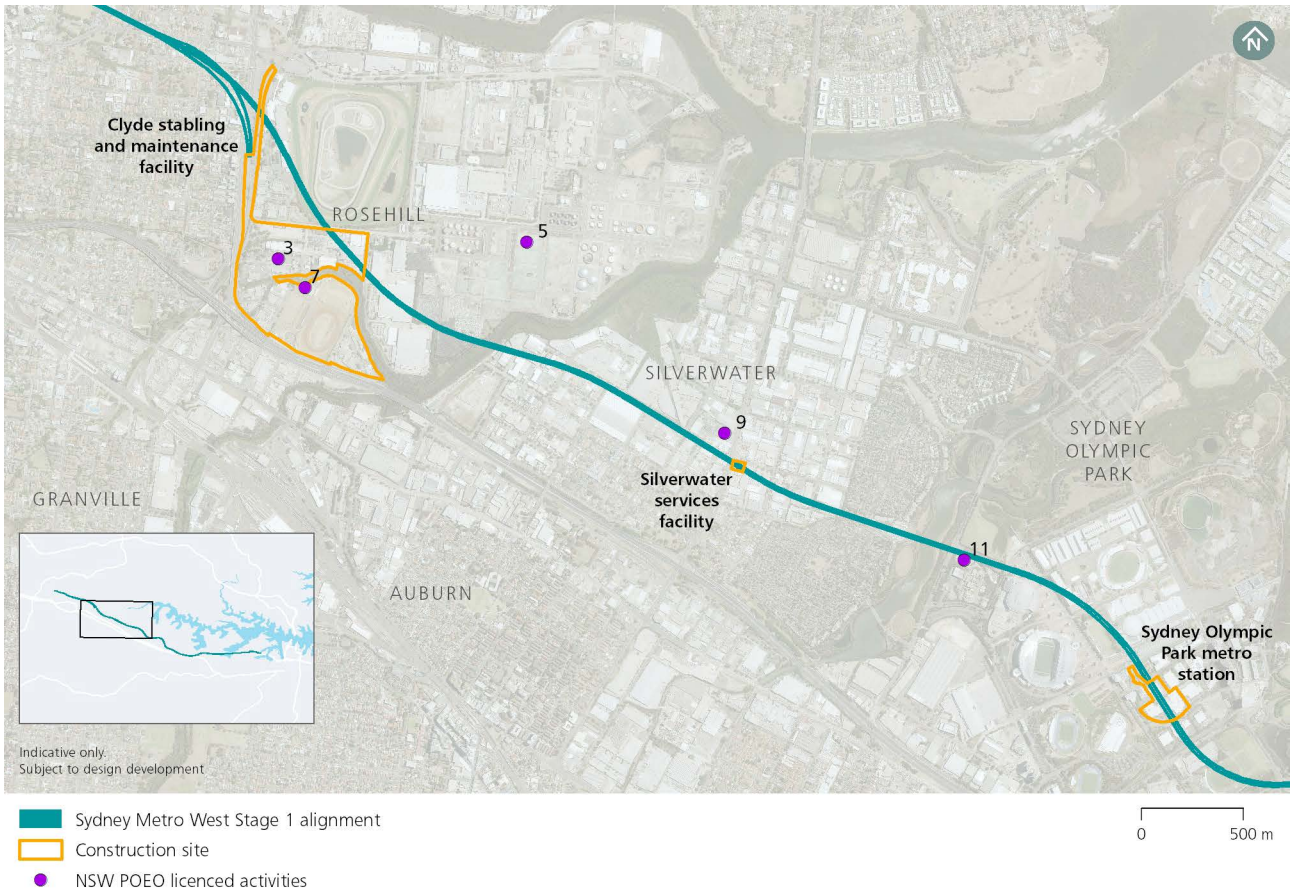

Figure 3-11: Potential contamination to Stage 1 elements (POEO licenced activities)

Table 3-23: Potential contamination to Stage 1 elements (POEO licenced activities)

Site	Site address	Stage 1 element	Mechanism	Contamination	Comment
Clyde stabling and maintenance facility construction site and alignment					
3	1A Unwin Street, Rosehill	Clyde stabling and maintenance facility (including Rosehill services facility shaft)	On-site spills, leaks and inappropriate management of wastes	Metals, hydrocarbons (TRH, BTEX, PAH), VHC, asbestos	

Site	Site address	Stage 1 element	Mechanism	Contamination	Comment
5	Durham Street, Camellia	Tunnels	Groundwater ingress, dewatering	Hydrocarbons (TPH, BTEX, PAH)	Groundwater ingress risk to services facility shaft
			Vapour ingress	Volatile hydrocarbons (TPH, BTEX).	Vapour ingress risk to services facility shaft
7	25 Wentworth Street, Granville	Clyde stabling and maintenance facility	On-site spills and leaks	Hydrocarbons (TRH, BTEX, PAH), VHC	
Silverwater services facility and alignment					
9	2-16 Wiblen Street, Silverwater	Tunnels	Groundwater ingress, dewatering	Heavy metals, hydrocarbons (TPH, BTEX, PAH), VHC	Groundwater ingress, dewatering
			Vapour ingress	Volatile hydrocarbons (TPH, BTEX), VHC	Vapour ingress
Sydney Olympic Park metro station construction site and alignment					
11	Corner of Pondage Link and Hill Roads, Homebush Bay	Tunnels	Groundwater ingress, dewatering	Hydrocarbons (TPH, BTEX, PAH)	Groundwater ingress risk to services facility shaft
			Vapour ingress	Volatile hydrocarbons (TPH, BTEX).	Vapour ingress risk to services facility shaft

3.9.6 Review of PFAS sources

Considering the high mobility of PFAS within the environment, a search of potential PFAS sources was carried out within one kilometre of the construction footprint and alignment. The search involved a review of:

- NSW EPA Contaminated Sites Record of Notices (under section 58 of the *Contaminated Land Management Act 1997*) and the list of contaminated sites notified to the NSW EPA (under section 60 of the *Contaminated Land Management Act 1997)* for PFAS as a contaminant of concern
- Current and historical (from 1955 onwards) aerial imagery for visually identifiable industry and/or operations which may be associated with PFAS contaminants (as defined by the PFAS NEMP, 2018) including aviation, coal works, power generation (including switchyards), petrochemical production, fuel production, petroleum products storage, aviation, sewage treatment plants and waste disposal
- A review of available aerial imagery services (*GoogleEarth*).

The results of the review to identify PFAS sources within one kilometre of the construction footprint and alignment are summarised in Table 3-24.

Table 3-24: Potential PFAS sources within one kilometre of the construction footprint and alignment

Suburb	Site address	Site activity	Information source	Potential PFAS source	Location relative to construction footprint and alignment	Comments
Clyde stabling and maintenance facility construction site and alignment						
Rosehill	Durham Street	Former Shell Clyde Refinery	NSW EPA	Firefighting activities	Approximately 200 metres north-east of construction site (Rosehill services facility shaft) and above alignment	Contamination (including perfluoroctane sulfonate) currently regulated under POEO Act (Table 3-23, Site 9).
Rosehill	Wentworth Street	Heliport	*GoogleEarth*	Hydraulic oils	Within construction site (stabling and maintenance facility) and above alignment	
Silverwater services facility and alignment						
Silverwater	Carnarvon Road	Landfill	NSW EPA	PFAS-containing waste in the landfill	Approximately 300 metres east of construction site and 200 metres south of alignment	The site is likely to be hydraulically separated from the stabling and maintenance facility construction site because of the position of the construction site relative to Duck River.
Sydney Olympic Park construction site and alignment						
Sydney Olympic Park	Kevin Coombes Drive	Landfill (Haslams Creek South Area 3)	NSW EPA	PFAS-containing waste in the landfill	Approximately 500 metres north of the alignment	Contamination (not specific to PFAS) formerly regulated under the CLM Act (Table 3-23, Site 14)
Sydney Olympic Park	Kevin Coombes Drive	Landfill (Kronos Hill Landfill)	NSW EPA	PFAS-containing waste in the landfill	Approximately 500 metres north of the alignment	Ongoing maintenance required to manage residual contamination associated with uncontrolled landfilling (not specific to PFAS) under the CLM Act (Table 3-23, Site 15)

Suburb	Site address	Site activity	Information source	Potential PFAS source	Location relative to construction footprint and alignment	Comments
Sydney Olympic Park	Sarah Durack Avenue	Landfill (Former Golf Driving Range Landfill)	NSW EPA	PFAS-containing waste in the landfill	Approximately 400 metres south-east of construction site and above the alignment	Ongoing maintenance required to manage residual contamination associated with uncontrolled landfilling (not specific to PFAS) under the CLM Act (Table 3-23, Site 16)
Sydney Olympic Park	Shane Gould Avenue	Landfill (Aquatic Centre)	NSW EPA	PFAS-containing waste in the landfill	Approximately 100 metres south west of construction site and alignment	Ongoing maintenance required to manage residual contamination associated with uncontrolled landfilling (not specific to PFAS) under the CLM Act (Table 3-23, Site 17)
Sydney Olympic Park	Bicentennial Park	Landfill	NSW EPA	PFAS-containing waste in the landfill	Approximately 400 metres east of construction footprint and adjacent to alignment	Ongoing maintenance required to manage residual contamination associated with uncontrolled landfilling (not specific to PFAS) under the CLM Act (Table 3-23, Site 18)
Homebush	1 Underwood Road	Mason park Substation	NSW EPA	Firefighting activities	Approximately 400 metres south of the alignment	
Homebush Bay	Corner Pondage Link and Hill Road	Landfill	NSW EPA	PFAS-containing waste in the landfill	Adjacent (north) to the alignment	
North Strathfield metro station construction site and alignment						
North Strathfield	Underwood Road	Switchyard	1955 aerial imagery	Firefighting activities	Approximately 500 metres west of construction site and the alignment	

Suburb	Site address	Site activity	Information source	Potential PFAS source	Location relative to construction footprint and alignment	Comments
The Bays Station construction site and alignment						
Rozelle	Robert Street	White Bay Power Station	NSW EPA	Firefighting activities	Within construction site and above alignment	Former EHC Act Revocation Notice for asbestos and PCB contamination (Table 3-23, Site 27).
Rozelle	Manning Street	Switchyard	2005 aerial imagery	Firefighting activities	Approximately 300 metres north of the alignment	

3.9.7 Previous contamination site investigations

A search of internet resources was carried out for previous contamination investigations and/or general contamination information for sites which were located within and/or adjacent to the construction footprint and alignment. The internet search used the key words "contamination", "remediation" and "site investigation" in the suburbs of Westmead, Parramatta, Harris Park, Camellia, Rosehill, Rydalmere, Silverwater, Newington, Sydney Olympic Park, Homebush, North Strathfield, Concord, Burwood, Croydon, Canada Bay, Five Dock, Rodd Point, Rozelle and Leichhardt. Additionally, a search of contamination information was carried out for major projects known to exist in the vicinity of the construction footprint and alignment including Parramatta Light Rail, WestConnex (M4 East and M4-M5 Link) and the Camellia town centre master plan.

Geotechnical and groundwater data collected by Sydney Metro for Sydney Metro West has been reviewed, in addition to the following publically available investigations and contamination information:

- *Lancer Barracks, Parramatta, New South Wales* (Department of Defence, 2016)
- *WestConnex M4 Widening, Pitt Street, Parramatta to Homebush Bay Drive, Homebush* (SMEC, 2014)
- *WestConnex, M4 East Environmental Impact Statement*, Appendix P (NSW Government, 2015)
- *Preliminary Site Investigation and Limited Detailed Site Investigation, 15-19 Berry Street, Clyde, NSW* (Trace Environmental, 2016)
- *Camellia Precinct, Contamination Study – Part 1 – High Level Contamination Review* (Golder, 2015a)
- *Camellia Precinct, Contamination and Remediation Study – Stage 2* (Golder, 2015b)
- *Clyde Terminal Conversion Project*, Chapter 17 (AECOM, 2013)
- *Viva Energy Clyde Western Area Remediation Project*. Appendix C: Conceptual Remedial Action Plan (AECOM, 21 January 2019)
- Transport for NSW, *Parramatta Light Rail, Stage 1 Contaminated Land Technical Paper* (Coffey, 2017)
- *Regulation Project. James Hardie Asbestos Waste Contamination Legacy. Summary Project Report* (DECCW, April 2010)
- *Parramatta River Estuary, Data Compilation and Review Study* (Cardno, 2008)
- *Fact Sheet – Remediation* (Sydney Olympic Park Authority, 2014a)
- *Environmental Management: Remediated Lands Management Policy* (Sydney Olympic Park Authority, 2014b)
- *Transport Access Program, North Strathfield Station Upgrade, Review of Environmental Factors* (NSW Government, 2018)
- *Environmental Risk and Planning Report* (Lotsearch 2016)
- *Preliminary Environmental Investigation 1 Cook Avenue, Canada Bay* (Alliance Geotechnical, 2014)
- *Addendum to Remedial Action Plan, Part Lot 6643 DP 1137663 Leichhardt Park, Mary Street Lilyfield NSW* (Consara, 2015)
- *Rozelle Rail Yards – Site Management Works, Review of Environmental Factors* (Roads and Maritime Services, 2016)
- *Phase 1 Contamination Assessment, 469-483 Balmain Road, Lilyfield NSW* (Douglas Partners, 2016)
- UrbanGrowth NSW. *Site Wide Remedial Concept Plan*. *The Bays Precinct Urban Transformation Area* (JBS&G, 4 December 2015).

Summaries are included below.

Sydney Metro West Geotechnical Investigation

Sydney Metro West undertook a geotechnical, groundwater and contamination investigation during the early stages of project development. In interpreting the results, the following NSW EPA endorsed screening levels (derived from NEPM, 2013) were adopted:

- Health investigation levels for commercial / industrial use
- Health screening levels for commercial / industrial use – vapour intrusion
- Ecological investigation levels for commercial / industrial use
- Ecological screening levels for commercial / industrial use – coarse soil.

Soil results were also compared against the *Waste Classification Guidelines* (EPA, 2014).

A total of 24 soil bores were installed. Results from selected soil samples reported elevated concentrations of heavy metal, asbestos, hydrocarbons, and benzo(a)pyrene above human health and/or ecological guidelines. Selected soil results classified soils initially as Restricted Solid Waste, Restricted Solid Waste Special Waste or Hazardous Waste. Following toxicity characteristic leaching procedure (TCLP) analysis, soil was classified as either General Solid Waste or General Solid Waste Special Waste. The results of the contamination assessment carried out in the close proximity to Stage 1 elements are detailed below.

- Parramatta metro station construction site – BH003 at a depth of 0.5 metres (fill) recorded concentrations of zinc above the adopted ecological guidelines
- Clyde stabling and maintenance facility construction site – BH011 at a depth of 0.0 – 0.3 metres (fill) recorded concentrations of nickel, zinc and TRH C10 – C16 above the adopted ecological guidelines, and asbestos was identified at the surface. BH020 at a depth 18 metres (no geological information beyond 15.1 metres provided in report) recorded concentrations of zinc above the adopted ecological guidelines, and the presence of Acid Sulfate Soils (ASS). BH021 at a depth of 0.25 metres (fill) recorded concentrations of nickel above the adopted ecological guidelines, and TRH C10 – C16 above ecological management limit. BH021 at a depth 14.5 metres (siltstone) and 15.25 metres (no geological information beyond 15.2 metres provided in report) recorded concentrations of zinc above the adopted ecological guidelines. BH022 at a depth of 8.05 – 8.15 metres clay – alluvium) recorded concentrations of zinc above the adopted ecological guidelines
- Sydney Olympic Park metro station – BH032 at a depth of 0.6 metres (fill) and 1.0 metres (fill) recorded concentrations of benzo(a)pyrene above the adopted ecological guidelines
- North Strathfield metro station – BH009 at a depth of 0.1 metres (fill) recorded concentrations of nickel above the adopted ecological guidelines. Acid sulfate soil was detected within BH038
- The Bays Station construction site – BH066 at a depth of 1.0 metres (fill) recorded concentrations benzo(a)pyrene above the adopted ecological guidelines. BH066 at a depth of 2.5 metres (fill) recorded concentrations of zinc and benzo(a)pyrene above the adopted ecological guidelines. BH067 at a depth of 0.5 metres (fill) recorded concentrations of copper above the adopted ecological guidelines.

Sydney Metro West groundwater monitoring

Sydney Metro undertook a groundwater investigation during early stages of project development. Around 57 groundwater wells were sampled to provide a preliminary insight into potential groundwater contamination at various sites. This found:

- LNAPLs and/or DNAPLs were not detected during sampling at the majority of monitoring wells. Six monitoring wells could not be checked for the presence of LNAPLs and DNAPLs due to faulty equipment. Based on information from the groundwater investigation report, monitoring wells BH003 (Parramatta), BH027 (Sliverwater), BH034 (Homebush), BH040 (Concord), BH066 (White Bay) and BH067 (White Bay) were not checked for the presence of LNAPLs or DNAPLs. Jacobs undertook a review of the TRH analytical data from the groundwater investigation for these monitoring wells. TRH concentrations were low or below Limits of reporting in water sampled from the above listed monitoring locations. The low to non-detectable concentrations of TRH reported within these monitoring wells would not be conducive to the formation of NAPLs (i.e. NAPL would be unlikely to be present in these monitoring wells).
- The majority of groundwater samples reported exceedances of iron and magnesium
- The main contaminants of concern exceeding the adopted criteria were nitrate, total phosphorous, ammonia, and selected heavy metals
- Sum of PFOS and PFHxS was recorded at concentrations exceeding the adopted drinking water guidelines at groundwater well locations BH007 (Camellia) and BH066 (White Bay).
- The water level in nine wells did not recover and were unable to be sampled.

Lancer Barracks, Parramatta, New South Wales (Department of Defence, 2016)

Lancer Barracks is located approximately 300 metres south-east of Parramatta metro station construction site and the alignment.

The Fact Sheet indicated a Stage 1 investigation had been carried out at the site, with no intrusive works completed to date. Lancer Barracks is considered low risk to human health and the environment, based on previous and current land use.

It is noted that investigations into the soil and/or groundwater in the vicinity of former underground storage tanks is required should future redevelopment be carried out.

WestConnex M4 Widening, Pitt Street, Parramatta to Homebush Bay Drive, Homebush (SMEC, 2014)

This assessment provides a high-level characterisation of potential impacts on soil, sediments, water quality and waste associated with M4 Widening project. In relation to contamination, the investigation found that:

- Construction works involved in the M4 Widening would cause erosion and runoff, impacting water quality and aquatic ecosystems in receiving waterways. Water quality in waterways in the vicinity of Parramatta and Homebush are already degraded as a result of historical and current land use
- Duck River potentially contains highly mobile sediments which could be affected by construction activities if not managed correctly
- Management measures were identified to optimise pollution mitigation to receiving environments during construction activities
- There was a high potential for acid sulfate soils to exist along the majority of the project between Parramatta and Homebush
- It was noted that contaminated lands and hazardous materials are likely to exist in the area, which could cause harm to human health if disturbed and not managed correctly
- Asbestos was identified in three areas within the project area

- Contamination from hydrocarbons, heavy metals, asbestos, PAHs, pesticides, and illegally dumped fill soils is likely to exist in the soils in this area.

WestConnex, M4 East Environmental Impact Statement, Appendix P (NSW Government, 2015)

The location of the site subject of this report is located adjacent to up to one kilometres south of the respective construction sites and the alignment between Homebush Bay Drive and Iron Cove Creek.

Through the application for upgrades and extension of the M4 Motorway from Homebush Bay Drive in Homebush to Parramatta Road and City West Link at Haberfield, a soil and land contamination assessment was carried out by GHD Pty Ltd (GHD). The assessment aimed to identify potential sources of contamination along the corridor and review the associated risks.

Areas assessed in this report involved a review of previous investigations, site inspections and some soil and groundwaters sampling along the corridor. The following information was identified:

Homebush Bay Drive to Pomeroy Street

- This area consisted of light industry, vacant land, retail shopping centres, service station and automotive services
- Fill was identified from 0 to 1.8 metres below ground level, underlain by natural soils from 0.2 to 3.5 metres below ground level. Asbestos containing material was identified in fill soils along the Western Motorway between Sydney Olympic Park and North Strathfield metro station construction sites
- Groundwater was identified at around six metres below ground level. Heavy metals were detected in the groundwater above adopted screening criteria (NEPM GIL Fresh Water), however they were predicted to be indicative of background metal concentrations

Pomeroy Street to Ismay Avenue

- This area consisted of residential land use and open space including a creek. Light industry such as automotive workshops, and commercial land use was also present
- Contamination within soils was not assessed in this section as no current activities were considered to be of medium or high risk through the desktop assessment
- Groundwater well search identified eight groundwater monitoring wells within a 500 metres vicinity of this section of the corridor. Standing groundwater level ranged from 0.68 metres to 3.07 metres below ground level

Ismay Avenue to Carrington Lane

- This area consisted of the main North Strathfield line, residential areas, open space, Powells Creek, and commercial shops
- Fill was recorded to a depth of one metre below ground level. Previous investigations in the area noted benzo(a)pyrene, heavy metals and asbestos in shallow fill materials. Benzo(a)pyrene TEQ was recorded above adopted criteria screening levels (commercial/industrial)
- A total of four groundwater monitoring wells were recorded in a 500 metres radius of this section. Groundwater was recorded between 0.9 metres and 5.55 metres below ground level. Heavy metals were recorded above screening criteria (NEPM GIL Fresh Water)

Carrington Lane to Broughton Street

- This area consisted of residential areas, car yards, automotive repair shops, and other industrial land uses
- Two contaminated sites notified to EPA register were identified. These included the Former Caltex service station on Concord Road, and the Caltex service station on Parramatta Road

- Fill was recorded to a depth of 0.1 to 0.9 metres below ground level. A slight hydrocarbon odour was noted with a PID reading of 281 ppm 0.3 to 0.5 metres below ground level in a borehole located at the Caltex Service Station. Polyaromatic hydrocarbons (PAHs) and TRH C16 – C34 were detected in soil bore located on an Ausgrid site above selected criteria
- Groundwater level was recorded at 1.54 to 8.252 metres below ground level along this section. Main contaminants of concern were heavy metals which exceeded the adopted criteria (NEPM GIL Freshwater). However, these are considered reflective of background concentrations

Broughton Street to Iron Cove Creek

- This area consisted of residential areas, open space, commercial land use, service stations, automotive workshops, substation and a former brick pit.

Preliminary Site Investigation and Limited Detailed Site Investigation, 15-19 Berry Street, Clyde, NSW (Trace Environmental, 2016)

The location of the site subject of this report is located approximately 500 metres south of the Clyde stabling and maintenance facility construction site and the alignment.

Trace Environmental undertook a site investigation to provide preliminary indication of soil and groundwater conditions at 15-19 Berry Street Clyde. This location is within the vicinity of the proposed Rosehill and Camellia sites. A total of 42 soils samples were collected in fill and natural soil material. Five groundwater monitoring wells were established and sampled from. From the investigation the following findings were established:

- The site had previously been developed for railroad purposes before 1930s until mid-1990s. It had since been vacant land or utilised for warehouse storage
- Remediation had occurred on a neighbouring site which included excavation and removal of fill materials to a depth of up to 3.5 mbgl. Following remediation works, the site was validated for proposed land uses which are believed to include commercial/industrial land use
- Results from soil analysis identified exceedances about the NEPM ecological guidelines at various locations in shallow soils across the site. Stained soils were observed at two locations across the Site at depth
- There was a high potential for actual or potential ASS to occurring in soils on site
- Groundwater analytical results detected no evidence of significant groundwater contamination at the site.

Camellia Precinct, Contamination Study – Part 1 – High Level Contamination Review (Golder Associates, 2015a)

The location of the site subject of this report is located adjacent to the Clyde stabling and maintenance facility construction site and above the alignment.

This high-level environmental review encompasses the Camellia precinct bounded by Parramatta River, Duck River and the Western Motorway, and James Ruse Drive. The review identifies a long industrial history for the area which may cause exposure to contaminated soils and/or groundwater should redevelopment occur. It is noted that areas of the precinct are contaminated with asbestos, hexavalent chromium in addition to other hazardous substances. Key findings of the review were:

- Areas of the precinct are believed to have been filled with asbestos and chrome waste, originating from historic manufacturing activities in the area. There is a high chance the ASS occurs within soils in the area.
- Groundwater is recorded between 1 – 4 mbgl
- Historic land uses of the area included, but are not limited to, railroad works, oil refinery, meat works, tannery, lumber yard, asbestos manufacturers, facilities producing roof tiles, rubber tyres, bitumen, chlorinated hydrocarbons, plastic pipe, paints, pharmaceuticals

- Many of the industrial facilities in the area are or have been subject to Environment Protection Licenses issued by the EPA
- The extent and nature of contamination identified the area is not fully understood. However, multiple studies in the area have confirmed that contaminants such as asbestos, hexavalent chromium, petroleum hydrocarbons, arsenic and chlorinated hydrocarbons exist in the soil and/or groundwater
- Multiple properties in the precinct have been notified as contaminated sites under Section 60 of the *Contaminated Land Management Act 1997*. The EPA has issued notices under the Act to manage contamination on most of these sites
- Many of the sites have been redeveloped into light industrial land use in recent years. Whilst, at the time of writing this review, other buildings have been demolished on sites, pending redevelopment.

Camellia Precinct, Contamination and Remediation Study – Stage 2 (Golder Associates, 2015b)

The location of the site subject of this report is located adjacent to the Clyde stabling and maintenance facility construction site and above the alignment.

Following on from Stage 1 (above), Golder Associates provided a more detailed review of contamination in selected areas within the precinct, Stage 2, and developed potential remediation options with cost estimates.

Stage 2 sites evaluated for large remediation work and associated costs include:

- 181 James Ruse Drive, Camellia – former asbestos manufacturer potentially requiring 6.3 hectares of remediation
- 1 Grand Avenue – former asbestos manufacturer potentially requiring 7.8 hectares of remediation
- Three hypothetical locations across the precinct of between three to five hectares potentially contaminated by landfilling and historic industrial activities
- The main contaminates of concern are fill materials of unknown sources, hexavalent chromium, asbestos containing fill material, hydrocarbon contamination, and acid sulfate soils.

Clyde Terminal Conversion Project, Chapter 17 (AECOM, 2013)

The location of the site subject of this report is located approximately 200 metres south-east of the Clyde stabling and maintenance facility construction site and above the alignment.

This report discusses existing and potential ecological and human health risks should the former Clyde refinery undergo development. The report outlines soil and groundwater conditions at the site as follows:

- Soil and groundwater in areas at the Shell Terminal in Clyde are regulated by Condition U1 of EPL No. 570 which involves a yearly monitoring program and report to the EPA
- Soils at the Terminal include fill to approximately one to 1.5 metres below ground level, underlain by clays, consisting of estuarine sediments and alluvial sediments, to up to eight metres below ground level
- Groundwater has been observed, through an extensive groundwater monitoring well network, at one to 4.5 metres below ground level
- Petroleum hydrocarbons and metals are present in groundwater beneath the Terminal. Impacts are considered isolated. Between 2011 and 2012 LNAPL was observed in four out of 152 wells gauged in the area. Quarterly gauging is carried out in the area
- Dissolved phase hydrocarbon impacts in groundwater have been identified in the central portions of the Terminal. BTEXN concentrations were observed across the site, however the concentrations detected were not in excess of adopted screening criteria (commercial/industrial)

- Heavy metal concentrations in groundwater were detected above ecological screening criteria, and are believed to be associated with leachate from imported fill material, or associated with background conditions. Hexavalent chromium concentrations were identified in numerous locations in the north-east portion of the Terminal
- PFOS was reported to be present in samples collected from four out of 10 groundwater samples submitted to the laboratory for analysis
- A butyl membrane was installed west, north-west and north of the Terminal in the 1980s to prevent chromium impact groundwater discharging into the wetlands. Investigations have shown this to be successful
- Asbestos was also identified in soil samples collected across the Terminal
- Acid sulfate soils are likely to occur on the western section of the Terminal at greater than four metres below ground level, eastern section of the Terminal at two to four metres below ground level, and a small strip along Duck River at zero to one 1 metre below ground level.

In general, investigations have shown that no ongoing releases of LNAPL and petroleum hydrocarbons are occurring at the Terminal, and that existing plumes of impacted groundwater appear stable. Impacted soils and groundwater cannot be linked directly to a source, but are co-located to process areas and tank farms.

The soil and groundwater at the Terminal are managed by a Soil and Groundwater Management Plan created in 2010.

Viva Energy Clyde Western Area Remediation Project. Appendix C: Conceptual Remedial Action Plan (AECOM, 21 January 2019)

The conceptual remedial action plan (RAP) was prepared for the western area of the former Clyde refinery located at Durham Street, Rosehill. The remediation of soils and groundwater within the western area is to facilitate future development of the land for other purposes permissible under the existing zoning classification.

Numerous soil, groundwater and surface water investigations have been carried out across the western area and the greater refinery site. Chemicals or potential concern within the western area include:

- Total petroleum/recoverable hydrocarbons (TPH/TRH)
- Benzene, Toluene, Ethyl-benzene and xylene compounds (BTEX)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Phenols
- Polychlorinated Biphenyls (PCB)
- Tetraethyl Lead
- PFAS.

Further, the sites historic use as a refinery means that other chemicals such as acids, ethanolamine, sodium hydroxide and solvents may also be present within the western areas drainage system.

There are also buried wastes/leaded sludges within the western area. There is also the potential for asbestos containing materials to be present within the western area. Light non-aqueous phase liquids (LNAPL) have been identified on the western area.

Soil and groundwater impacts at the site are likely to be associated with losses to ground from a variety of sources across the western area that have occurred over the refinery's history, as opposed to one or more releases from a single localised area/source.

The remediation approach proposed would:

- Address petroleum hydrocarbon impacts in shallow soil horizons
- Address soil/sludge impacts in the drainage network and surrounds
- Removing LNAPL to the extent practicable
- Ensuring short and long term contamination risks to the environment are removed or mitigated.

Transport for NSW, Parramatta Light Rail, Stage 1 Contaminated Land Technical Paper (Coffey, 2017)

Coffey undertook a Stage 1 Contaminated Land Technical Paper review of the proposed Paramatta light rail area. The review includes Westmead, Parramatta North, Parramatta CBD, Rosehill, Camellia, and Carlingford, and identified 48 areas of environment interest along the Parramatta Rail line with may pose a risk to the project during the construction stages. Mitigation and management measures were proposed for each area.

The report discusses Camellia land use and contamination outlining intensive historic industrial use. Contaminates in soil and groundwater in the Camellia industrial area were identified as including asbestos, hexavalent chromium, petroleum hydrocarbons, chlorinate hydrocarbons and arsenic.

Potential contaminates in soil and groundwater across most suburbs included asbestos, TRH, BTEX, PAH, VOCs, metals, OCP, OPP, PCBs, asbestos. Sediments in Parramatta River (affecting Parramatta North and Parramatta CBD) were noted as potentially containing nutrient contamination also.

Regulation Project. James Hardie Asbestos Waste Contamination Legacy. Summary Project Report (DECCW, April 2010)

In 2007 the former Department of Environment, Climate Change and Water (DECCW) was made aware of the potential existence of several sites in the Sydney area containing asbestos associated contamination resulting from former operations of James Hardie Industries and related entities (James Hardie). The sites were used by James Hardie as asbestos disposal sites, and identification of the sites would facilitate effective management and decision making by responsible parties.

The former DECCW was informed of incidents of asbestos waste being uncovered at several of the former James Hardie asbestos disposal sites, mainly in the Parramatta City Council area, and to ensure the future protection of public health and the environment, the former DECCW initiated and developed a strategy to identify, assess and propose recommendations for management by appropriate stakeholders of the potential contamination legacy of these sites.

A review of the information contained within the report indicated that there are two sites located within the footprint of the Clyde stabling and maintenance facility construction site. These sites were:

- Former Campbell's Transport site – Tennyson Street, Clyde
- Granville Showground / Parramatta City Raceway – Rosehill (now the Sydney Speedway).

With respect to the former Campbell's Transport site, the former DECCW summarised the asbestos issue as follows:

"There is evidence of asbestos at the site, however if asbestos is undisturbed it is not considered a significant risk to human health and the environment. Further information is required to determine the degree of potential exposure to asbestos at the back of the Sakrete property".

Recommendations detailed by the former DECCW included:

- *"The visible asbestos is removed following recognised Occupational Health and Safety practises.*
- *A management plan is developed by an occupational hygienist with recognised experience in asbestos identification and management to ensure the asbestos is not disturbed, unless appropriate plans for investigation/remediation are developed and assessed as suitable for implementation by a site auditor accredited under the CLM Act.*
- *Council considers making appropriate notation on the relevant planning certificates (i.e. s. 149 certificate).*
- *Further information is obtained to determine whether the stockpiled material at the back of the Sakerete property contains asbestos. Then these material should be lawfully removed and disposed".*

With respect to the Granville Showground / Parramatta City Raceway site (now Sydney Speedway), the former DECCW summarised the asbestos issue as follows:

"James Hardie associated companies have notified DECCW that asbestos has been disposed of on the site. However, inspections undertaken by DECCW found there was no visible evidence of asbestos on the open area of the site".

Recommendations detailed by the former DECCW included:

- Council consider noting factual information on the sites planning certificate (i.e. s. 149 certificate).
- Should the area be disturbed then appropriate asbestos management plans for the site should be developed to ensure that human health is protected.

Parramatta River Estuary, Data Compilation and Review Study (Cardno, 2008)

Cardno undertook a review of data on the Parramatta River Estuary. The review identifies the degradation of natural environments along the river caused by anthropogenic activities such as urbanisation and industrialisation. Contaminated lands and alterations to the foreshore of the river are identified, which have contributed to poor water quality and contamination in sediments in the river.

The industrial history of the land along Parramatta River is seen as major potential point sources of pollution. Contamination soils from these industrialised sites are identified as potentially contributing to contamination of the river and seen as a significant issue for management. Affected water quality and sediments potentially poses an environmental and human health risk.

Cardno undertook a search of the Section 58 of the *Contaminated Land Management Act 1997* in 2008 which identified 45 sites within the Parramatta River catchment. The following suburbs were identified as containing sites with records of notices issued under the *Contaminated Land Management Act 1997*; Ashfield, Auburn, Bankstown, Baulkham Hills. Blacktown, Burwood, Canada Bay, City of Ryde, Holroyd, Hunters Hill, Leichardt, Parramatta, and Strathfield.

The report also identifies the historic chromium and heavy metal seepage into Parramatta River from sites located in Camellia. During the writing of this report, remediation strategies were being developed for the area.

Factsheet – Remediation (Sydney Olympic Park Authority, 2014a)

Numerous areas of landfilling exist within Sydney Olympic Park precinct. Closest known areas of landfilling to the Olympic Park metro station construction site are approximately 150 metres to the south and south west. The footprint of the tunnel is overlain by (The Pyramid Marker, former Golf Driving Range and Bicentennial Park) and adjacent to (Kronos Hill, Aquatic Centre Carpark) a number or areas of landfilling.

SOPA outlined the long-term management of ten engineered landfills constructed at Sydney Olympic Park between 1983 and 2001.

A combination of legal and illegal landfilling operations occurred over several decades at Sydney Olympic Park. In the early 1990s, soil and groundwater samples were collected from generally 1.6 metres deep boreholes installed on a 50 metre grid across the site. Waste was identified across the site consisting of power station ash, demolition rubble, asbestos, industrial hydrocarbons, domestic garbage, and dredging material from the Parramatta River.

Between 1992 and 2000, the area underwent an auditor remediation program consisting of recovery, consolidation and containment of approximately nine million cubic meters of waste. Acid sulfate soils were detected in the areas of parklands at Sydney Olympic Park. The areas contained acid sulfate soils were either excavated, consolidated in deep pits or used as landfill mounds.

Areas of designed containment cells of acid sulfate soils are known to produce some leachate. A leachate transfer system transports the majority of this liquid to a nearby commercial treatment location, whilst some is contained in constructed evaporative ponds.

Environmental Management: Remediated Lands Management Policy (Sydney Olympic Park Authority, 2014b)

The Environmental Management: Remediated Lands Management Policy has been prepared by the Sydney Olympic Authority (SOPA) to support the planning of works or development on remediated landfills within Sydney Olympic Park.

Key elements of the policy are:

- A strategy for management of the remediated lands of Sydney Olympic Park. The commitments contained in this strategy form the basis for regulatory approval of this Plan
- Management objectives and system components of individual landfills
- Management guidelines and procedures to be applied in implementing the various elements of the strategy. These include current technical specifications for remediated lands management and monitoring contracts.

The landfills (i.e. remediated lands) subject of the policy are detailed in Figure 3-12.

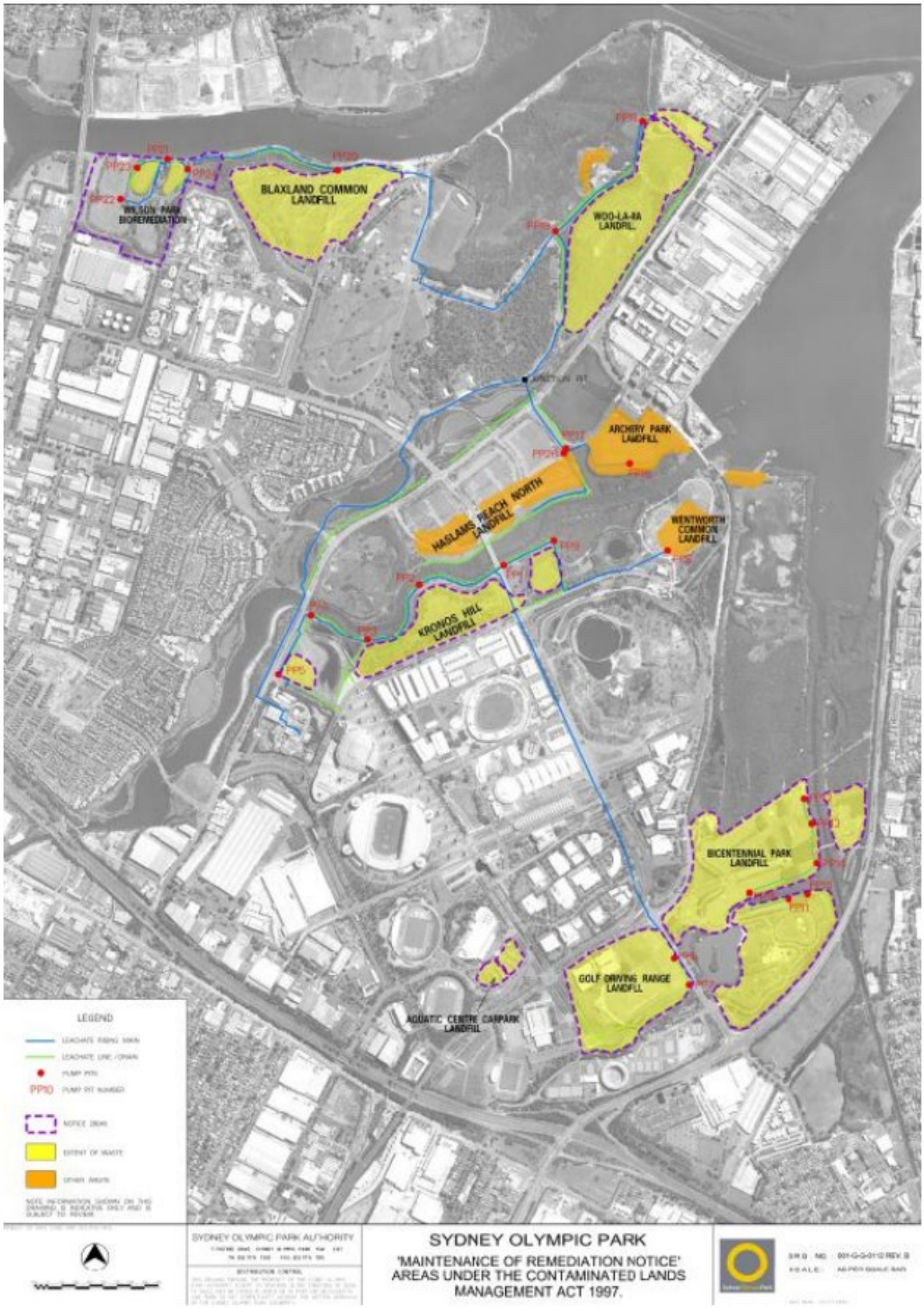

Figure 3-12: Remediation lands (source: Sydney Olympic Park Authority, 2014b)

Transport Access Program, North Strathfield Station Upgrade, Review of Environmental Factor (NSW Government, 2018)

The location of the site subject of this report is located within the construction site of North Strathfield metro station and above the alignment.

The NSW Government, under Transport for NSW (TfNSW), undertook a Review of Environmental Factors (REF) to assess environmental impacts associated with planned station upgrades at North Strathfield Station.

Contamination assessments identified the following:

- Historic activities resulting in ground modifications include excavations, earth fillings, rail road activities, and construction of buildings and associated underground infrastructure
- The probability of acid sulfate soils was considered extremely low
- Contamination associated with rail road activities include; fuel spills, leaks, ash spills, operation activities, filling activities. Land to the west of the existing rail corridor was previously used for industrial activities, much of which has developed into residential land use. Asbestos is also likely to be present in buildings surrounding or on the station
- Two contaminated sites were identified through a search in 2018 of the public registers of notices issues by NSW EPA under the *Contaminated Land Management Act 1997*. These were the Budget service station on Concord Road, and the former Caltex service station on Concord Road. One licensed activity was identified under the *Protection of the Environment Operations Act 1997* as being registered for John Holland and Sydney Water Corporation
- A total of ten groundwater monitoring wells were identified within 500 metres radius of the station. The nearest bore located 460 meters from the station, recorded groundwater at 1.4 metres below ground level.

Environmental Risk and Planning Report (Lotsearch, 2016)

The location of the site subject of this report is located adjacent to the Burwood North Station construction site and the alignment.

This report outlines environmental risks and planning considerations for a T-shaped area covering the intersection of Parramatta and Shaftesbury Road, Burwood.

The report identifies two sites listed on the NSW EPA contaminated land list:

- Burwood STA Deport on the corner of Shaftesbury and Parramatta Road, Burwood. The site is a service station and, at the time of reporting, was listed on the current EPA list.
- Caltex Service Station 87-89 Parramatta, Concord. Service station that, at the time of reporting, was under EPA assessment.

A variety of EPA licenced activities, under regulation at the time of reporting, existed within a one kilometre radius of the T-shaped Site. These included road construction activities associated with WestConnex M4 East, and railway systems activities associated with Sydney Trains network.

Delicensed activities within a one kilometre radius included three sites whose activities were associated with hazardous, industrial or group A waste generation or storage.

A list of businesses in the area between 1950 to 1991 included but not limited to; motor car dealer, motor tuning specialists, motor garages, fuel merchants, metal workers, welders, tool makers, dry cleaners, cafés, garden suppliers, bakers, furniture manufactures, building supplies, and construction equipment hiring services.

Aerial photography between 1955 to 2007 showed no major changes with the exception of increased residential development, apparent increased commercial activity, and moderate developments to Concord Oval.

Registered groundwater wells within a one kilometre radius of the site describe soil as sandy clays from 0 to 0.8 mbgl, underlain by clays to approximately 2.0 mbgl, underlain by shale. Standing water levels are documented at 1.5 to 1.6 mbgl.

Preliminary Environmental Investigation 1 Cook Avenue, Canada Bay (Alliance Geotechnical, 2014)

The location of the site subject of this report is located approximately 500 metres north of the alignment.

This report identified current and historic activities which had/have the potential to cause soil and groundwater contamination at this site. The main environmental concerns for the site include the former industrial use of the site, current site buildings and origin of potential fill material.

The site buildings were constructed prior to 1985, therefore there is a high probability that asbestos containing material was used and is still present onsite, however the buildings were inaccessible during site visits and this was unconfirmed.

Research indicated that the area had no evidence of acid sulfate soils, and that they were unlikely to exist. No underground or aboveground storage tanks were identified. The majority of the site was sealed and soils were not accessible. The report recommended hazardous building material audits to assess the site prior to any demolition.

Addendum to Remedial Action Plan, Part Lot 6643 DP 1137663 Leichhardt Park, Mary Street Lilyfield (NSW Consara, 2015)

The location of the site subject of this report is located above the alignment.

This report outlines the actions carried out to remediate an area of Leichardt Park to make it suitable for use as a childcare centre. The addendum outlines considerations for intrusive works, describes what was carried out in the initial assessment of the property, and the development of a Remedial Action Plan (RAP).

Surface soils were found to contain polyaromatic hydrocarbons greater than the adopted criteria, with a potential for asbestos containing material to exist within the fill also. Arsenic and zinc was also identified in fill soils, greater than the relevant criteria. Fill existed to a depth of 3.6 – 7.9 mbgl, consisting of sandy, silty clays with gravels, ashy materials, glass, brick and wire.

The RAP stated that no existing site soil should be accessible, and a physical barrier between site users and site soil was required to be installed to remediated the Site and make it acceptable for use as a childcare facility. Site-wide capping was used in the form of concrete and imported growing media.

Validation of the remediation works was confirmed through sampling of imported materials, and confirmation that the childcare centre was constructed in accordance with construction plans provided in the RAP and Addendum to the RAP.

Rozelle Rail Yards – Site Management Works, Review of Environmental Factors (Roads and Maritime Services, 2016)

The location of the site subject of this report is located approximately 150 metres south west of the Bays Station construction site and 300 metres south of the alignment.

The former Roads and Maritime Services undertook a Review of Environmental Factors along the former Rozelle Rail Yards which proposed to remove rail and rail related infrastructure in order to manage existing issues at the site such as waste and noxious weeds.

The assessment notes the existence of contamination in the form of redundant rail infrastructure. This includes waste, stockpiles, vegetation, rail infrastructure, ballast, sleepers, remnant service lines, buildings and noxious weeds. These structures were causing ongoing environment management, maintenance and safety issues.

Phase 1 Contamination Assessment, 469-483 Balmain Road, Lilyfield NSW (Douglas Partners, 2016)

The location of the site subject of this report is located less than 100 metres south of the alignment.

Douglas Partners undertook and Phase 1 Investigation of 469-483 Balmain Road, Lilyfield. The investigation involved a site walkover, and a review of historical information and records. No intrusive investigations were carried out.

The assessment reviewed the potential for contamination of the site and provided advice on whether further investigations and/or management was required. Douglas Partners reviewed the NSW WorkCover Dangerous Goods Database, which identified one 5,000 litre, one 10,000 litres, and one 20,000 litre underground storage tank registered at the site, all containing mineral spirit.

Historical records state that a UST was decommissioned, however evidence of former fill point and possible pipework was evident.

Possible importation of fill from unknown sources, historic use of asbestos containing material in building materials, presence of USTs, and historic commercial/industrial activities onsite are areas of environmental concern.

Based on the site history, the report states that the site has a low to moderate potential for significant or broad scale contamination. Moderate to high concentrations of localised contamination is possible at the UST locations.

UrbanGrowth NSW. Site Wide Remedial Concept Plan. The Bays Precinct Urban Transformation Area (JBS&G, 4 December 2015)

The site wide remedial concept plan (SWRCP) was prepared to identify strategies and remedial options to address the identified environmental impacts present at the Bays that would render the site suitable for the proposed land uses.

The Bays Precinct Urban Transformation Area comprised the seven precincts including:

- Precinct 1 – Blackwattle Bay
- Precinct 2 – White Bay Power Station
- Precinct 3 – Rozelle Rail Yards
- Precinct 4 – Rozelle Bay
- Precinct 5 – Glebe Island
- Precinct 6 – White Bay
- Precinct 7 – Wentworth Park.

One of the objectives of the SWRCP was to provide a summary of historical characterisation investigation works completed across the Bays and present a Conceptual Site Model (CSM) documenting the overall understanding

of site contamination characteristics and potential exposure pathways applicable to all or portions of the Bays site.

Based on information from the SWRCP, the contamination status for each of the precincts is summarised below.

Precinct 1 – Blackwattle Bay

- Fill material and natural soil at selected locations are impacted by heavy metals (primarily comprising lead but also arsenic), benzo(a)pyrene, total PAHs and petroleum hydrocarbons.
- Groundwater is impacted by petroleum hydrocarbons and PAHs in the vicinity of Banks Street and the Fish Markets carpark. Elevated heavy metals (above background concentrations) have been detected in groundwater at selected locations across the precinct.

Precinct 2 – White Bay Power Station

- Near surface and sub-surface fill material within the yard area and foreshore of the White Bay Power Station are impacted by lead, benzo(a)pyrene, total PAHs, petroleum hydrocarbons and asbestos. Limited available subsurface information available for commercial properties within the broader White Bay Power Station Precinct, indicate the presence of impacted soil underlying the subject properties also contaminated with heavy metals, PAHs including benzo(a)pyrene and petroleum hydrocarbons.
- Free product transformer oil impacts have been identified in groundwater within the north west portion of the power station site underlying the former transformer yard area. Elevated heavy metals (above background concentrations) and petroleum hydrocarbons have been detected in groundwater at selected locations across the precinct.

Precinct 3 – Rozelle Rail Yards

- Surface and subsurface fill material in various portions of the precinct are impacted to varying degrees with heavy metals including lead, arsenic and zinc (noting the absence of data for cadmium, chromium and nickel), benzo(a)pyrene and total PAHs and petroleum hydrocarbons.
- Elevated petroleum hydrocarbons have been detected in groundwater at selected locations across the precinct.

Precinct 4 – Rozelle Bay

- Fill material selected locations are impacted by benzo(a)pyrene, total PAHs and petroleum hydrocarbons. Asbestos and organotins impacts have been identified in surface and sub-surface fill materials in the vicinity of The Crescent.
- Elevated heavy metals and PAHs have been detected in groundwater at selected locations across the precinct.

Precinct 5 – Glebe Island

- Historical assessment of the Glebe Island Precinct has been limited in scope and whilst to date the presence of significant soil and/or groundwater contamination has not been identified, detailed characterisation may identify the presence of specific areas of the Precinct that will require management during future redevelopment.

Precinct 6 – White Bay

- Sampling locations completed in the vicinity of port workshops located in the central portion of the precinct have previously identified the occurrence of both light fraction and heavy fraction petroleum hydrocarbon impacts in subsurface soil/fill material.
- No groundwater characterisation data was available for this precinct at the tie of preparing the SWRCP.

Precinct 7 – Wentworth Park

- Fill material and natural soil at selected locations are impacted by heavy metals (comprising lead, copper and zinc), benzo(a)pyrene, total PAHs and petroleum hydrocarbons in the vicinity of identified fuel storage facilities.
- Elevated heavy metals, petroleum hydrocarbons, naphthalene and PAHs have been detected in groundwater at selected locations across the precinct.

4. Contamination investigation findings

4.1 Areas of environmental interest – Construction footprint and alignment

Based on the findings of the desktop review and site inspections, a number of known and potential contamination sources (areas of environmental interest – AEIs) have been identified within and/or adjacent to the construction footprint and alignment. To understand the potential interaction of construction activities with potential contamination and to assess the potential impact of contamination on construction during Stage 1, sites have been categorised into five categories of potential contamination impact (very low, low, moderate, high and very high) based on the impact prioritisation methodology in Section 2.4.

Some sites contain multiple potential contamination sources (AEIs) which were defined by activities/operations and not by cadastral boundaries. Where this occurs, a range of categories of potential contamination impact has been provided for the site.

The results of this exercise are provided in Table 4-1 to Table 4-9. The tables also include references to potential mitigation measures which are discussed further in Section 7. Figure 4-1 to Figure 4-9 shows sites of moderate potential contamination impact and above.

A number of previously recorded contaminated sites within and or next to the construction footprint and alignment are considered to represent a low potential for contamination to impact upon construction. No further consideration of contamination has been provided for these low potential sites.

A number of sites have been identified as having moderate to high potential for contamination to impact upon construction. Additional information would need to be obtained and reviewed (such as site-specific data) in order to determine the most appropriate site-specific responses or controls, which may include remediation (refer to Section 7). Construction sites or parts of the alignment with moderate to high potential for contamination to impact upon construction are:

- Westmead metro station construction site and alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including mechanical workshop activities, dumping of construction wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Parramatta metro station construction site and alignment – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including possible commercial/industrial land use, dry cleaning operation and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Clyde stabling and maintenance facility construction site and alignment in Rosehill/Clyde – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including industrial land use, industrial land use on adjoining sites, vehicle maintenance at Sydney Speedway, historical land reclamation around on-site waterways, heliport operations, known groundwater contamination on adjoining or nearby sites (James Hardie and Clyde Refinery), landfilling of asbestos and PFAS containing wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Silverwater services facility construction site and alignment – Soils, groundwater and vapour within / beneath the construction site and above the alignment have been assigned a **moderate to high potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to

the site including possible commercial/industrial land use, known VOC contamination on-site, dumping of construction wastes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures

- Sydney Olympic Park metro station construction site and alignment – Groundwater and landfill gas within / beneath the construction site and above the alignment have been assigned a **high potential contamination impact** associated with historical burial of waste materials and potential firefighting activities adjacent to the site
- North Strathfield metro station construction site and alignment – Soils within the construction site or above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures and potential firefighting activities adjacent to the site
- Burwood North Station construction site and alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including mechanical workshop activities and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- Five Dock Station construction site and alignment – Soils within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on and/or adjacent to the site including the operation of funeral homes and the possible inappropriate management (during demolition) and/or degradation of hazardous building materials within current and former on-site structures
- The Bays Station construction site and alignment – Soils and groundwater within / beneath the construction site and above the alignment have been assigned a **moderate potential contamination impact** associated with the current and historical activities carried out on (power station) and adjacent (industrial land use) to the site, historical land reclamation, potential firefighting activities (on and in the vicinity of the site) and the possible inappropriate management (during demolition) of hazardous building materials in former structures adjacent to the site.

4.2 Westmead metro station construction site and alignment

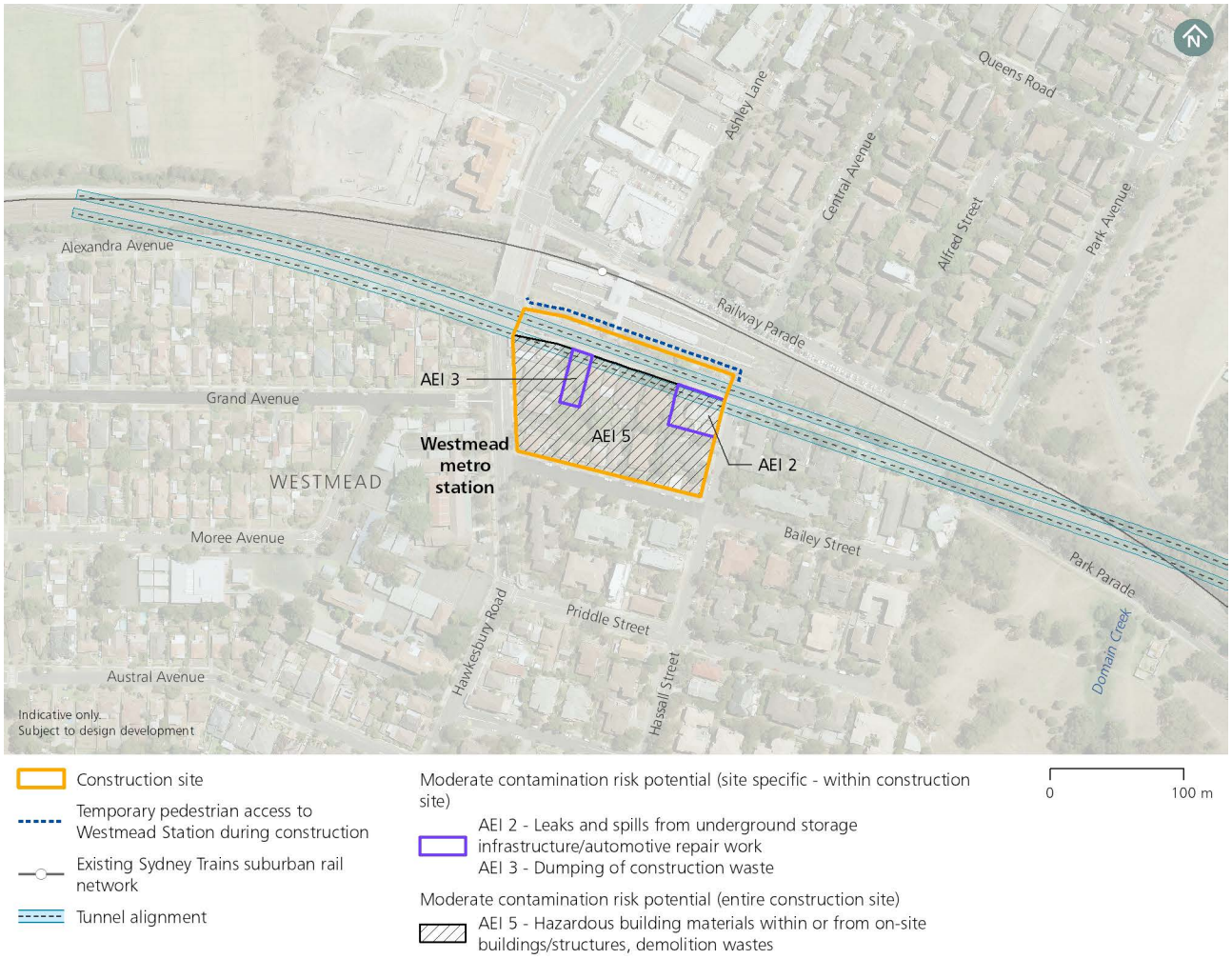

Figure 4-1: Potential contamination impact – Moderate and above – Westmead metro station construction site and alignment

Table 4-1: High-level contamination prioritisation – Westmead metro station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 1** Current Westmead Station – Residuals from historical and present railway usage.	Surface soils Heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, herbicides, asbestos	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Very low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 2** Mechanical workshop / services – Leaks and spills from underground petroleum storage infrastructure / automotive repair work	Surface soils Heavy metals, hydrocarbons (TRH, BTEX, PAH), asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) would be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
		Groundwater Hydrocarbons (TRH, BTEX, PAH), volatile organic compounds (VOC)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 3** Dumping of construction waste	Surface soils Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
Station (shallow excavation)	**AEI 4** Dumping of construction waste and demolition of former structures	Surface soils Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 5** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soils Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction site and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

4.3 Parramatta metro station construction site

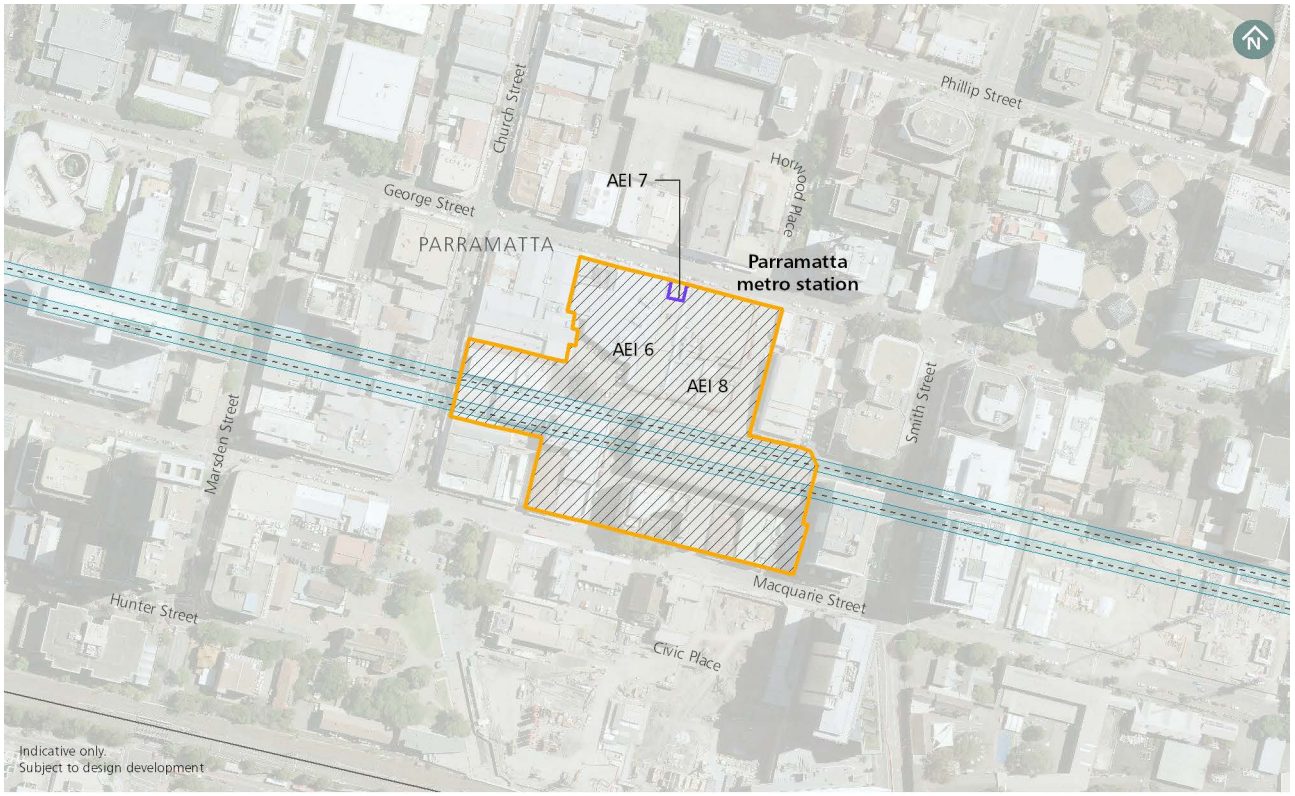

Figure 4-2: Potential contamination impact – Moderate and above – Parramatta metro station construction site and alignment

Table 4-2: High-level contamination prioritisation – Parramatta metro station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 6** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 7** Dry cleaners – Residuals from current dry cleaning activities. inappropriate disposal of solvents, depth distribution associated with potential underground tanks	Surface soil Chlorinated hydrocarbons, VOCs	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent (volatilisation of compounds)	SE1	Within construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Chlorinated hydrocarbons, VOCs	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater.	PR2	Moderate
		Vapour Chlorinated hydrocarbons, VOCs	Contamination possibly present at concentrations above the relevant assessment criteria and potentially widespread	SE3	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via vapour emissions. Adjacent site users could be exposed to contamination via vapour emissions (inh)	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 8** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust	PR3	Moderate
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI9** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

4.4 Clyde stabling and maintenance facility construction site and alignment

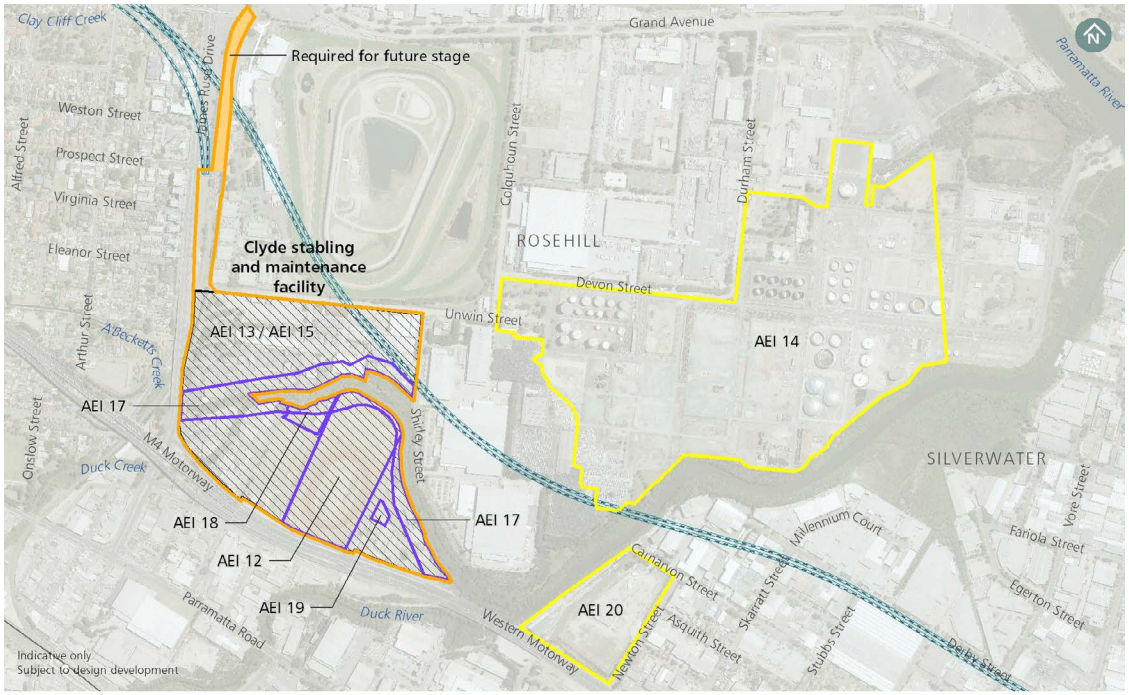

Figure 4-3: Potential contamination impact – Moderate and above– Clyde stabling and maintenance facility construction site and alignment

Table 4-3: High-level contamination prioritisation – Clyde stabling and maintenance facility construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 10** Historical industrial use (former James Hardie factory – 1 Grand Avenue, Camellia) – Known contamination in the fill material and groundwater at 1 Grand Avenue, Camellia.	Surface soil Asbestos, arsenic	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Approx. 500 metres north-east of alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Very low
		Groundwater Zinc, phenol, PAH	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres north-east of alignment	Contaminated groundwater from the source site unlikely to migrate towards alignment (groundwater flow direction likely to be towards Parramatta River)	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Rosehill dive and tunnel portal structures (depth)	**AEI 11** Rosehill Gardens racecourse – Equestrian related activities	Surface soil Pesticides, nutrients, disinfectants	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Very low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure)	**AEI 12** Sydney Speedway – Leaks and spills from vehicle maintenance and use	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (sediment) during construction	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure)	**AEI 13** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel and Rosehill services facility (depth)	**AEI 14** Historical industrial use (former Shell Clyde Refinery – Durham Street, Rosehill) – Known groundwater contamination and current EPL	Groundwater Light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH), lead, chromium and perfluorooctane sulfonate.	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 200 metres north-east of the construction footprint. Approx. 200 metres east of services facility shaft. Within tunnel alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint and alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 14 cont.	Vapor Hydrocarbons (TPH, BTEX)	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 200 metres north-east of the construction footprint and within alignment	Contamination (if present) could be exposed during tunnel excavation	Construction workers could be exposed to contamination via contact (inh) with vapours. Adjacent site users could be exposed to contamination via vapour emissions (inh).	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Rosehill services facility (surface and depth)	**AEI 15** Current and historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal (e.g. James Hardie asbestos disposal sites) and management etc and current EPL (Downer EDI Works)	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH) and asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust.	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 15 cont.	Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (sediment and water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Rosehill dive structure and tunnel portal (surface and depth) Rosehill services facility (surface and depth)	**AEI 16** Current commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure)	**AEI 17** Land reclamation – Historical use of potentially contaminated fill within former waterways	Surface soil and soils at depth Heavy metals, hydrocarbons (TRH, PAH), pesticides, PCB, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface and deeper materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos. Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (sediment) during construction	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Tunnel (depth)	**AEI 18** Rosehill Helipad (Wentworth Street, Rosehill) – Leaks and spills from petroleum storage infrastructure, maintenance and refuelling, PFAS from hydraulic fluids and current EPL	Surface soil Hydrocarbons (TRH, BTEX, PAH), VOC, PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (sediment) during construction.	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 18 cont.	Groundwater Hydrocarbons (TRH, BTEX, PAH), VOC, PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of A'Becketts and Duck Creeks, and Duck River could be exposed to contamination via uncontrolled releases (sediment and water) during construction Possible hydraulic separation for groundwater contamination between the tunnel and the	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
							source site by Duck River		
Clyde stabling and maintenance facility – civil construction works (land formation, services installation, drainage infrastructure) Tunnel (depth)	**AEI 19** Rapid Oil Distributors (Deniehy Street, Rosehill) – Leaks and spills from petroleum storage infrastructure	Surface soil Hydrocarbons (TRH, BTEX, PAH)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (sediment) during construction	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 19 cont.	Groundwater Hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of A'Becketts Creek, Duck Creek and Duck River could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 19 cont.						Possible hydraulic separation for groundwater contamination between the tunnel and the source site by Duck River.		

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth) – East of Duck River only	**AEI 20** Landfill (Carnavon Road, Silverwater) – PFAS containing waste materials	Groundwater PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 200 metres south-east of the construction footprint and 100 metres west of alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within alignment. Groundwater contamination from source site unlikely to migrate and be exposed during construction of stabling facility (hydraulic separation from the source site by Duck River)	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of Duck River could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

4.5 Silverwater services facility construction site and alignment

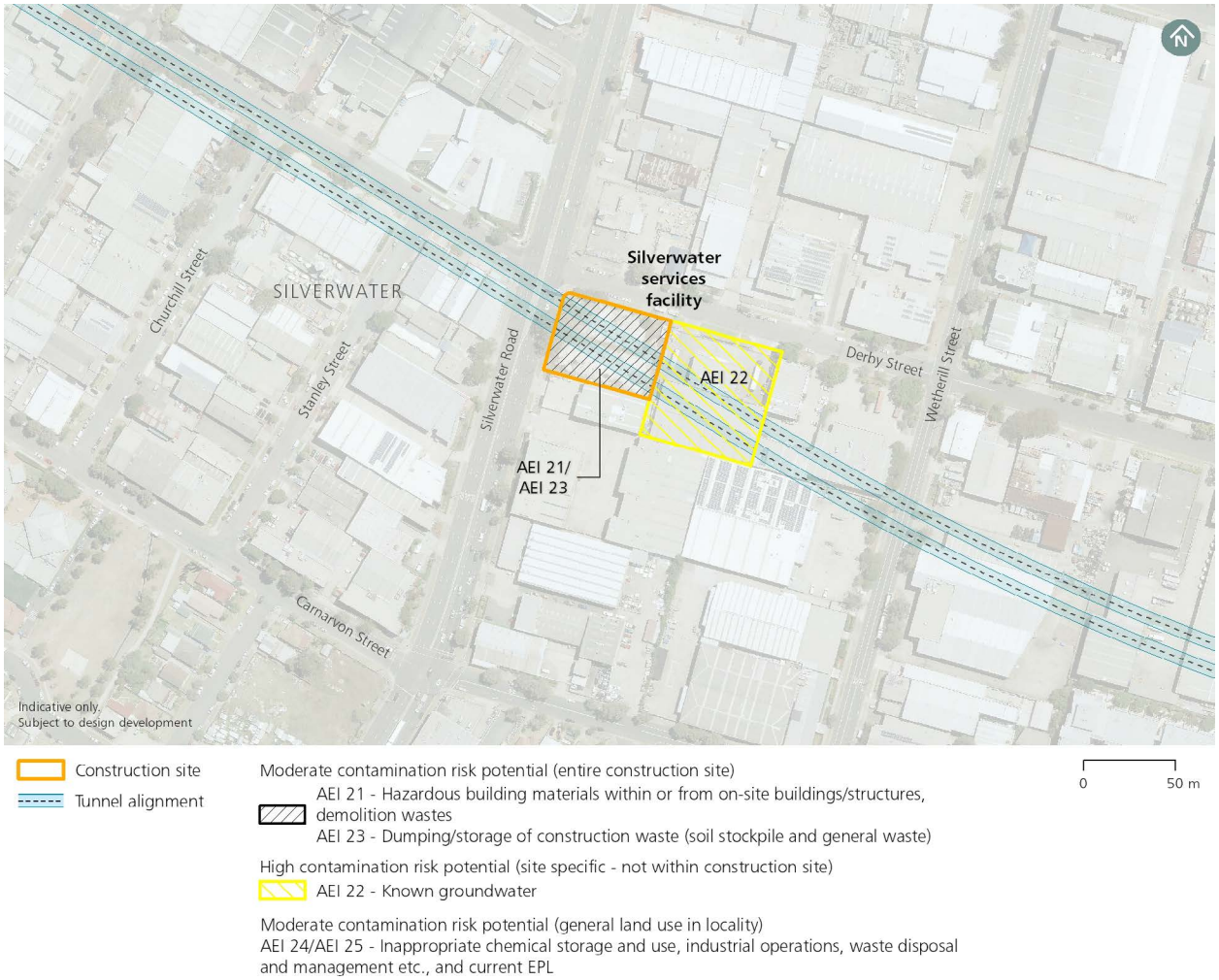

Figure 4-4: Potential contamination impact – Moderate and above – Silverwater services facility construction site and alignment

Table 4-4: High-level contamination prioritisation – Silverwater services facility construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Services facility (shallow excavation)	**AEI 21** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Services facility and tunnel (shallow and depth)	**AEI 22** Historical industrial use (former storage facility – 54-58 Derby Street, Silverwater) – Known groundwater contamination	Vapour Chlorinated hydrocarbons, VOCs	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction.	Construction workers could be exposed to contamination via vapour emissions (inh) Adjacent site users could be exposed to contamination via vapour emissions (inh)	PR2	Moderate
		Groundwater Chlorinated hydrocarbons, VOCs	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Within construction footprint and alignment	Contamination could be exposed during excavation of materials to the depth of construction.	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	High

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Services facility (shallow excavation)	**AEI 23** Dumping / storage of construction waste (soil stockpile and general wastes)	Surface soils Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
Services facility and tunnel (shallow and depth)	**AEI 24** Current commercial / industrial use within locality (construction machinery hire, mechanical workshops, offices, storage facilities,	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	service station warehouses, offices, plastic fabrications and metal works, concrete recycling, metal manufacturing) – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc and current EPL (Cleanaway Daniels NSW)	Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Services facility and tunnel (shallow and depth)	**AEI 25** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

4.6 Sydney Olympic Park metro station construction site and alignment

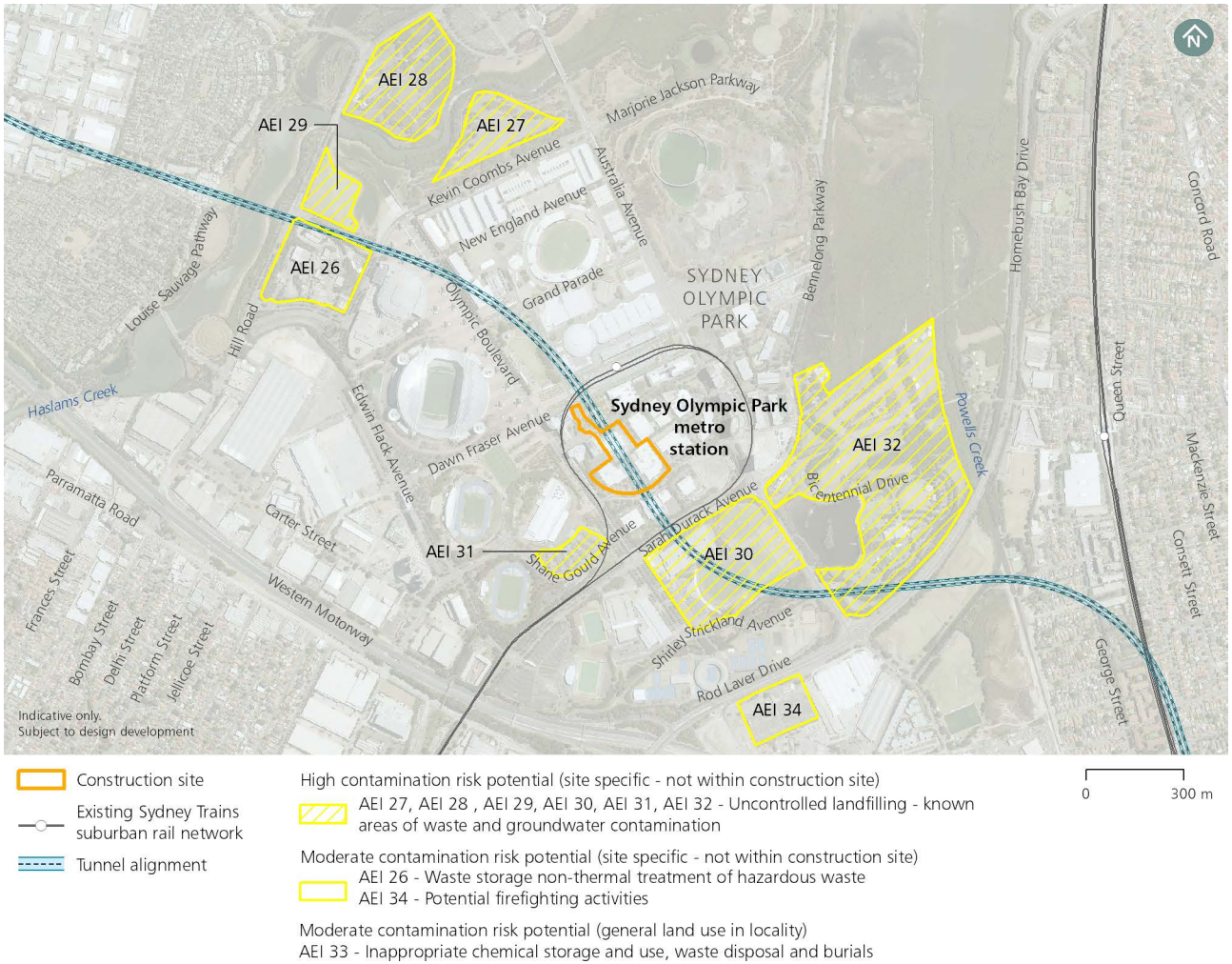

Figure 4-5: Potential contamination impact – Moderate and above – Sydney Olympic Park metro station construction site and alignment

Table 4-5: High-level contamination prioritisation – Sydney Olympic Park metro station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 26** Waste storage - hazardous, restricted solid, liquid, clinical and related waste and asbestos waste Non-thermal treatment of hazardous and other waste.	Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE2	Above the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Haslams Creek and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 27** Uncontrolled landfilling (former Haslams Creek South Area 3 Landfill – Kevin Coombes Drive, Sydney Olympic Park) – Known areas of waste and groundwater contamination	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres north of the alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low
		Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Approx. 500 metres north of the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Haslams Creek and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 27 cont.	Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres north of the alignment	Potential for landfill gas and vapour from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh) Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh)	PR2	Moderate
Tunnel (depth)	**AEI 28** Uncontrolled landfilling (former Kronos Hill Landfill – Kevin Coombes Drive, Sydney Olympic Park) – Known areas of waste and groundwater contamination	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres north of the alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 28 cont.	Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Approx. 500 metres north of the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of Haslams Creek and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High
		Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres north of the alignment	Potential for landfill gas and vapour from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh) Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh)	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 29** Uncontrolled landfilling (Corner Pondage Link and Hill Road, Sydney Olympic Park) – Known areas of waste and groundwater contamination	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Adjacent (north) of the alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low
		Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Adjacent (north) of the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Haslams Creek and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 29 cont.	Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Adjacent (north) of the alignment	Potential for landfill gas and vapour from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh). Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh).	PR2	Moderate
Station and tunnel (shallow and depth)	**AEI 30** Uncontrolled landfilling (former Golf Driving Range Landfill – Sarah Durack Avenue, Sydney Olympic Park) – Known areas of waste and groundwater contamination	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 400 metres south-east of construction footprint and above the alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 30 cont.	Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Approx. 400 metres south-east of construction footprint and above the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Lake Belvedere and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High
		Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 400 metres south-east of construction footprint and above the alignment	Potential for landfill gas and vapour from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh). Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh).	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 31** Uncontrolled landfilling (Aquatic Centre Landfill – Shane Gould Avenue, Sydney Olympic Park) – Known areas of waste and groundwater contamination	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 100 metres south west of construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low
		Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Approx. 100 metres south west of construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Lake Belvedere and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 31 cont.	Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 100 metres south west of construction footprint and alignment	Potential for landfill gas and vapour from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh). Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh).	PR2	Moderate
Station and tunnel (shallow and depth)	**AEI 32** Uncontrolled landfilling (Bicentennial Park Landfill – Bicentennial Drive, Sydney Olympic Park) – Known areas of waste	Waste Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 400 metres east of construction footprint and adjacent to alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 32 cont.	Groundwater Nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS.	Known contamination present at concentrations above the relevant assessment criteria and widespread	SE5	Approx. 400 metres east of construction footprint and adjacent to alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint or the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Lake Belvedere and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	High
		Vapour and landfill gas Methane, Hydrogen sulphide, carbon dioxide, VOC	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 400 metres east of construction footprint and adjacent to alignment	Potential for landfill gas and vapour from off-site source to be present at depth within construction footprint or the alignment	Construction workers could be exposed to contamination via landfill gas and vapour emissions (inh). Adjacent site users could be exposed to contamination via landfill gas and vapour emissions (inh).	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 33** Former abattoir – Inappropriate chemical storage and use, waste disposal and burials	Surface soil Pathogens, pesticides	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Nutrients, pathogens	Contamination possibly present at concentrations above the relevant assessment criteria and widespread.	SE3	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Lake Belvedere and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 34** Mason Park Substation – Potential firefighting activities	PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 400 metres metres south of the alignment	Potential for contaminated groundwater to be present within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater. Ecosystems of Lake Belvedere and receiving waters could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

4.7 North Strathfield metro station construction site and alignment

Figure 4-6: Potential contamination impact – Moderate and above – North Strathfield metro station construction site and alignment

Table 4-6: High-level contamination prioritisation – North Strathfield metro station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 35** Current North Strathfield Station – Residuals from historical and current railway use	Surface soils Heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, herbicides, asbestos	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Very low
Station and tunnel (depth)	**AEI 36** Funeral home – Embalming chemicals	Groundwater Hydrocarbons (TRH, BTEX), solvents (namely formaldehyde)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 37** Dry cleaners – Residuals from current dry cleaning activities	Surface soil Chlorinated hydrocarbons, VOCs	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Chlorinated hydrocarbons, VOCs	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
	AEI 37 cont.	Vapour Chlorinated hydrocarbons, VOCs	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via vapour emissions (inh) Adjacent site users could be exposed to contamination via vapour emissions (inh)	PR2	Moderate
Station (shallow excavation)	**AEI 38** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 39** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater.	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 40** Switch Yard (Underwood Road, North Strathfield) – Potential firefighting activities	Groundwater PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 500 metres west of construction site and the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint or the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

4.8 Burwood North Station construction site and alignment

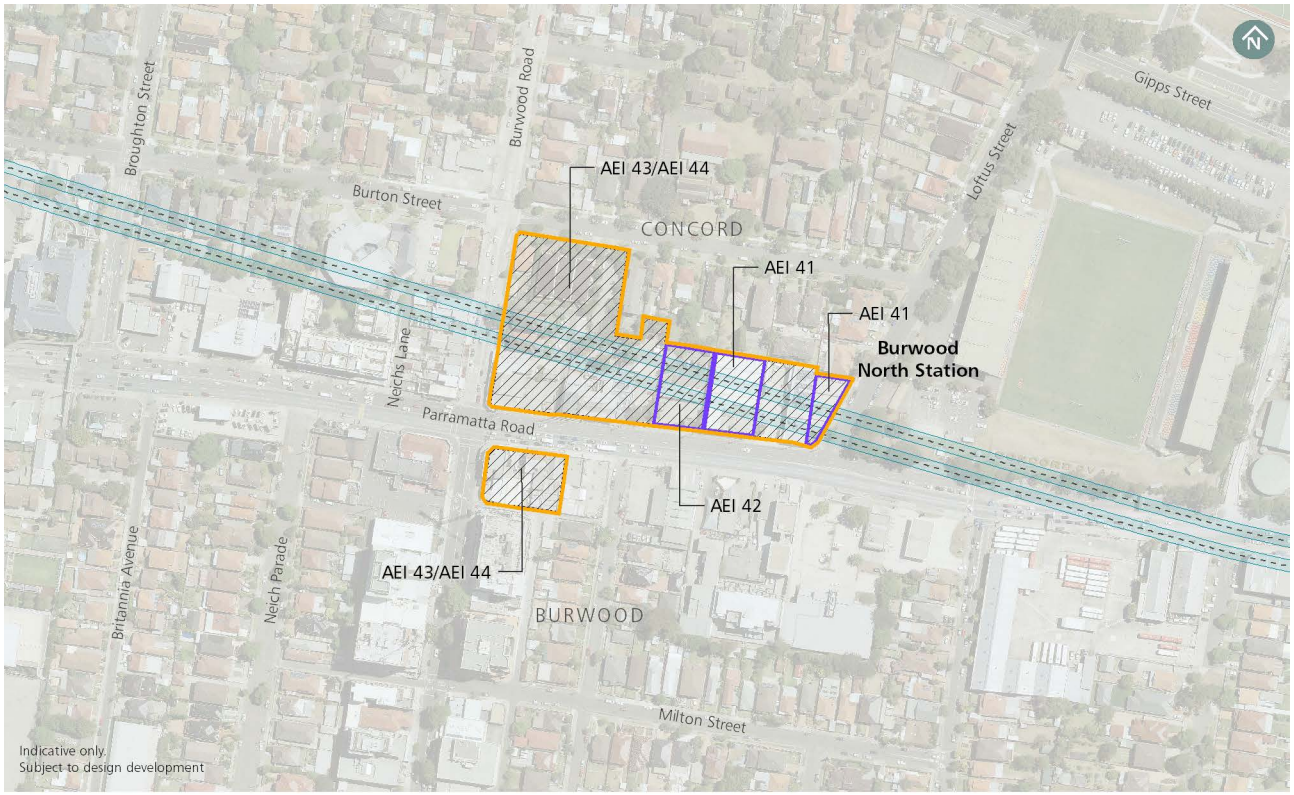

Figure 4-7: Potential contamination impact – Moderate and above – Burwood North Station construction site and alignment

Table 4-7: High-level contamination prioritisation – Burwood North Station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 41** Mechanical workshop – Leaks and spills from automotive facilities, car dealerships and bus depot	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH), asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
		Groundwater Hydrocarbons (TRH, BTEX, PAH), volatile organic compounds (VOC)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 42** Car wash and detailing – Chemical and wax use	Surface soil Solvents (VOC), surfactants, PFAS	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Solvents (VOC), surfactants, PFAS compounds (VOC)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater.	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 43** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
Station (shallow excavation)	**AEI 44** Parramatta Road – Vehicle particulate deposition	Surface soil Lead, PAHs, asbestos	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint	Surficial contamination (if present) could be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 45** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater.	PR2	Moderate

4.9 Five Dock Station construction site and alignment

Figure 4-8: Potential contamination impact – Moderate and above – Five Dock Station construction site and alignment

Table 4-8: High-level contamination prioritisation –Five Dock Station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (depth)	**AEI 46** Funeral home – Embalming chemicals	Groundwater Hydrocarbons (TRH, BTEX), solvents (namely formaldehyde)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Approx. 150 metres north and south of the construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate
Station (shallow excavation)	**AEI 47** Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station (shallow excavation)	**AEI 48** Chamber Substation – Operational sub-station	Surface soil PCB	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
Station and tunnel (depth)	**AEI 49** Former service station – Leaks and spills from underground petroleum storage infrastructure	Groundwater Hydrocarbons (TRH, BTEX)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 50** Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH)	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

4.10 The Bays Station construction site and alignment

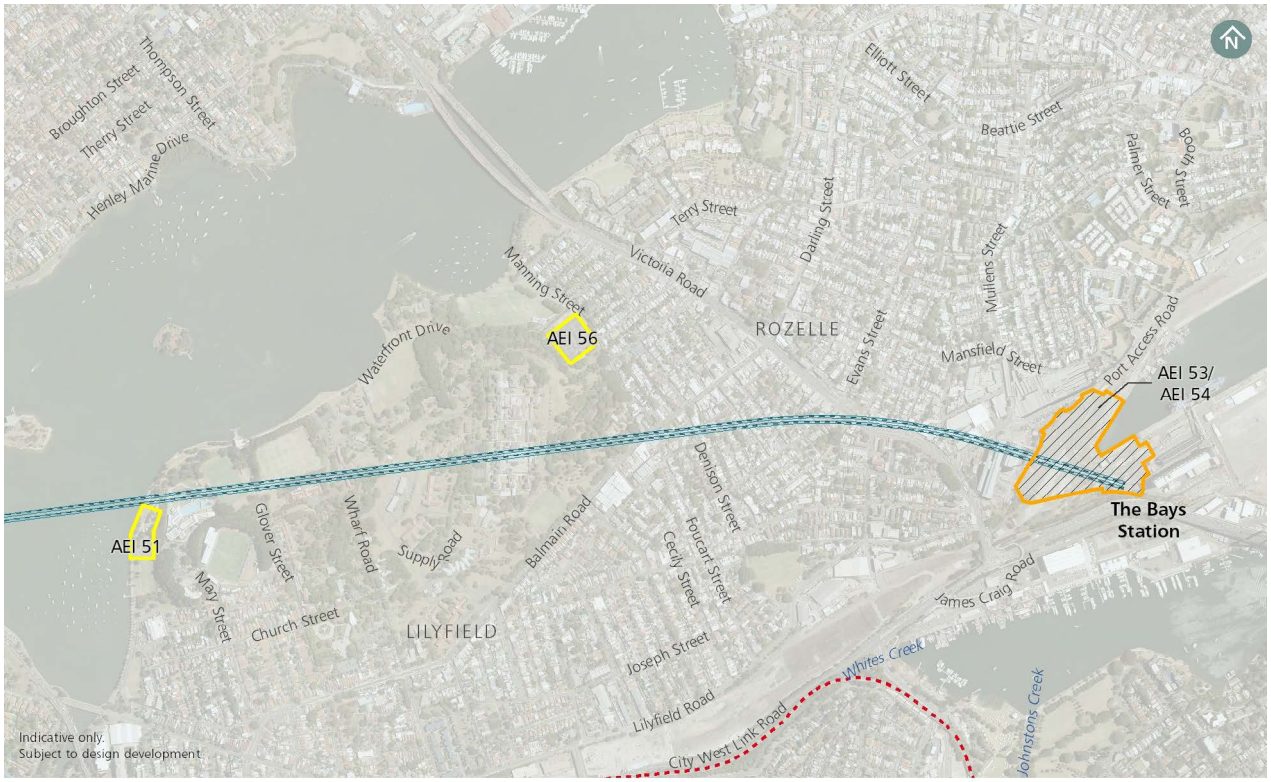

Figure 4-9: Potential contamination impact – Moderate and above – The Bays Station construction site and alignment

Table 4-9: High-level contamination prioritisation – The Bays Station construction site and alignment

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Tunnel (depth)	**AEI 51** Historical commercial / industrial use (including 469-483 Balmain Road, Lilyfield) – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), volatile organic compounds (VOC)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Above the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 52** Mechanical workshop – Leaks and spills from automotive facilities	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH), asbestos	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate from source site and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Hydrocarbons (TRH, BTEX, PAH), VOC	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within the alignment	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of White Bay could be exposed to contamination via uncontrolled releases (sediment and water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 53** Former White Bay Power Station activities (with substation) and structures (including potential firefighting activities)	Surface soil Heavy metals, hydrocarbons (TRH, PAH), PCB, asbestos, PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos.	PR3	Moderate
		Groundwater Heavy metals, hydrocarbons (TRH, PAH), PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of White Bay could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 54** Land reclamation – Historical use of potentially contaminated fill adjacent to waterways	Surface soil Heavy metals, hydrocarbons (TRH, PAH), pesticides, PCB, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
		Groundwater Heavy metals, hydrocarbons (TRH, PAH)	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Contamination (if present) could be exposed during excavation of materials to the depth of construction	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater Ecosystems of White Bay could be exposed to contamination via uncontrolled releases (water) during construction	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (shallow and depth)	**AEI 55** Historical commercial / industrial use – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc	Surface soil Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS	Low potential for contamination to be present at concentrations above the relevant assessment criteria and limited in extent	SE1	Adjacent to construction footprint and alignment	Surficial contamination from source site unlikely to migrate and be exposed during construction	Contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and environmental receptors	PR1	Very low
		Groundwater Heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Adjacent to construction footprint and alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Station and tunnel (depth)	**AEI 56** Switch Yard (Manning Street, Rozelle) – Potential firefighting activities	Groundwater PFAS	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Approx. 300 metres north of the alignment	Potential for contaminated groundwater migration from off-site source to be present at depth within construction footprint	Construction workers could be exposed to contamination via contact (der, ing) with contaminated groundwater	PR2	Moderate

5. Power supply routes

A number of power supply routes are proposed to be constructed as part of the project to supply power to TBM support sites. The power supply routes would generally be located within existing road reserves using open trench constructions and under bores when crossing major infrastructure. The power supply routes beyond the immediate vicinity of the Stage 1 construction sites are detailed in the following sections.

To assess the potential contamination impacts associated with the construction of the power supply routes, a broad assessment of current and historical land use (with respect to potential contamination) within and immediately adjacent to the power supply routes was undertaken. The findings of this assessment are provided in the following sections. In addition to this, all power supply routes would connect into existing sub-stations. Contamination associated with the use of these sites as sub-stations, including potential firefighting activities may be present.

5.1 Existing environment

5.1.1 Westmead metro station construction site

The majority of the Westmead power supply route follows Park Parade, with the eastern portion located adjacent to Pitt and Macquarie Streets and the West Parramatta zone substation (refer to Figure 5-1). The majority of the land use (possibly less than 100 years) surrounding the power supply route is likely to have been utilised for agricultural and recreational open space (Parramatta Park and the former Parramatta Golf Club) with residential present within the western portion (Westmead) and residential / commercial present within the eastern portion (Parramatta). The power supply route adjacent to Park Parade is located adjacent to the T1 North Shore and Western Line. Significant industrial land use is unlikely to have occurred in the near vicinity of the power supply route. Park Parade is likely to have been a formalised road for the last 50 years and significant filling beneath the road is unlikely to have occurred. Based on a review of GoogleEarth, the T1 North Shore and Western Line in some locations is raised above Park Parade probably to facilitate the drainage of Domain Creek. It is possible that fill material has been used to raise the rail line at some locations. The open space area to the north and south of Park Parade may have been subject to some filling in the past, potentially associated with reclamation and/or flood mitigation, especially in the vicinity of waterways (i.e. Domain Creek and Parramatta River). Filling in the vicinity of the power supply route may potentially contain material of unknown quality and/or construction wastes.

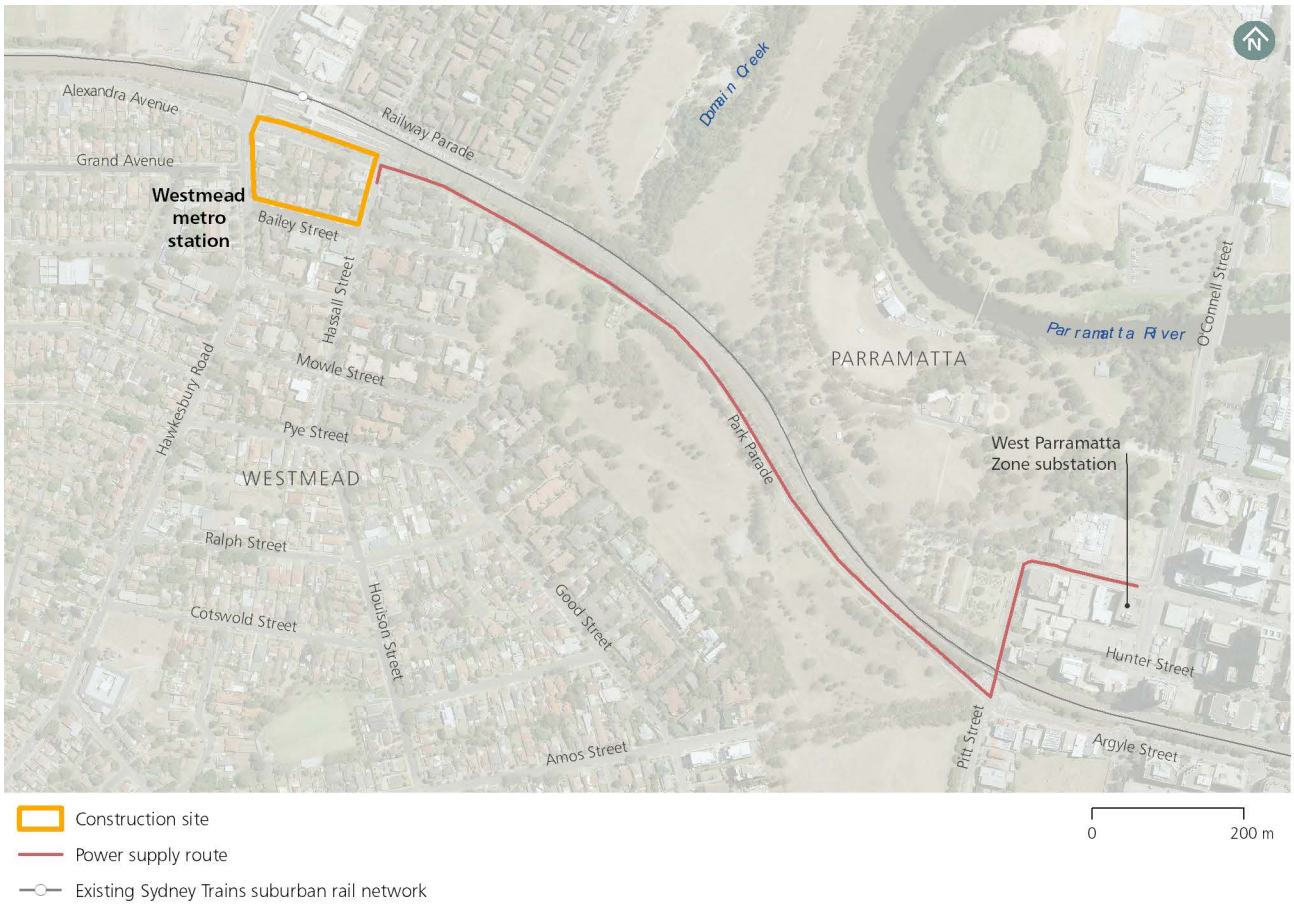

Figure 5-1: Westmead metro station construction site –power supply route

5.1.2 Parramatta metro station construction site

The majority of the power supply route follows George, O'Connell and Macquarie Streets (refer to Figure 5-2). The majority of the land use (possibly less than 100 years) surrounding the power supply route is likely to have been utilised for residential and commercial uses. Significant industrial land use is unlikely to have occurred in the near vicinity of the power supply route. George, O'Connell and Macquarie Streets are likely to have been formalised roads for the last 50 years and significant filling beneath these roadways is unlikely to have occurred.

Figure 5-2: Parramatta metro station construction site – power supply route

5.1.3 Clyde stabling and maintenance facility construction site

The power supply route follows Unwin Street (refer to Figure 5-3). The majority of the land use (possibly less than 100 years) surrounding the power supply route is likely to have been utilised for industrial purposes. It is possible that industrial wastes (potential asbestos wastes) may have been used in the construction of the roadways and as fill within the local area. Any construction activities for the power supply route which extends into groundwater could expose contamination known to be present in this general locality. It is anticipated that the groundwater inflow to excavations for power supply route would generally be relatively minor (if at all). Minor short-term dewatering may potentially be required for the construction of the power supply route.

Figure 5-3: Clyde stabling and maintenance facility construction site – power supply route

5.1.4 The Bays metro station construction site

The majority of the power supply route follows Robert, Mullens, Mansfield, Cross, Merton, Darling, Waterloo, Moodie, Mccleer, Callan and Manning Streets (refer to Figure 5-4). The majority of the land use (possibly less than 100 years) surrounding the power supply route is likely to have been utilised for residential, commercial and industrial uses. Industrial activities are likely to be concentrated within the eastern end of the power supply route. It is possible that wastes associated with historical industry within the general locality or from harbourside industry (potential coal/coke wastes, ash and slag) may have been used in the construction of the roadways and as fill within the local area.

Figure 5-4: The Bays metro station construction site – power supply route

5.2 Areas of environmental interest – Power supply routes

Based on an understanding of land use within the vicinity of the power supply routes, a number of known and potential contamination sources (AEIs) have been identified within and/or adjacent to the power supply routes (including sub-station connections). To understand the potential interaction of construction activities with potential contamination and to assess the potential impact of contamination on construction during Stage 1, the power supply routes have been categorised into five categories of potential contamination impact (very low, low, moderate, high and very high) based on the risk prioritisation methodology in Section 2.4. The results of this exercise are provided in Table 5-1.

A number of the power supply routes and all sub-station connections have been identified as having moderate potential for contamination to impact upon construction. Additional information would need to be obtained and reviewed (such as site-specific data) in order to determine the most appropriate site-specific responses or controls, which may include remediation (refer to Section 7). Power supply routes and all sub-station connections with moderate potential for contamination to impact upon construction are:

- Westmead metro station construction site: Power supply route: Soils above the power supply route have been assigned a **moderate potential contamination impact** associated with the potential for filling (material of unknown quality, construction wastes) within the railway corridor and reclamation of areas adjacent to waterways.
- Clyde stabling and maintenance facility construction site: Power supply route - Soils above the power supply route have been assigned a **moderate potential contamination impact** associated with the potential for industrial wastes (potential asbestos wastes) to have been used in the construction of the roadways and as fill in the general locality. Any construction activities for the power supply route which extend into groundwater could expose contamination known to be present in this general locality

- The Bays metro station construction site: Power supply route - Soils above the power supply route have been assigned a **moderate potential contamination impact** associated with the potential for wastes associated with historical industry within the general locality or from harbourside industry (potential coal/coke wastes, ash and slag) to have been used in the construction of the roadways and as fill in the general locality
- All PSR sub-station connections – Soils within sub-stations have been assigned a **moderate potential contamination impact** associated with the use of these sites as sub-stations including potential firefighting activities.

Table 5-1: High-level contamination prioritisation – Power supply routes

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Westmead metro station construction site: Power supply route (shallow excavation)	Railway line and areas adjacent to waterways – Filling (material of unknown quality, construction wastes).	Surface soils Heavy metals, hydrocarbons (TRH, PAH), pesticides, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within PSR	Contamination (if present) would be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Clyde stabling and maintenance facility construction site: Power supply route (shallow excavation)	Industrial wastes (potential asbestos wastes) may have been used in the construction of the roadways and as fill in the general locality	Surface soils Heavy metals, hydrocarbons (TRH, PAH), asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within PSR	Contamination (if present) would be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate
	Historical industrial use (former Shell Clyde Refinery – Durham Street, Rosehill) – Known groundwater contamination	Groundwater Zinc, phenol, PAH	Contamination possibly present at concentrations above the relevant assessment criteria and widespread	SE3	Within PSR	Contamination (if present) unlikely to be exposed during excavation of surface materials at significant volumes	Significant contamination unlikely to be exposed during construction and therefore unlikely to impact upon human and ecological receptors	PR1	Low

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
The Bays metro station construction site: Power supply route (shallow excavation)	Wastes associated with historical industry within the general locality or from harbourside industry (potential coal/coke wastes, ash and slag) to have been used in the construction of the roadways and as fill in the general locality	Surface soils Heavy metals, hydrocarbons (TRH, PAH), PCB, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

Construction element and anticipated depth	Site of concern and potential source of contamination	Contamination severity and extent assessment			Pathways and receptors Assessment of relationship to construction footprint and scope				Potential contamination impact
		Media and COPCs	Contamination status	Refer to Table 2-1	Location relative to Stage 1	Potential for contamination to be intersected by Stage 1	Exposure pathways (der – direct contact, ing – ingestion or inh – inhalation)	Refer to Table 2-1	
Sub-stations connections: All power supply routes (shallow excavation)	Sub-station including potential firefighting activities	Heavy metals, hydrocarbons (TRH, PAH), PCB, PFAS, asbestos	Contamination possibly present at concentrations above the relevant assessment criteria and limited in extent	SE2	Within construction footprint and alignment	Surficial contamination (if present) will be exposed during excavation of surface materials	Construction workers could be exposed to contamination via contact (der, ing, inh) with contaminated soils and dust. Adjacent site users could be exposed to contamination via dust emissions (inh), namely asbestos	PR3	Moderate

6. Assessment of impacts

The following information details potential impacts to Stage 1 from contamination identified as part of this investigation.

6.1 Contamination – soil

Based on the information reviewed, a number of sites have a moderate to high potential contamination impact. If contamination risks are not quantified at these sites and appropriately managed, construction activities may expose workers, the public and environmental receptors to contaminated soil. Potential impacts as a result of disturbance of contaminated soil without appropriate management and/or remediation may include:

- Contaminant exposure risk to construction personnel and the general public
- Contaminant exposure to environmental receptors
- Cross contamination associated with the incorrect handling or disposal of spoil/unexpected finds
- Contamination of previously clean areas.

All potential soil contamination identified can be managed subject to the implementation of appropriate management measures and/or remediation.

Higher risks and increased management and/or remediation effort during construction could be associated where materials contain dispersible fibres (i.e. asbestos), could generate vapours (hydrocarbons and VOC) or contain concentrations of contaminants which categorise material at a higher waste classifications (i.e. restricted or hazardous waste). The appropriate management measures and/or remediation can only be determined based on the results of additional information reviews and investigations, which would be completed prior to the commencement of construction.

Contaminated and potentially contaminated soils which may be exposed during construction activities at construction sites include:

- Westmead metro station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, VOC and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- Parramatta metro station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, VOC and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- Clyde stabling and maintenance facility construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, VOC and asbestos. Deeper soils adjacent to waterways maybe impacted by heavy metals, hydrocarbons (TRH, PAH), pesticides, PCBs and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the services facility shaft and the dive structure,

areas where vegetation is to be removed and (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.

- Silverwater services facility construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, VOC and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the access shaft and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- Sydney Olympic Park metro station construction site – Landfilled wastes may contain levels of metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils and potentially waste materials is unlikely to occur across other areas of the construction site. However, disturbance of surface soils and waste materials associated with site preparation and general construction activities could increase the potential for impact.
- North Strathfield metro station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, herbicides and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- Burwood North Station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides, VOC and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and access shaft and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- Five Dock Station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), pesticides and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and access shaft and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site. However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.
- The Bays Station construction site – Surface soils across the construction footprint maybe impacted by heavy metals, hydrocarbons (TRH, PAH), pesticides, PCB, VOC and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated surface soils to facilitate the construction of the station box and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction). Significant excavation of existing surface soils is unlikely to occur across other areas of the construction site.

However, disturbance of surface soils associated with site preparation and general construction activities could increase the potential for impact.

- Surface soils along power supply routes – Surface soils along power supply routes for Westmead metro station construction site, Clyde stabling and maintenance facility construction site, The Bays Station construction site and associated sub-station connections maybe impacted by heavy metals, hydrocarbons (TRH, PAH), pesticides, PCB, PFAS and asbestos. Increased potential for impact is likely to be associated with the removal of potentially contaminated soils to facilitate the construction of the power supply route and the handling/management of materials within spoil storage areas (i.e. where potentially contaminated materials need to be disturbed and handled during construction).

6.2 Contamination – groundwater

Contaminated groundwater may be encountered during the construction activities, namely during excavation dewatering and tunnelling in the vicinity of sites with contamination potential. If groundwater contamination is not assessed and appropriately managed, construction activities may expose workers, the public and environmental receptors to contaminated groundwater via direct contact or discharge to surface waters. Potential impacts as a result of contact with or discharge of contaminated groundwater may include:

- Contaminant exposure risk to project personnel and the general public
- Contaminant exposure to environmental receptors
- Degradation of aquatic ecosystems.

All potential groundwater identified can be managed subject to the implementation of appropriate management measures and/or remediation.

Higher risks and increased management and/or remediation effort are likely to be associated with groundwater contamination where the source is not located on the construction site (i.e. construction will not remove all and/or part of the contamination source). The appropriate management measures and/or remediation can only be determined based on results of intrusive investigations which would be completed prior to the commencement of construction.

Based on the information reviewed, groundwater contamination could be present beneath the following construction sites and alignment:

- Westmead metro station construction site – Groundwater may be impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH) and VOC. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the station box
- Parramatta metro station construction site – Groundwater may be impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH) and VOC. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the station box
- Clyde stabling and maintenance facility construction site – Groundwater is known to be impacted by heavy metals (including chromium), phenol, light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH) and PFAS compounds (specifically perfluoroctane sulfonate). Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the services facility shaft and dive structure
- Silverwater services facility construction site – Groundwater is known to be impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH) and VOC. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater and management of dewatering during the construction of the station box. Increased potential for impact is likely to be associated with the ingress of contaminated

groundwater into excavation voids and management of dewatering during the construction of the access shaft

- Sydney Olympic Park metro station construction site – Groundwater may be impacted by nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC, PFAS and pathogens. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the station box
- Burwood North Station construction site – Groundwater may be impacted heavy metals, hydrocarbons (TRH, BTEX, PAH) and VOC. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the station box and access shaft
- The Bays Station construction site – Groundwater may be impacted by heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC and PFAS. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the station box
- Tunnel – Groundwater in the vicinity of the tunnel within the suburbs of Clyde, Silverwater, Sydney Olympic Park, North Strathfield and Rozelle may be impacted by PFAS. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the tunnel
- Tunnel – Groundwater in the vicinity of the tunnel within the suburb of Clyde may be impacted by heavy metals (including chromium), phenol, light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH). Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the tunnel
- Tunnel – Groundwater in the vicinity of the tunnel within the Sydney Olympic Park may be impacted by nutrients, heavy metals, hydrocarbons (TRH, BTEX, PAH), VOC and pathogens. Increased potential for impact is likely to be associated with the ingress of contaminated groundwater into excavation voids and management of dewatering during the construction of the tunnel.
- Power supply routes – Groundwater in the vicinity of the Clyde stabling and maintenance facility construction site power supply route may be impacted by heavy metals (including chromium), phenol, light non-aqueous phase liquid, hydrocarbons (TPH, BTEX, PAH) and PFAS compounds (specifically perfluoroctane sulfonate). Increased potential for impact is likely to be associated with the ingress of significant volumes of contaminated groundwater into excavation voids and management of dewatering during the construction of the power supply route in this location.

6.3 Contamination – vapour and gas

Vapours are generally partitioned from volatile compounds present within soil and groundwater. The generation of vapours can be influenced by sub-surface conditions and the presence of below ground and on surface structures. If present within and/or adjacent to the construction footprint and alignment, vapours could accumulate within below ground excavations and enclosed structures associated with Stage 1 at concentrations which could represent an explosion or acute/chronic health risk.

Landfill gas can be generated during the degradation/breakdown of total organic carbon present within organic compounds present in buried wastes. If present within and/or adjacent to the construction footprint and alignment, landfill gas could accumulate within below ground excavations and enclosed structures associated with Stage 1 at concentrations which could represent an asphyxiation or explosion risk.

Potential vapour and landfill gas sources were identified at the following construction sites:

- Parramatta metro station – vapour from solvent use could contain VOC. Increased potential for impact is likely to be associated with the ingress and accumulation of vapour into excavation voids during the construction of the station box, tunnel and associated below ground services

- Clyde stabling and maintenance facility – vapour from solvent use could contain VOC. Increased potential for impact is likely to be associated with the ingress and accumulation of vapour into excavation voids during the construction of the services facility shaft, dive structure, tunnel and associated below ground services
- Silverwater services facility – vapour from solvent use could contain VOC. Increased potential for impact is likely to be associated with the ingress and accumulation of vapour into excavation voids during the construction of the access shaft, tunnel and associated below ground services
- Sydney Olympic Park metro station – landfill gas from the biological breakdown of organic wastes could contain methane and hydrogen sulphide and wastes could contain VOC. Increased potential for impact is likely to be associated with the ingress and accumulation of vapour into excavation voids during the construction of the station box, tunnel and associated below ground services.

6.4 Cumulative impacts

Potential cumulative impacts were considered for assessment based on the likely interactions of Stage 1 with other projects. The approach to assessment and the other projects considered are described further in Appendix G (Cumulative impacts assessment methodology).

Potential cumulative impacts from contamination have been assessed in consideration of the interaction of multiple projects (including construction of Stage 1) that would increase, decrease and/or alter potential contamination impacts to common human and/or environmental receptors.

Cumulative impacts would be dependent on a variety of factors including the presence of contamination and the type of potentially affected media (eg soil, groundwater), the nature and timing of construction disturbance (associated with Stage 1 and other projects), as well as complete exposure pathways for contamination to human and/or environmental receptors.

Contamination impacts from individual projects, prior to appropriate typical mitigation measures being implemented could include (but are not limited) to the following:

- Excavation activities and liberation of contamination (as dust or fibres) which could deposit on adjacent land and be transported by surface water flows to surrounding areas
- Dewatering activities and discharge of contaminated water to adjacent land and waterways
- Odours/vapours detectable at site boundaries
- Accumulation of gas within below ground structures and low lying land form features on adjacent land.

It should be noted that contamination is reported as a concentration (e.g. mg/kg, µg/L, g/m^3) and not as mass. As such, the measurement of contamination from multiple sources at a receptor is not compounded, rather it would be reported as an average concentration. If contamination is not migrating from source sites at concentrations above criteria protective of receptors, then the cumulative contamination from the source sites is unlikely to impact upon that receptor.

Management of contamination associated with the construction of Stage 1 and construction and operation of other projects would need to be undertaken in accordance with the following legislation (where triggered):

- *Contaminated Land Management Act 1997* (CLM Act) – Sites containing existing contamination and sites that have been contaminated by future operations where the contamination is deemed significant enough to warrant regulation by the regulator (NSW EPA)
- *Protection of the Environment Operations Act 1997* (POEO Act) – Establishes the NSW environmental regulatory framework and includes a licensing requirement for certain activities to control the localised, cumulative and acute impacts of pollution in NSW.

In consideration of the construction of Stage 1, with the exception of the use and storage of chemicals associated with construction activities (e.g. fuels and oils associated with the operation of plant and equipment), the construction activities associated with Stage 1 are unlikely to represent a significant source of contamination. Management measures associated with the use and storage of chemicals during construction activities would be detailed in the respective construction environmental management plans and implemented by the contractor.

With respect to existing contamination (known and potential), the construction of Stage 1 is likely to reduce the overall contamination loading currently existing within project construction sites and the alignment associated with the removal of contaminated materials to facilitate construction (e.g. excavation of contaminated soils to facilitate station construction and removal of contaminated groundwater during dewatering activities).

It is envisaged that contamination sources associated with the construction and operation of other projects would also be managed in accordance with appropriate construction environmental management plans (including appropriate licensing requirements to meet legislative obligations under the POEO Act, where applicable). Any new projects to be undertaken within the vicinity of Stage 1 would need to undertake contamination investigations to assess the suitability of the site/s for the proposed land use. Where contamination is identified, it would need to be remediated to remove or suitably reduce the exposure to human and/or environmental receptors in accordance with the legislative requirements of the CLM Act. Both the management of contamination sources during construction and operation of these projects and remediation works to render the project sites suitable for use is unlikely to increase potential cumulative impacts from contamination exposure to common receptors (i.e. unlikely that cumulative impacts would arise).

6.5 Summary of potential construction impacts

A summary of the potential construction impacts at the respective construction sites are detailed in Table 6-1.

Table 6-1: Summary of potential construction impacts

Construction site	Potential contamination impacts to construction		
	Soil	Groundwater	Vapour / gas
Westmead metro station	X	X	
Parramatta metro station	X	X	X
Clyde stabling and maintenance facility	X	X	X
Silverwater services facility	X	X	X
Sydney Olympic Park metro station		X	X
North Strathfield metro station	X		
Burwood North Station	X	X	
Five Dock Station	X		
The Bays Station	X	X	
Westmead metro station construction site – power supply route	X		
Clyde stabling and maintenance facility construction site - power supply route	X	X	
The Bays metro station construction site - power supply route	X		
Sub-stations connections (all power supply routes)	X		

7. Mitigation and management

Based on the assessed level of potential contamination impact to construction detailed in Section 4 and the contamination potential associated with the construction of the PSR (detailed in Section 5.3), a range of mitigation and management measures have been developed in order to manage potential contamination during construction (refer to Table 7-1). These have been termed mitigation measures C1 to C5.

Construction at all sites would be managed in accordance with the Soil and Water management plan, as required in the Construction Environmental Management Framework (refer to Appendix D). This plan includes the implementation of an unexpected finds procedure. For construction sites that have been assessed to have a low contamination impact potential, the application of the Construction Environmental Management Framework, associated plans and standard mitigation measures would be sufficient to manage any residual risks.

For sites that have been assessed to have a moderate to very high contamination impact potential, additional measures would be implemented (refer to Table 7-1). These additional mitigation and management measures would be dependent on the outcomes from further investigations, noting:

- Remedial Action Plans would typically be prepared for construction sites where there is more significant, widespread contamination that requires detailed remedial planning, followed by implementation of standard construction practices such as excavation and off-site disposal or capping and containment
- Involvement of an accredited Site Auditor, and issue of a Site Audit Statement (SAS) and Site Audit Report (SAR) would occur where contamination is highly complex, such as significant groundwater contamination; contamination associated with vapour; contamination that requires specialised remediation techniques; or contamination that requires ongoing active management during and beyond construction.

Table 7-1: Summary of mitigation and management measures for potential construction impacts

Ref	Mitigation measure	Application location(s)[1]
C1	For sites where contamination impact potential is moderate, high or very high, a further review of data would be performed. Where the additional data review provides sufficient information that contamination is likely to have a very low or low impact potential, the site would then be managed in accordance with the Soil and Water Management Plan. This would typically occur where there is minor, isolated contamination that can be readily remediated through standard construction practices such as excavation and off-site disposal.	WMS, PMS, CSMF, SSF, SOPMS, NSMS, BNS, FDS, TBS, PSR
C2	Where data from the additional data review (mitigation measure C1) is insufficient to understand the potential impact of contamination, a Detailed Site Investigation would be carried out in accordance with the NEPM (2013) and other guidelines made or endorsed by the NSW EPA. The sites requiring Detailed Site Investigation would be confirmed following the additional data review (mitigation measure C1), however on the basis of the Stage 1 assessment, it is anticipated that Detailed Site Investigation would be required at the application locations.	Dependant on the outcomes of C1, locations may include CSMF, SSF, SOPMS, TBS, and as applicable

Ref	Mitigation measure	Application location(s)[1]
C3	Where data from additional data review (mitigation measure C1) or the Detailed Site Investigation (mitigation measure C2) confirms that contamination would have a moderate to very high risk, a Remedial Action Plan would be developed for the area of the construction footprint. Each RAP would detail the remediation works required to mitigate risks from contamination throughout and following completion of construction. The Remedial Action Plan would be prepared in accordance with relevant NSW EPA guidelines and where applicable, detail remediation methodologies in accordance with Australian Standards and other relevant government guidelines and codes of practice. Remediation would be performed as an integrated component of construction and to a standard commensurate with the proposed end use of the land. The sites requiring Remedial Action Plans and remediation would be confirmed following the additional data review (mitigation measure C1) and Detailed Site Investigation (mitigation measure C2), however on the basis of the Stage 1 assessment, it is anticipated that Remedial Action Plans and remediation could be required at the specified application locations.	Dependant on the outcomes of mitigation measures C1 and C2, locations may include CSMF, SSF, SOPMS, TBS, and as applicable
C4	Where contamination is highly complex, such as where there is significant groundwater contamination; contamination associated with vapour; contamination that requires specialised remediation techniques; or contamination that requires ongoing active management during and beyond construction, an accredited Site Auditor would review and approve the Remedial Action Plan and remediation activities and will develop a Site Audit Statement and Site Audit Report upon completion of remediation. The sites requiring Site Audit Statements would be confirmed following the completion of the Remedial Action Plans (mitigation measure C3), however on the basis of the Stage 1 assessment, it is anticipated that site auditing would be required at the specified application locations.	Dependant on the outcomes of mitigation measures C1, C2 and C3, locations may include CSMF, SSF, SOPMS, TBS, and as applicable
C5	Ongoing management and monitoring measures would be documented in an appropriate form and implemented for any areas where minor, residual contamination remains following construction.	As applicable

[1] WMS: Westmead metro station; PMS: Parramatta metro station; CSMF: Clyde stabling and maintenance facility; SSF: Silverwater services facility; SOPMS: Sydney Olympic Park metro station; NSMS: North Strathfield metro station; BNS: Burwood North Station; FDS: Five Dock Station; TBS: The Bays Station; Metro rail tunnels: Metro rail tunnels not related to other sites (eg tunnel boring machine works); PSR: Power supply routes.

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