Transport for NSW

Chapter 18
Soils and contamination

NSW GOVERNMENT

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18. Soils and contamination

This chapter provides the soils and contamination assessment for the project. It describes the existing soils environment, including potential areas of contamination, assesses the potential impacts during construction and operation, and provides measures to mitigate and manage the impacts identified.

18.1 Approach

Construction work can expose contaminated soils and groundwater in areas where there are naturally occurring high risk soils or on lands subject to previously contaminating activities or land uses. Exposing contaminated soils and/or groundwater can mobilise contaminants, potentially leading to environmental, health and safety risks. The disturbance of soil, if improperly managed, can lead to soil erosion, increase soil salinity levels, and/or cause oxidation/acid generation, all of which could affect receiving environments.

It is important that such risks are identified and planned for during project development so that they can be avoided, minimised and effectively managed through appropriate design and construction planning.

A soils and contamination assessment has been carried out in general accordance with the framework for the assessment of site contamination outlined in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended on 16 May 2013 (the NEPM). The soils and contamination assessment has also been undertaken in accordance with:

- the SEARs (see Appendix A (SEARs compliance table))
- applicable legislation and planning instruments (including the Contaminated Land Management Act 1997 (NSW) (the CLM Act), the POEO Act, and State Environmental Planning Policy (Resilience and Hazards) 2021
- other relevant policies and guidelines, including guidelines for consultants reporting on contaminated sites, guidelines for assessing and managing groundwater contamination, and guidelines on the duty to report contamination under the CLM Act.

An overview of the approach to the assessment is provided below.

18.1.1 Study area

The study area for the soils and contamination assessment is the project site, as described in Chapter 2 (Location and setting). Desktop searches for the contamination assessment also extended a further one kilometre around the project site.

18.1.2 Key tasks

The assessment was based on a previous desktop assessment and site investigations (undertaken by Nation Partners in 2018 and Coffey Services Australia Pty Ltd ('Coffey') in 2019, respectively). Tasks included:

- identifying sites and areas of known and potential contamination in the study area, including reviewing the following NSW EPA databases:
  - register of contaminated sites and list of notified sites under sections 58 and 60 of the CLM Act
  - environment protection licence records under section 308 of the POEO Act
- reviewing publicly available data and web-based information searches, background information relevant to the study area, survey data and topography, including historical aerial photographs, geological maps, soil landscape maps, acid sulfate soil risk mapping, and hydrogeological landscape mapping
- reviewing previous contamination assessments applicable to the project site
- undertaking a preliminary site investigation, including:
  - obtaining soil samples from 32 land based geotechnical boreholes
  - obtaining sediment samples from four over water geotechnical boreholes (BH07, BH08, BH38 and BH46) located between Camellia and Lidcombe
  - conversion of seven boreholes to groundwater monitoring wells and groundwater gauging, purging and sampling from these seven wells
  - analysis of soil, sediment and groundwater samples for contaminants of potential concern
  - comparing the analytical results to health and environmental screening criteria
- identifying the potential to disturb acid sulfate soils and areas of salinity
- assessing potential construction and operation impacts that may result from contaminated land or groundwater, and the potential impacts on soils
- identifying measures to reduce or minimise identified impacts.

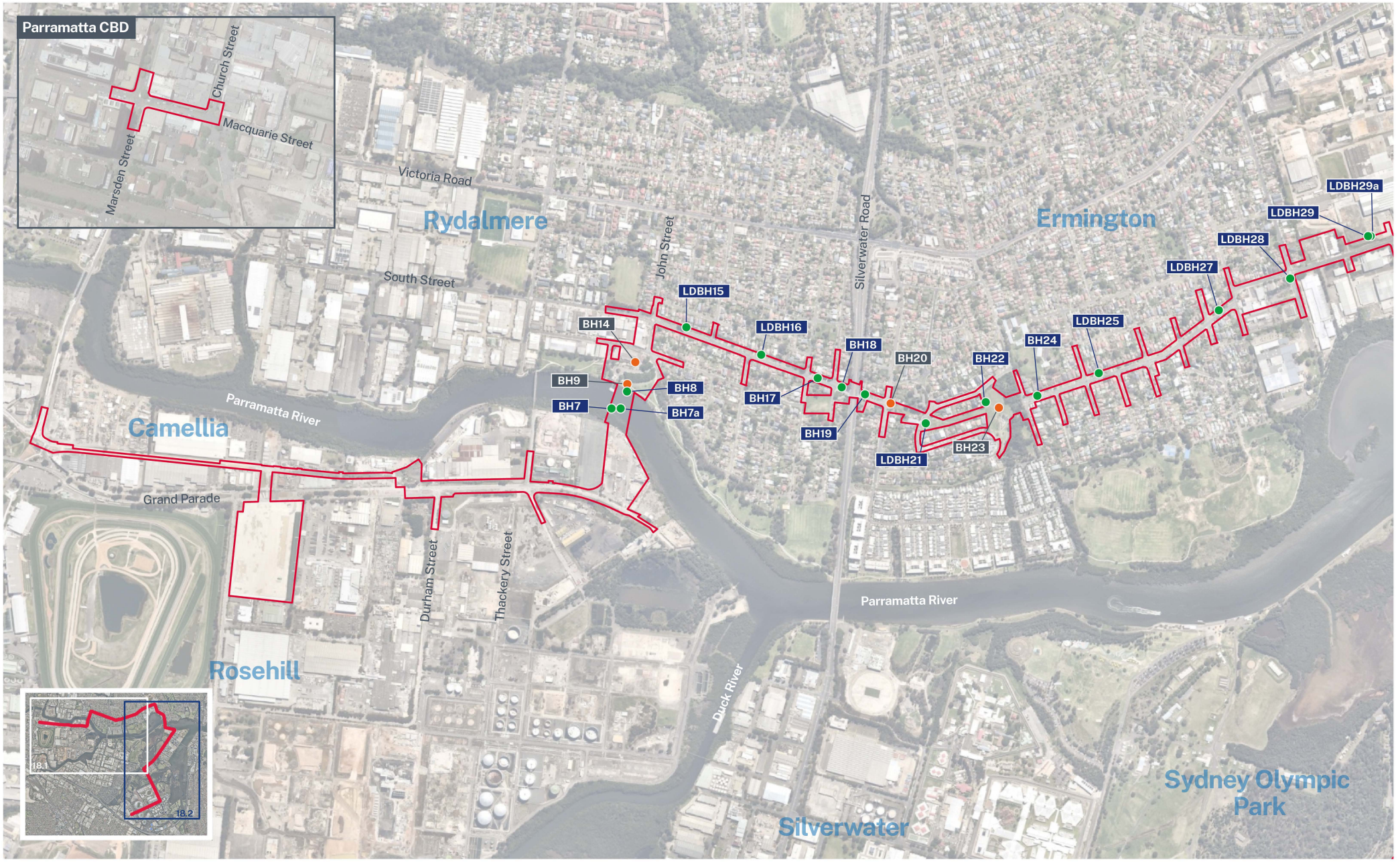
The locations of the land-based boreholes, over water boreholes and groundwater monitoring wells are shown on Figure 18.1 and Figure 18.2.

18.1.3 How potential impacts have been avoided or minimised

The approach to design development included a focus on avoiding and/or minimising the potential for impacts during key phases of the design process. As described in Chapter 5 (Design development, alternatives and options) a project corridor and alignment options assessment process was undertaken to identify the preferred alignment. This process considered a range of factors, including where existing contamination was present within the project site.

The design has been refined to avoid contamination impacts and impacts to soil where possible, including:

- managing contamination in accordance with relevant legislative and policy requirements
- designing the project to minimise impacts from soil issues
- minimising the area of disturbance
- siting infrastructure to avoid the location of the leachate management system in Sydney Olympic Park (described further in section 18.2.3)
- developing the construction methodology within the stabling and maintenance facility to avoid penetrating the existing integrated capping layer (described further in section 18.2.3).



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- Project site
- Monitoring well
- Boreholes

Figure 18.1 Contamination sampling locations - map 1

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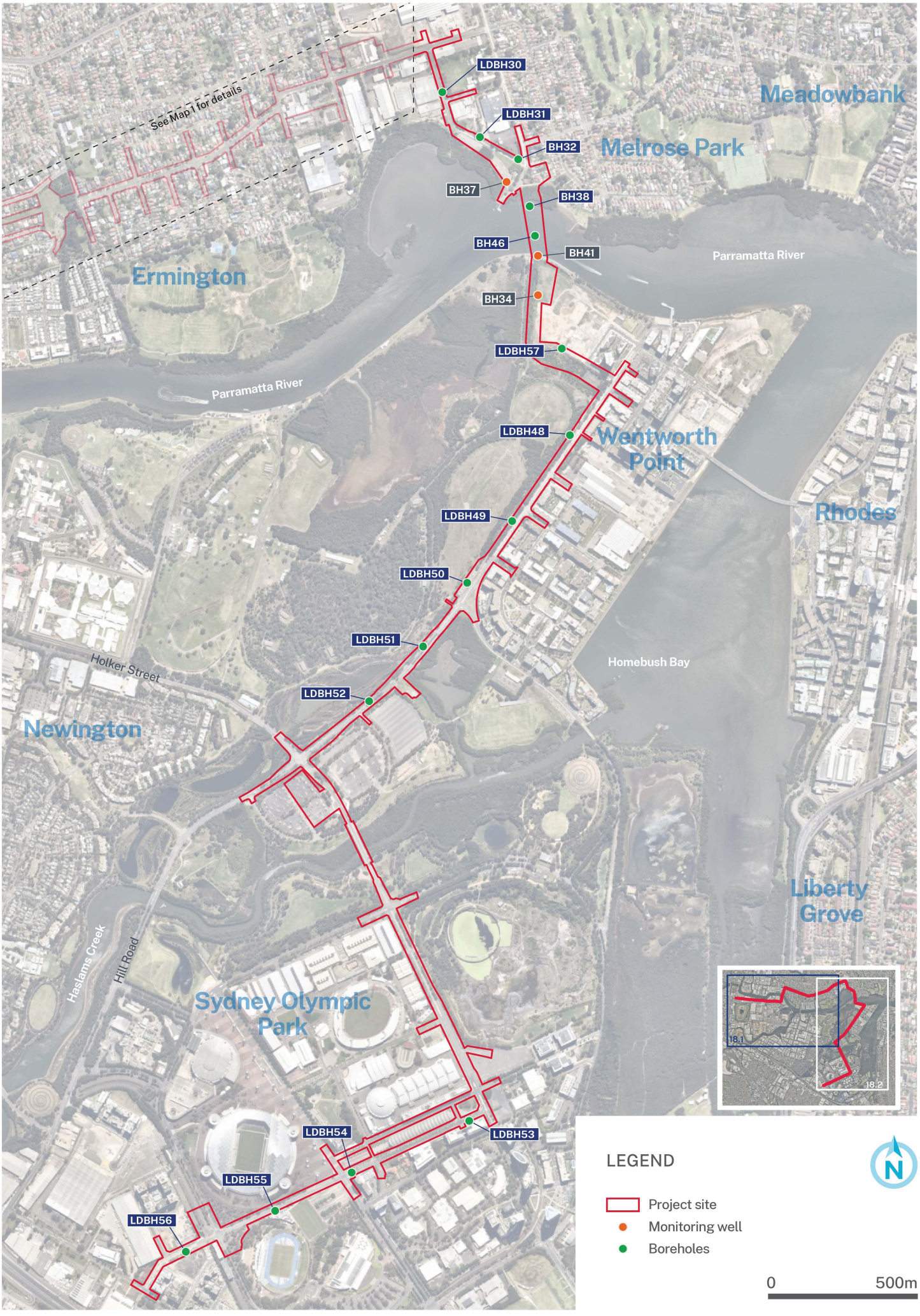


Figure 18.2 Contamination sampling locations - map 2

18.2 Existing environment

18.2.1 Topography and geology

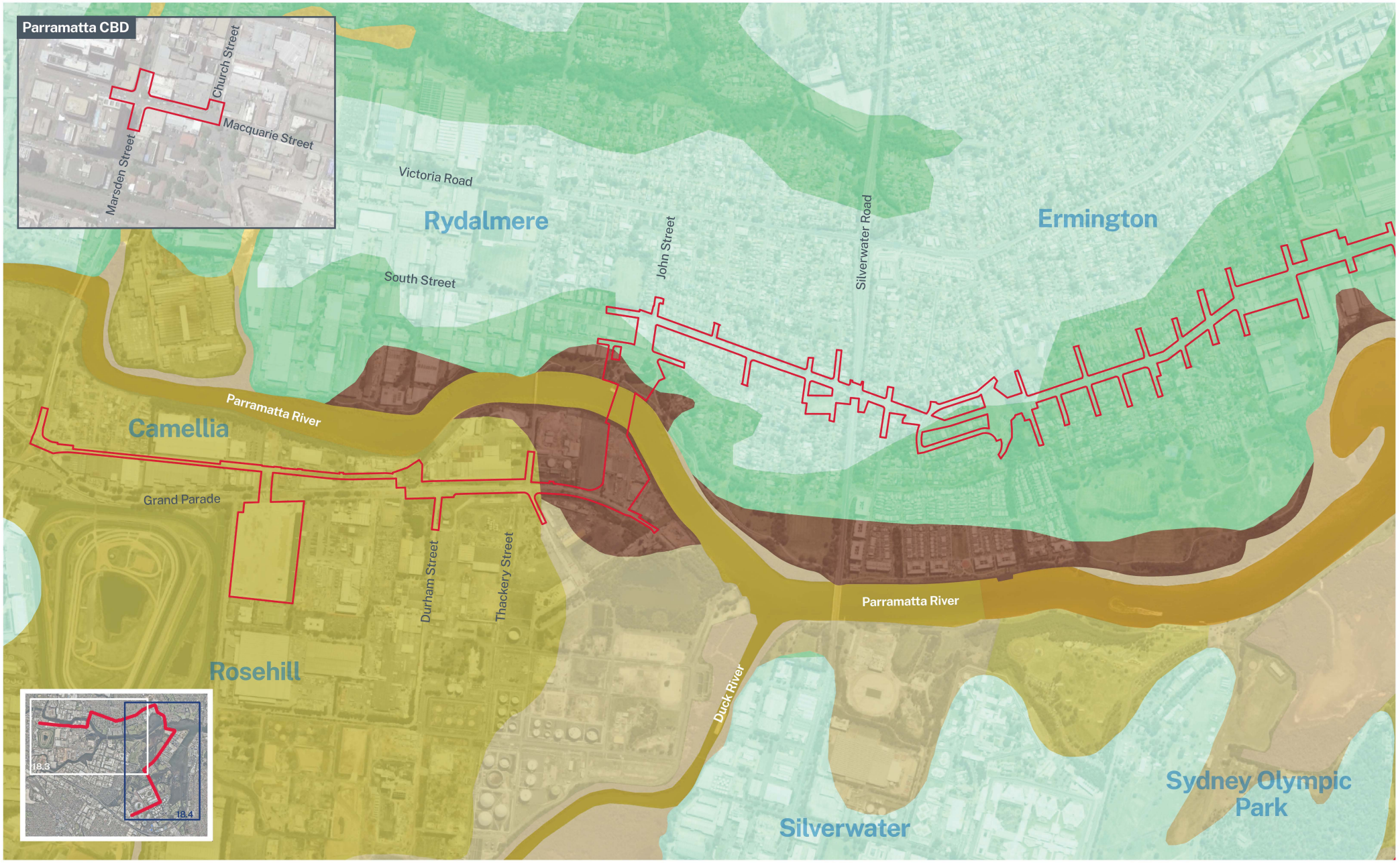
The project site ranges in elevation from sea level to 30 metres Australian height datum (AHD). In the Parramatta CBD and Camellia the topography is relatively flat (between six and seven metres AHD).

North of the Parramatta River the project site rises in elevation from the river crossing through Rydalmere up to the highest elevation at about 30 metres AHD, before decreasing in elevation into Melrose Park and back across the river. In the eastern part of the project site, through Wentworth Point and Sydney Olympic Park, the topography is generally flat at an elevation of about 10 metres AHD.

The western extent of the project site (in the Parramatta CBD) is underlain by the Triassic-aged Ashfield Shale, belonging to the Wianamatta Group. In Camellia the project site is underlain by fill, which consists of dredged estuarine sand and mud, demolition rubble, and other waste materials. Towards the Parramatta River, the underlying geology transitions to Quaternary alluvial and estuarine sediments, comprising silty to peaty quartz sand, silt and clay.

The geology north of the Parramatta River is characterised by the Triassic-aged Ashfield Shale and Hawkesbury Sandstone belonging to the Wianamatta Group, with Quaternary alluvial and estuarine sediments directly north of the river. In Wentworth Point and Sydney Olympic Park, the project site is underlain by a combination of Quaternary alluvial and estuarine sediments and man-made fill, transitioning to fill underlain by Ashfield Shale south of Haslam's Creek.

The geology which underlies the Camellia to Sydney Olympic Park section of the project site is shown on Figure 18.3 and Figure 18.4.



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Project site

Permian-triassic basins

- Hawkesbury Sandstone
- Ashfield Shale

Cenozoic sedimentary province

- Holocene estuarine basin and bay: clay, silt, shell, fluvial or marine sand
- Holocene estuarine channel: marine sand, silt, clay, shell, gravel
- Holocene saline swamp: organic mud, peat, clay, silt, marine sand, fluvial sand
- Paleogene to Pleistocene high level terrace silt, clay, gravel, fluvial sand
- Modern fill on Quaternary deposits
- Modern reclaimed estuarine areas
- Quaternary valley fill: silt, clay, fluvial sand, gravel
- Modern disturbed land

Figure 18.3 Regional geology - map 1

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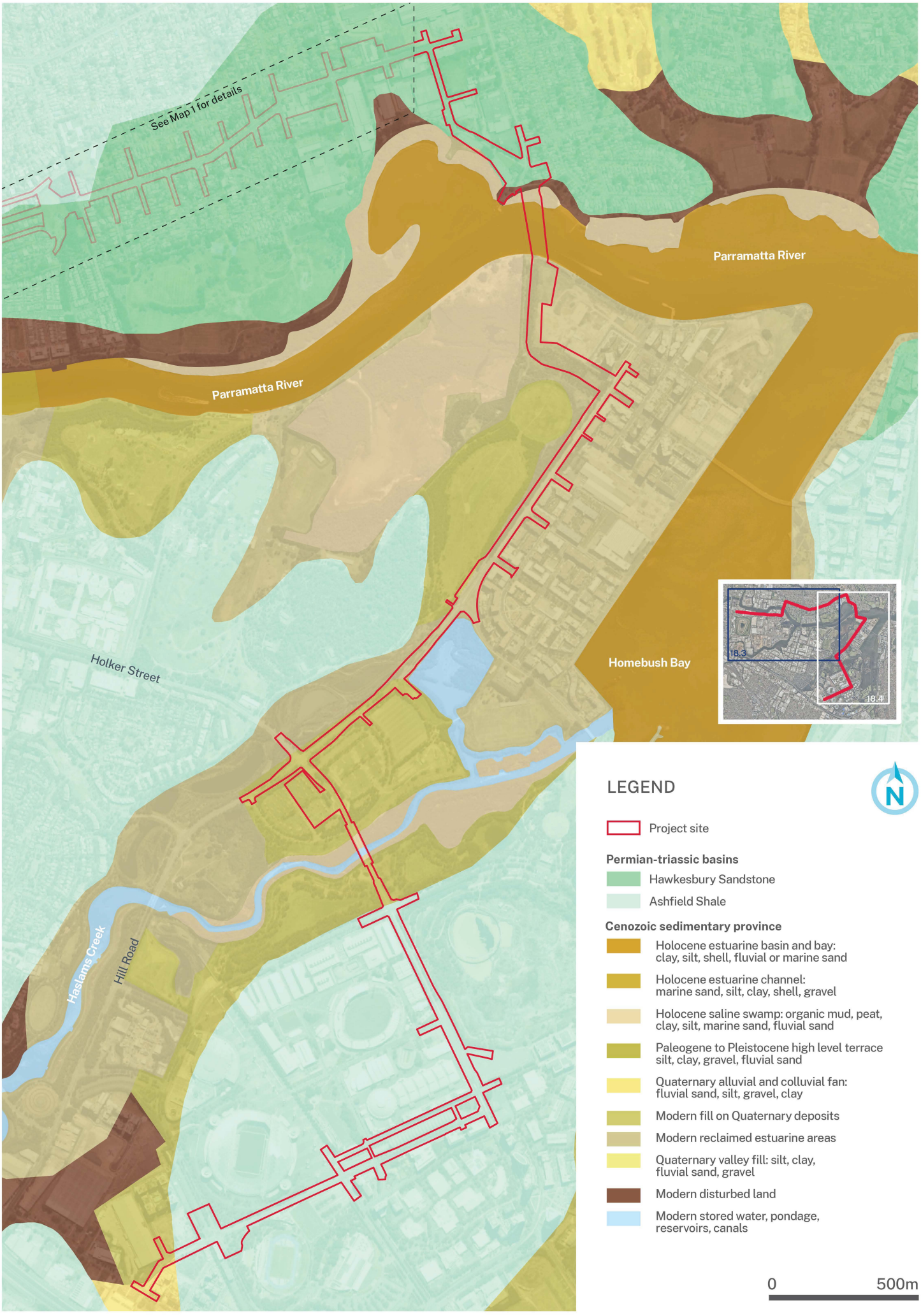

Figure 18.4 Regional geology - map 2

18.2.2 Soils

Soil types

The main soil landscapes within the project site are summarised in Table 18.1.

Table 18.1 Soil landscapes

Soil landscape	Location (suburb)	Characteristics
Disturbed terrain	Camellia, Wentworth Point, Sydney Olympic Park	Original soil materials have been removed, greatly disturbed or buried, and landfill, including soil, rock, building and waste materials, may have been added. As a result, the erosion and drainage potential of this soil landscape depends on the nature of the disturbed soil or fill. Limitations include the potential for contamination to be associated with this soil landscape.
Lucas Heights (residual landscape)	Rydalmere, Ermington, Melrose Park	Moderately deep (between 0.5 and 1.5 metres deep) hardsetting yellow podzolic soils and yellow soloths (soils formed from saline material). Yellow earths on outer edges. Occurs on gently undulating rises on the Mittagong Formation (upper part of the Hawkesbury Sandstone). Limitations include stony soil, low soil fertility, low available water holding capacity.
Blacktown (residual landscape)	Parramatta CBD, Rydalmere, Ermington, Sydney Olympic Park, Lidcombe	Shallow to moderately deep (less than one metre deep) red and brown podzolic soils. Occurs on gently undulating rises on Wianamatta Group shales and Hawkesbury shale. Limitations include moderately reactive, highly plastic subsoil, low soil fertility, poor soil drainage.
Glenorie (erosional landscape)	Rydalmere, Ermington, Melrose Park	Occurs in areas underlain by Wianamatta shales where there is more relief, with slope gradients up to 20 degrees. Soils are moderately deep and can be moderately reactive. Limitations include high soil erosion hazard, localised impermeable highly plastic sub soi, moderately reactive.
Birrong (alluvial landscape)	Wentworth Point, Sydney Olympic Park, Lidcombe	Deep (greater than 2.5 metres) yellow pozolic soils and yellow solodic soils on older alluvial terraces or solodic soils and yellow solonetz on the Parramatta River floodplain. Occurs on level to gently undulating alluvial floodplains draining to Wianamatta Group shales. Limitations include localised flooding, high soil erosion hazards, saline subsoil, seasonal waterlogging, very low soil fertility.
Ettalong (swamp landscape)	Sydney Olympic Park	Deep (greater than 1.5 metres) organic acid peats, peaty podzols and humus podzols often overlying buried siliceous sands. Occurs on level to gently undulating coastal swamps. Limitations include flooding, permanently high water table, extremely acid organic soil of low fertility.

Acid sulfate soils

Acid sulfate soils and potential acid sulfate soils are naturally occurring soils containing iron sulfides. On exposure to air, iron sulfides oxidise and create sulfuric acid. This increases soil acidity and can result in the mobilisation of aluminium, iron and manganese from the soils.

The CSIRO Australian Soil Resource Information System indicates that there is a high probability of acid sulfate soils within most of the project site, except for areas in:

- Parramatta CBD, Ermington and Melrose Park, which are mapped as having a low probability of having acid sulfate soils
- Sydney Olympic Park, where the potential for acid sulfate soils is unknown due to disturbed terrain.

Table 18.2 lists acid sulfate risk classifications for land within and in the vicinity of the project site. The risk classifications are based on the NSW Government acid sulfate soil risk mapping. Acid sulfate soil risk mapping is shown on Figure 18.5.

Table 18.2 Acid sulfate soil classifications

Location	Acid sulfate soil class	Work that would potentially expose acid sulfate soils
Camellia – western section of project site Parramatta CBD (location of Macquarie Street turnback facility)	4	Work more than two metres below the natural ground surface and work where the water table is likely to be lowered by more than two metres below the natural ground surface.
Camellia – eastern section of project site	3	Work beyond one metre below the natural ground surface and work where the water table is likely to be lowered one metre below natural ground surface.
Parramatta River banks (between Camellia and Rydalmere)	1	Any work below the natural ground surface.
Parramatta River banks (between Melrose Park and Wentworth Point) The northern section of the project site in Wentworth Point Sydney Olympic Park – low-lying areas near Haslams Creek	2	Work beyond the natural ground surface and work where the water table is likely to be lowered.
Rydalmere, Ermington and Melrose Park (other areas)	5	Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres of adjacent class 1, 2, 3 or 4 land.

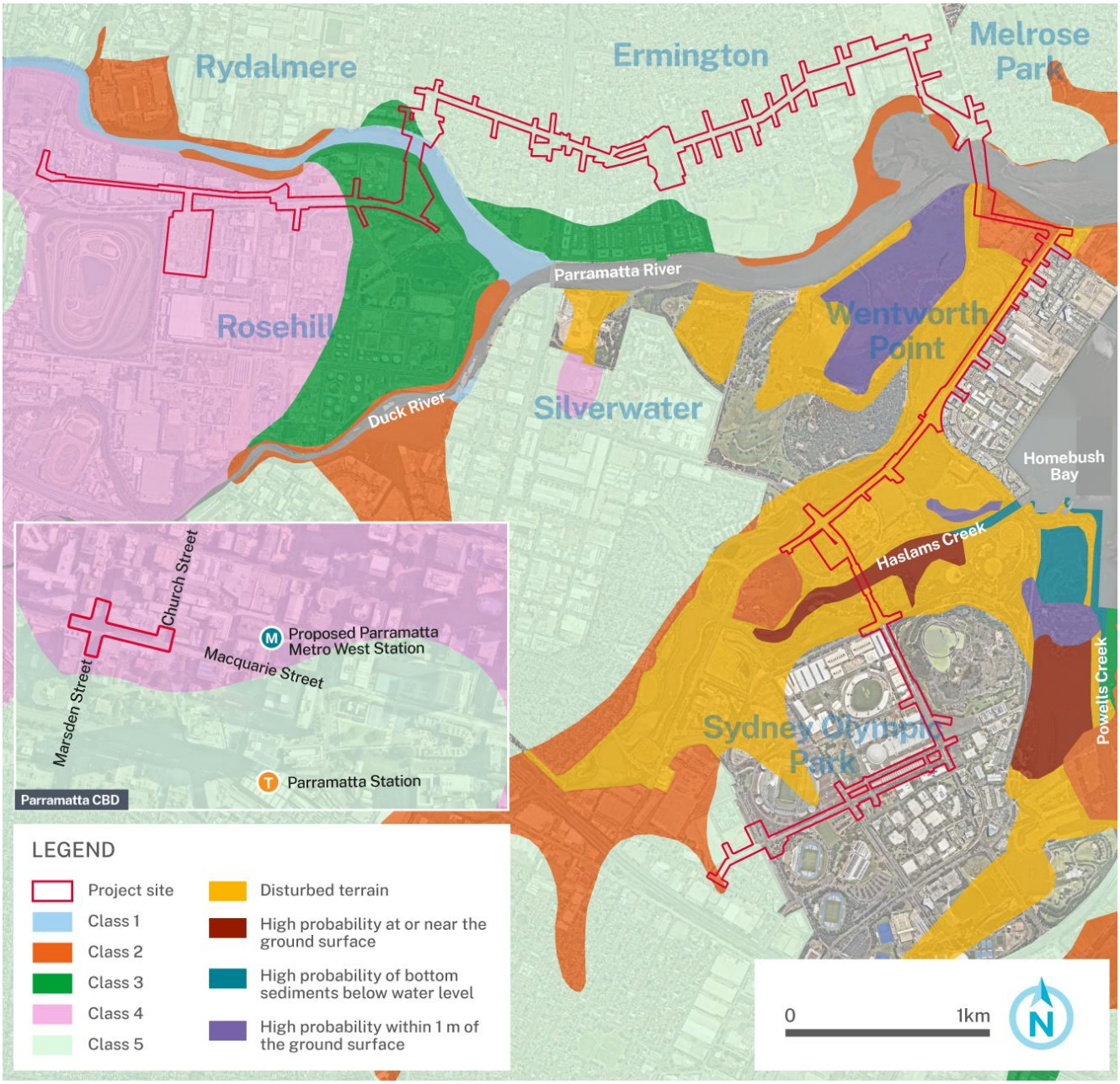

Figure 18.5 Acid sulfate soils risk mapping

Soil salinity

Salinity has the potential to damage foundations of infrastructure, make soils unsuitable for re-use as fill, and may affect landscaping. Saline soil and water have the potential to damage concrete and metal structures, including bridge piers and foundations.

The project site is generally classified as having moderate salinity potential. Exceptions to this are areas on the northern side of the Parramatta River classified as having low salinity potential.

18.2.3 Contamination

This section provides an overview of the areas of contamination concern according to the suburbs along the project site. It includes listed contaminated sites located within/close to the project site, and key previous and existing land uses. Further information on land use and properties in the project site is provided in Chapter 13 (Land use and property).

Key areas of contamination concern are shown on Figure 18.6 and Figure 18.7.

Parramatta CBD

The Parramatta CBD area has been predominantly used for commercial activities from the 1950s. From the early 1990s onwards, land use has included a mix of general commercial, retail and high-rise residential apartments.

Listed contamination sites

A search of the NSW EPA register of contaminated sites and list of notified sites under sections 58 and 60 of the CLM Act identified one listed contaminated site located in the vicinity of the project site as summarised in Table 18.3 and shown on Figure 18.6.

Table 18.3 Listed contaminated sites – Parramatta CBD

Site name	Location	Contamination status	Location in relation to the project site
Coleman Oval Embankment	Corner of Pitt Street and Macquarie Street, Parramatta	Regulation not required	About 320 metres north-west of the project site

Areas of contamination concern

Table 18.4 provides an overview of potential contamination sources and contaminants of concern. The potential to encounter significant or widespread contamination is considered to be low.

Table 18.4 Overview of potential contamination within the Parramatta CBD

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historically uncontrolled fill along roadways and road reserves. Historic and current commercial activity.	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals	Waste classification undertaken in this area during construction of Parramatta Light Rail Stage 1 reported the presence of polycyclic aromatic hydrocarbons in soil from the historic use of coal tar asphalt in road formations.

Camellia

The suburb of Camellia area has a long history of mixed industrial development, dating back to the 1880s. Industrial development has included a number of potentially contaminating land uses including a tannery, meatworks, lumber yard, asbestos manufacturing, oil refining, chemical production, and soil and liquid waste facilities. Many of these facilities have been, or are currently subject to, environment protection licences issued by the NSW EPA. Areas in Camellia have been subject to disturbance and reclamation resulting in the presence of fill material. This fill material includes waste products from asbestos and chrome ore processing.

Listed contaminated sites

Listed contaminated sites in the vicinity of the project site are shown on Figure 18.6 and summarised in Table 18.5.

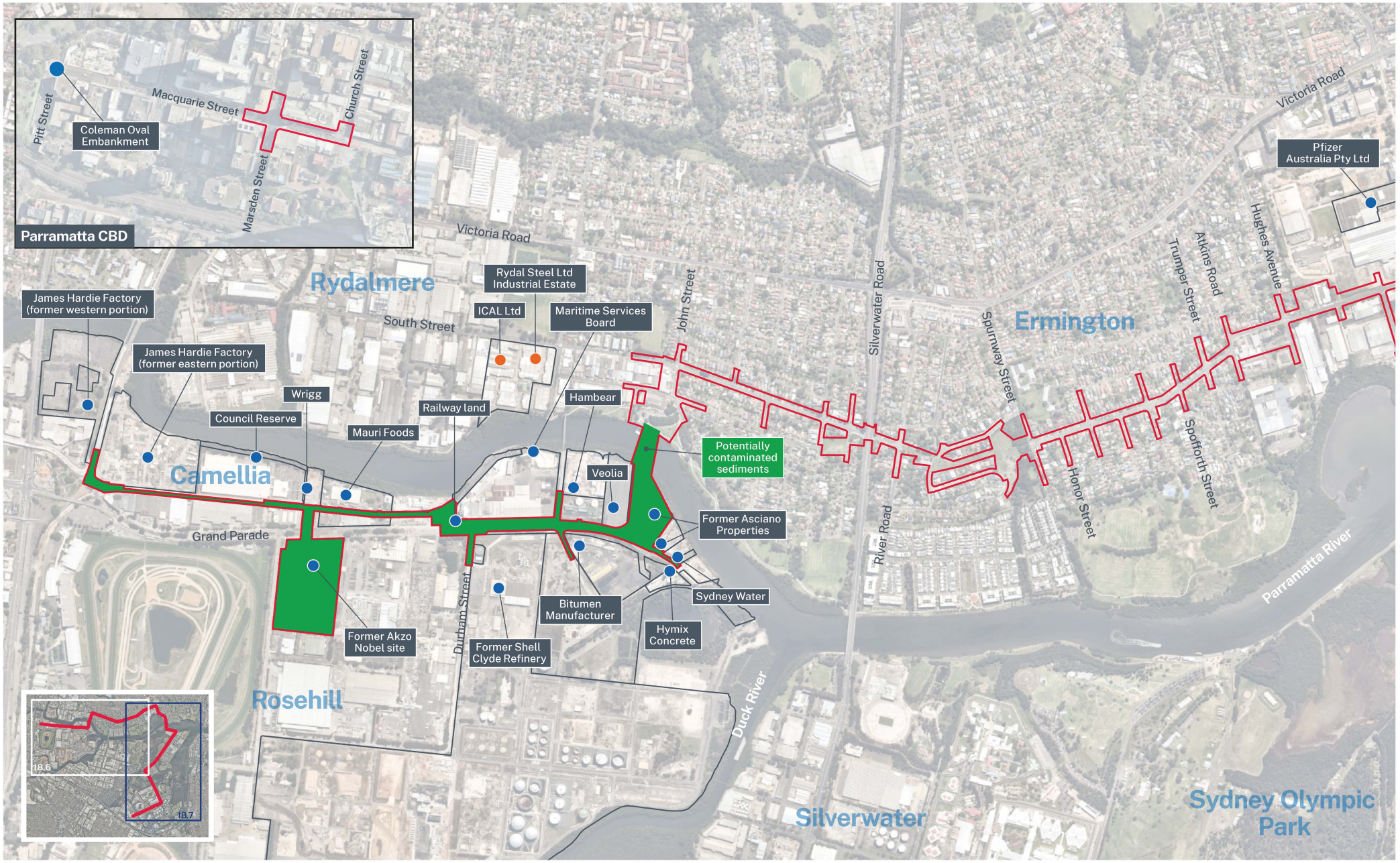

Figure 18.6 Areas of contamination concern - map 1

LEGEND

- Project site
- Areas of environmental concern
- EPA notified and reported contaminated sites
- Other potential contaminated sites
- Lot boundaries

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Figure 18.7 Areas of contamination concern - map 2

Table 18.5 Listed contaminated sites – Camellia

Site name	Location	Contamination status	Location in relation to the project site
James Hardie manufacturing facility (former western portion)	181 James Russ Drive, Rosehill	Ongoing maintenance required to manage residual contamination (CLM Act)	About 30 metres north-west of the project site
James Hardie manufacturing facility (former eastern portion)	1 Grand Avenue, Camellia	Currently regulated under CLM Act	Directly adjacent (north)
Former Akzo Nobel site	6 Grand Avenue, Camellia	Currently regulated under CLM Act	Within the project site (the stabling and maintenance facility)
Council reserve	11B Grand Avenue, Camellia	Regulation under CLM Act not required	Directly adjacent (north)
Bitumen manufacturer	12 Grand Avenue, Camellia	Currently regulated under CLM Act	Directly adjacent (south)
Wrigg	13 Grand Avenue, Camellia	Under preliminary investigation order	Directly adjacent (north)
Hymix Concrete	14 Grand Avenue, Camellia	Currently regulated under CLM Act	Directly adjacent (south)
Mauri Foods	15 Grand Avenue, Camellia	Regulation being finalised	Directly adjacent (north and south)
Railway land	27 Grand Avenue, Camellia	Regulation under CLM Act not required	Within project site
Maritime Services Board	33A Grand Avenue, Camellia	Regulation under CLM Act not required	About 130 metres north of the project site
Veolia	37 Grand Avenue, Camellia	Currently regulated under CLM Act	Directly adjacent (north and west)
Former Asciano properties	37A and 39 Grand Avenue, Camellia	Currently regulated under CLM Act	Within project site (37A) and directly adjacent (39 – north-east)
Sydney Water	41 Grand Avenue, Camellia	Currently regulated under CLM Act	Directly adjacent (north-east)
Hambear	14 Thackeray Street, Camellia	Regulation under CLM Act not required	Directly adjacent (north-east)
Former Shell Clyde Refinery	Durham Street Camellia	Currently regulated under CLM Act	Directly adjacent (south)

Areas of contamination concern

Detailed site assessments undertaken by Transport for NSW and others on many properties in Camellia have confirmed the presence of contamination in soils and groundwater, with the main contaminants of concern being hexavalent chromium, petroleum hydrocarbons, chlorinated hydrocarbons, and asbestos.

Hexavalent chromium contamination has originated from the former Chrome Chemicals facility at 6-8 Grand Avenue, and possibly also from the former Wesco Paints facility at 13 Grand Avenue, a former tannery in Thackeray Street, and a former timber yard in Grand Avenue. Hexavalent chromium waste materials have also been used as fill materials within a number of sites along Grand Avenue. Hexavalent chromium contamination has been detected in soil and groundwater in a number of previous investigations undertaken at sites along Grand Avenue (Golder Associates, 2015). Hexavalent chromium is a known carcinogen, with the main exposure pathways being via inhalation of dusts and aerosols and direct contact with contaminated soil and groundwater resulting in skin absorption and potential ingestion. Hexavalent chromium also presents a health risk to sensitive ecological species.

Petroleum hydrocarbon contamination in groundwater has likely originated from the Clyde refinery site, the SAMI bitumen plant site at 12 Grand Avenue, and the Hymix Australia site at 14 Grand Avenue. Petroleum hydrocarbons in groundwater may present both human health risks, via inhalation or direct contact, and ecological risks.

Asbestos waste from the James Hardie manufacturing facility has resulted in large scale asbestos contamination at the former James Hardie sites at 181 James Russ Drive and 1 Grand Avenue. Asbestos material has also been reported in shallow soil along Grand Avenue, in the former Sandown Line north of Thackeray Street, and within the Clyde Refinery site. The disturbance of asbestos particles can lead to inhalation which may cause asbestos-related cancers.

The Parramatta Light Rail stabling and maintenance facility is located on the former Akzo Nobel site. The site was historically used for chemical manufacturing purposes, including chrome chemicals and chlorofluorocarbons, which resulted in contamination of soils and groundwater. The site has been subject to long-term regulation by the NSW EPA, and numerous environmental investigations and targeted remedial activities in selected areas have been undertaken at the site. Remediation works commenced in 2019 and are due to be completed in 2023. The works are being undertaken to make the site suitable for its proposed use as the stabling and maintenance facility. To date these works have involved:

- installing a hydraulic barrier wall along the site perimeter to prevent groundwater migration to and from site
- removing the existing groundwater treatment plant and installing a replacement plant
- installing an integrated capping system across the surface of the site to mitigate soil vapour exposure pathways and hexavalent chromium wicking processes, and to physically separate future site users from remnant contamination
- constructing a containment cell to contain contaminated material excavated during the remediation works.

Construction of the facility is currently underway (as part of Parramatta Light Rail Stage 1). Outstanding remediation activities include the construction of hardstand, landscaping works, and the installation of ventilation pipes. These activities will be completed as part of the facility.

The stabling and maintenance facility site is being managed in accordance with a long-term environmental management plan (prepared in February 2021), which documents the procedures to be followed during any future works on the site. The long-term environmental management plan requires regular inspection of the remediation system and monitoring of groundwater, soil vapour and hazardous ground gas. The management plan also restricts intrusive works below the final ground level of the site.

During construction of Parramatta Light Rail Stage 1, asbestos impacted fill from other areas of the Stage 1 project site in Camellia was stored within containment cells located at 13A Grand Avenue and a section of the former Sandown Line. These containment cells are located within the project site for this project. Prior to the use of 13A Grand Avenue for an asbestos containment cell, existing contamination was remediated to make the site suitable for the construction and operation of light rail. These locations are now being managed in accordance with a long-term environmental management plan (prepared in December 2021), which includes requirements for shallow and deep intrusive works.

The site at 37A Grand Avenue Camellia is currently listed on the NSW EPA's contaminated land record of notices under the same listing as 39 Grand Avenue, both of which were former Asciano properties. Previous investigations undertaken at 37A and 39 Grand Avenue have identified the presence of hexavalent chromium contamination in soil and groundwater due to the use of hexavalent chromium waste materials as fill in this area. The notices on the NSW EPA's record of notices include an approved voluntary management proposal (which requires remediation in accordance with a remediation action plan). It is understood that, to date, remediation of contamination at 37A Grand Avenue has not been undertaken. Track infrastructure and bridge abutments would be constructed within 37A Grand Avenue, and the site would also be used as a compound location.

Fill material consisting of building rubble up to a depth of two metres has been identified along the southern banks of the Parramatta River. In addition, soil and groundwater adjacent to the Parramatta River, between the James Hardie site and Clyde Refinery site, has been reported as contaminated with chromium (Golder Associates, 2015). There have also been reported incidents of chromium polluted stormwater flowing into the Parramatta River. The Golder Associates report noted that an assessment of chromium contamination in Parramatta River was undertaken by AWT Ensight in 1995. The assessment included sampling of mudflat sediments at eight locations in front of surface drainage channels along the river north of Grand Avenue, and surface water sampling at a selection of these locations. The assessment did not detect hexavalent chromium in the mud flat sediments. However, hexavalent chromium was detected in surface water samples at four locations, including one adjacent to 39 Grand Avenue.

Table 18.6 provides an overview of potential contamination sources and contaminants of concern, including the results of the site investigations undertaken as described in section 18.1.

Table 18.6 Overview of potential contamination – Camellia

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historic and current industrial activity, including a timber yard, a tannery, oil refining, a meatworks, a lumber yard, asbestos manufacturing, chemical production and soil and liquid waste facilities Land reclamation using contaminated fill materials	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals • hexavalent chromium • volatile organic compounds including chlorinated hydrocarbons • pesticides (organochlorine and organophosphorus pesticides) • semi volatile organic compounds	**Soil and groundwater** • While no sampling was undertaken in this area as part of the site investigation undertaken by Coffey, as noted above previous investigations have identified the presence of asbestos, heavy metals, polycyclic aromatic hydrocarbons and hexavalent chromium in soil and/or groundwater. **Sediments** • Concentrations of total recoverable hydrocarbons and heavy metals (chromium, copper, lead, mercury, zinc and arsenic) exceeded guideline levels for toxicants in sediments. • Reportable concentrations of dioxins were detected in sediment samples; however, there are no established criteria for this contaminant. The concentrations were considered representative of background concentrations in the Parramatta River and are likely due to former industrial activities in Homebush Bay.

Rydalmere and Ermington

The majority of areas in the immediate vicinity of the project site have been subject to residential development since the 1940s, with agricultural uses prior to this time. While these areas are characterised by low density residential land use, the area directly north of the Parramatta River, where the project site crosses from Camellia, has been used for industrial purposes since the late 1960s.

Listed contaminated sites

No listed contaminated sites are located within the study area. The following James Hardie asbestos waste sites are located within 500 metres of the project site (see Figure 18.6):

- Rydal Steel Ltd Industrial Estate, located on South Street, Rydalmere, about 380 metres west of the project site
- ICAL Ltd site, located 38 South Street, Rydalmere, about 400 metres west of the project site.

Areas of contamination concern

Table 18.7 provides an overview of potential contamination sources and contaminants of concern. The potential to encounter significant or widespread contamination is considered to be low.

Table 18.7 Overview of potential contamination – Rydalmere and Ermington

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historic and current industrial activity Asbestos waste from James Hardie sites	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals • volatile organic compounds including chlorinated hydrocarbons • pesticides (organochlorine and organophosphorus pesticides) • semi volatile organic compounds	**Soil** • Potential asbestos containing materials were identified adjacent to the Parramatta River (borehole BH09) within Eric Primrose Reserve. Historical aerial photographs show that parts of Eric Primrose have been subject to reclamation. **Groundwater** • Concentrations of copper, nickel and zinc were detected above the laboratory limit of reporting and/or above the adopted assessment criteria for the protection of marine and freshwater ecosystems; however, these concentrations are considered representative of background concentrations. • Low levels of hydrocarbons were reported at one location (borehole BH20) on South Street.

Melrose Park

Melrose Park has been subject to residential development since the 1940s, with agricultural uses prior to this time. Industrial land uses have been present within the suburb since the 1960s. Of relevance to the project, industrial properties that have held licences for chemical and dangerous good manufacturing under the POEO Act are located along Wharf Road and Hope Street, adjacent to the project site.

Listed contaminated sites

Listed contaminated sites in the vicinity of the project site are summarised in Table 18.8 and shown on Figure 18.6 and Figure 18.7.

Table 18.8 Listed contaminated sites – Melrose Park

Site name	Location	Contamination status	Location in relation to the project site
Pfizer Australia Pty Ltd	38-42 Wharf Road, West Ryde/Melrose Park	Regulation under CLM Act not required	About 280 metres north of the project site
Reckitt Benckiser	44 Wharf Road, West Ryde/Melrose Park	Regulation under CLM Act not required	Directly adjacent (north)

Areas of contamination concern

Table 18.9 provides an overview of potential contamination sources and contaminants of concern. The potential to encounter significant or widespread contamination in this area is considered to be low.

Table 18.9 Overview of potential contamination – Melrose Park

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historic and current commercial/industrial activity.	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals • volatile organic compounds including chlorinated hydrocarbons • pesticides (organochlorine and organophosphorus pesticides) • semi volatile organic compounds	**Soil** • No concentrations of contaminants of concern were detected above the assessment criteria. **Groundwater** • Concentrations of copper, nickel and zinc were detected above the laboratory limit of reporting and/or above the adopted assessment criteria for the protection of marine and freshwater ecosystems; however, these concentrations are considered representative of background concentrations. • Low levels of hydrocarbons were reported at one location (borehole BH37) at the end of Wharf Road. **Sediments** • Concentrations of heavy metals (chromium, copper, lead, mercury, zinc) exceeded guideline levels for toxicants in sediments. • Reportable concentrations of dioxins were detected in sediment samples; however, there are no established criteria for this contaminant. The concentrations were considered representative of background concentrations in the Parramatta River and are likely due to former industrial activities in Homebush Bay.

Wentworth Point

Historical land uses include industrial activities and shipping terminals between Hill Road and Homebush Bay. Investigations undertaken in relation to urban development in the vicinity of the project site have identified areas of contamination, including soil contamination and the presence of ground gases (including methane and carbon dioxide) (Department of Planning and Infrastructure, 2014). Concept remediation plans identified that ground contamination could be managed by capping, while ground gas could be managed by a combination of sub-floor ventilation and use of concrete foundations with limited service penetrations cast into the slab.

Listed contamination sites

Listed contamination sites in the vicinity of the project site are summarised in Table 18.10 and shown on Figure 18.7.

Table 18.10 Listed contaminated sites – Wentworth Point

Site name	Location	Contamination status	Location in relation to the project site
RMS Eastern Precinct	3-7 Burroway Road, Wentworth Point	Regulation under CLM Act not required	About 30 metres east of the project site
Former TNT Express	23 Bennelong Parkway, Wentworth Point	Regulation under CLM Act not required	Directly adjacent (east)

Areas of contamination concern

Table 18.11 provides an overview of potential contamination sources and contaminants of concern.

While the current status of remediation at Wentworth Point is unknown, it is assumed that the presence of residential land use and a school means that appropriate remediation has been undertaken as the land has been approved for these land uses. Based on this and the results of the intrusive investigations, the potential to encounter significant or widespread contamination is considered to be low.

Homebush Bay is located on the southern banks of the Parramatta River, to the east of the project site at Wentworth Point and Sydney Olympic Park. Parts of Homebush Bay were subject to a maintenance order issued by NSW EPA due to the presence of dioxin contamination in sediments associated with the manufacture of agent orange at the former Lednez site on the eastern side of Homebush Bay. Parts of Homebush Bay were subsequently remediated in 2010 by excavation and capping.

Table 18.11 Overview of potential contamination – Wentworth Point

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historic industrial activity	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals • volatile organic compounds including chlorinated hydrocarbons • pesticides (organochlorine and organophosphorus pesticides) • semi volatile organic compounds • dioxins	**Soil** • Total recoverable hydrocarbons above the assessment criteria were detected in one shallow sample collected adjacent to the River Walk, within the boundary of 14 Hill Road. The source of the impact is unknown; however, may be localised and/or associated with natural oils within the mulch. **Groundwater** • No concentrations of contaminants of concern above the adopted assessment criteria were detected in groundwater. **Other** • The lower explosive limit for methane was exceeded whilst carrying out background atmospheric gas monitoring adjacent to borehole LDBH57 (Sanctuary Wentworth Point). The alarm on the gas meter was triggered when spoil was recovered from 1.5 metres below ground surface, which was below where groundwater seepage was encountered within fill. Fill was encountered at this location to a depth of 2.9 metres below ground surface. This may indicate the presence of hazardous ground gas which may pose a risk to human health during construction of the project.

Sydney Olympic Park

Sydney Olympic Park was historically used for industrial activity as far back as the early 1900s. Industrial land uses in the area included State abattoirs, State brickworks and various chemical manufacturers. Sydney's rapid expansion in the 1950s and 1960s meant that more space was required for waste. By 1978 most low-lying land had been filled and by 1988 there was an estimated nine million cubic metres of waste and contaminated soils spread across the Sydney Olympic Park site. The waste was not homogenous and included potential acid sulfate soils, illegally dumped wastes along the waterways, petroleum waste, municipal waste, industrial waste and contamination from site activities.

Controlled and uncontrolled landfilling operations occurred over several decades on lands that are now within Sydney Olympic Park. Between 1983 and 2001 a number of engineered landfills were constructed to ensure the containment of waste and the protection of human health and the environment. The landfills have been rehabilitated and have been transformed into parklands and open space where waste is contained in large mounds.

Contaminated leachate from the waste mounds is collected and treated at three biological leachate treatment systems located on and off site. Sydney Olympic Park Authority is responsible for managing the engineered landfills and associated leachate management system via a management plan that provides principles for landfill management. These include ensuring that site activities avoid damage to the landfill infrastructure, avoiding off-site disposal of any contaminated landfill material, implementing monitoring programs to inform site management, and ensuring compliance with discharge conditions.

Listed contamination sites

Listed contamination sites in the vicinity of the project site are summarised in Table 18.12 and shown on Figure 18.7. A number of these sites are the engineered landfills. The location of these landfills and associated leachate management infrastructure is shown on Figure 18.8.

Table 18.12 Listed contaminated sites – Sydney Olympic Park

Site name	Location	Contamination status	Location in relation to the project site
RMS Western Precinct	14A-14E and 16 Hill Road	Regulation under CLM Act not required	Partially within and adjacent (west)
Haslams Creek South Area 3	At Kronos Hill, Kevin Coombes Avenue	Currently regulated under CLM Act	Within and adjacent (northeast)
Bicentennial Park	Bicentennial Drive	Ongoing maintenance required to manage residual contamination (CLM Act)	About 430 metres south-east of the project site
Former Golf Driving Range Landfill	Sarah Durack Avenue	Ongoing maintenance required to manage residual contamination (CLM Act)	About 440 metres south of the project site
Kronos Hill Landfill	Kevin Coombes Avenue	Ongoing maintenance required to manage residual contamination (CLM Act)	Directly adjacent (west)
Woo-la-ra Landfill	Hill Road	Ongoing maintenance required to manage residual contamination (CLM Act)	Directly adjacent (west)
Aquatic Centre Carpark Landfill	Shane Gould Avenue	Ongoing maintenance required to manage residual contamination (CLM Act)	280 metres south

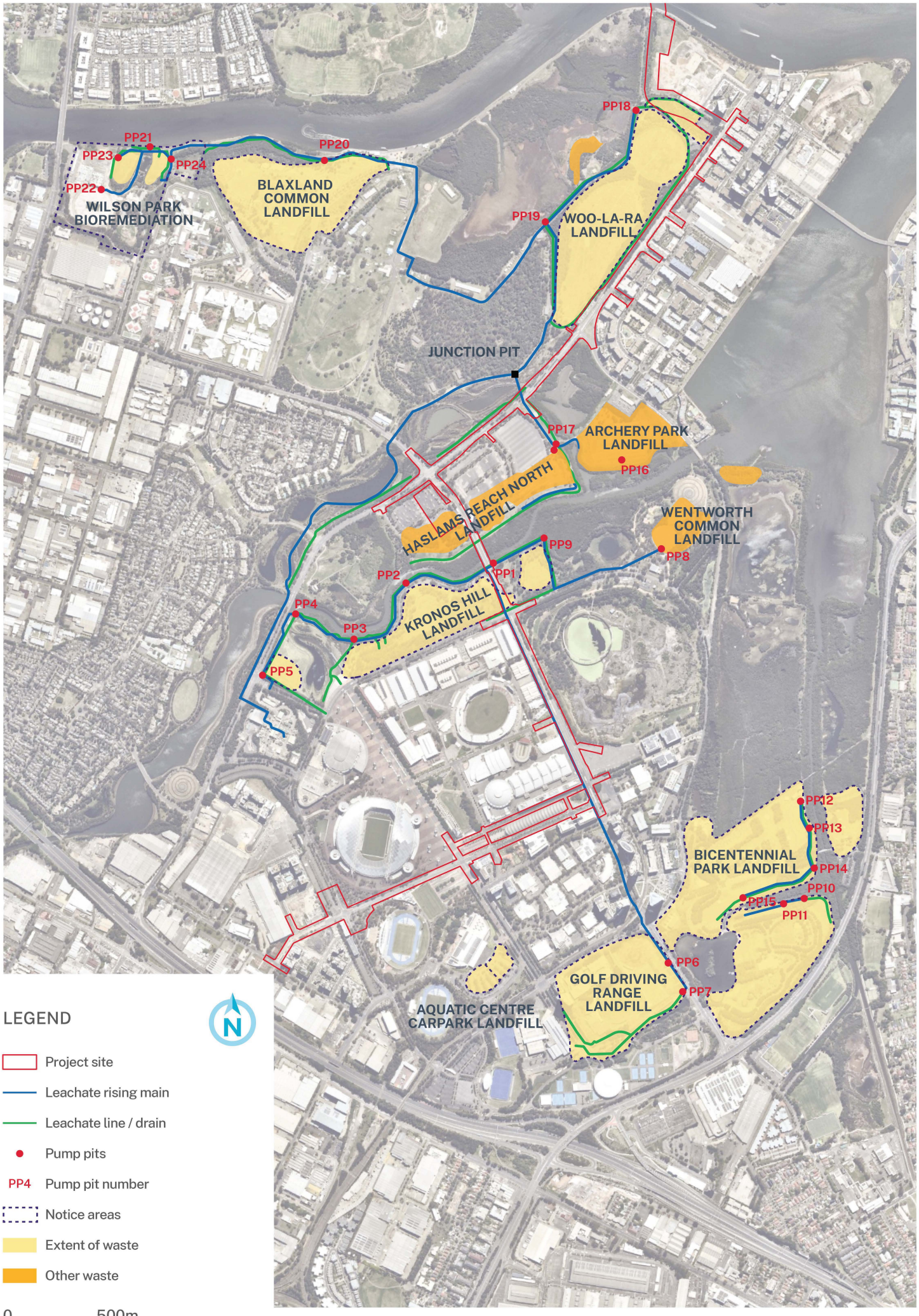

Figure 18.8 Historic landfills and associated infrastructure at Sydney Olympic Park

Areas of contamination concern

Table 18.13 provides an overview of potential contamination sources and contaminants of concern.

Table 18.13 Overview of potential contamination – Sydney Olympic Park

Potential source of contamination	Contaminants of potential concern	Outcomes of site investigations
Historic industrial and landfilling activities	• total recoverable hydrocarbons • polycyclic aromatic hydrocarbons • asbestos containing materials • heavy metals • volatile organic compounds including chlorinated hydrocarbons • pesticides (organochlorine and organophosphorus pesticides) • semi volatile organic compounds. • ammonia • dioxins • landfill gas such as methane	**Soil** • No concentrations of contaminants of concern were detected above the assessment criteria. **Groundwater** • No concentrations of contaminants of concern above the adopted assessment criteria were detected in groundwater.

18.3 Assessment of construction impacts

18.3.1 Potential to encounter contamination

There is potential for contamination to be encountered across the project site. The key potential areas of concern are located in:

- Camellia – the potential to encounter contamination during works in Camellia is high due to the historical use of the area for industrial activity and the results of previous investigations that have identified soil and groundwater contamination. Further intrusive investigation is required to determine the need for remediation.
- Parramatta River – the potential to encounter soil, sediment and groundwater contamination during works within and adjacent to the river is high due to the presence of contamination from activities in Camellia, and current and historical industrial land uses located on either side of the river.
- Wentworth Point (along Hill Road) and Sydney Olympic Park – works in this area would need to consider the potential to encounter soil and/or groundwater contamination and landfill gases due to the use of this area for historical industrial activities and landfilling, as well as the presence of the leachate management system and engineered landfills.

If inadequately managed, disturbance of contaminated areas has the potential to:

- mobilise contaminants, affecting nearby soils, surface water and groundwater
- increase the migration of contaminants into surrounding areas via leaching, overland flow and/or subsurface flow (water and/or vapour) or dust, with the potential to impact on receiving environments, such as the Parramatta River, Haslams Creek and the surrounding community
- increase the risk of exposure to contaminants (direct contact and/or inhalation) by site workers, visitors and the local community.

The risk of disturbing or encountering contaminated material during construction varies depending on the extent and type of contamination and the work undertaken. A preliminary contamination risk evaluation (considering the potential for risks without implementation of appropriate controls or remediation) was undertaken to understand the potential risk of the identified areas of contamination concern. The risk evaluation was undertaken by assessing identified areas of contamination concern based on the likelihood of:

- encountering contamination
- the exposure pathway for human and/or ecological receptors being realised.

The following risk categories were assigned:

- low – impact can be managed by implementing standard construction management practices in accordance with relevant guidelines
- medium – contamination specific management plans and controls are required
- high – engineered controls and/or environmental/health monitoring are required.

Table 18.14 summarises the findings of the preliminary contamination risk evaluation, describing potential impacts during works across all areas, and additional impacts that are specific to the key potential risk areas (where relevant). Impact-specific approaches to managing the risks have also been identified, with these approaches forming the basis for the mitigation and management measures provided in section 18.6. Additionally, further contamination investigation across the project site is currently underway, and will provide more information on contaminants present, their concentration in soil and groundwater, and their coverage across the project site. These additional sampling results would be used to inform further actions and decisions in relation to the need for remediation of areas and the approach to mitigation.

Table 18.14 Preliminary contamination risk evaluation (without controls or remediation)

Project site location	Construction activity	Potential impact	Risk rating
All areas	Ground disturbance and excavation activities.	Mobilisation of contamination and water quality impacts – the disturbance of soils could result in erosion and contaminated sediment laden run-off discharging to surface water or stormwater.	Medium
		Health impacts – the disturbance of contaminated soil and groundwater could result in site workers and/or the community being exposed to contaminants via: • inhalation of dust containing contaminants, including airborne asbestos fibres • vapour intrusion and subsequent inhalation • ingestion or direct contact with contaminated soil or groundwater during excavation.	Medium
		Cross contamination – the movement of equipment, vehicles and personnel from unsealed areas containing soil contamination to 'clean' areas, either within the project site (eg compounds, areas without exposed soil contamination) or outside the project site could result in cross contamination. This could affect workers, via direct contact/ingestion, or the increased potential for contaminated sediment laden run-off.	Low
		Contaminated material – where contaminated material, including soil, sediments or groundwater is encountered, whether known or unknown, the project would be required to remediate, treat and/or dispose of this material. If not appropriately managed this has the potential to impact surrounding receiving environments.	Medium

Project site location	Construction activity	Potential impact	Risk rating
Camellia	Ground disturbance and excavation activities.	Mobilisation of contamination – ground disturbance activities could damage the integrated capping system within the stabling and maintenance facility, or the asbestos containment cells in 13A Grand Avenue and the former Sandown Line, resulting in the mobilisation of contamination.	High
		Water quality impacts – due to the presence of shallow contaminated groundwater near the Parramatta River, extraction of groundwater during excavation could result in contamination of the receiving surface water environment if any extracted groundwater is not treated adequately prior to discharge to surface water or stormwater.	High
Parramatta River	Piling for bridge piers	Water quality impacts – works within the river could disturb and mobilise contaminated sediments, which could affect water quality and aquatic ecosystems.	Medium
Along Hill Road in Wentworth Point and Sydney Olympic Park	Excavation and ground disturbance activities.	Mobilisation of contamination – ground disturbance activities have the potential to disturb the existing leachate management system or encounter groundwater which has come into contact with waste material (leachate).	High
		Health and amenity impacts – odours and landfill gas could be generated during works near the engineered landfill areas, which could result in health and amenity impacts on workers and the surrounding community.	Medium
		Health impacts – the establishment of enclosed or confined places near the engineered landfills or areas of historic landfilling, including trenches for utilities, could result in the accumulation of gases creating an explosive atmosphere. This could also result in the depletion of oxygen levels inside compound buildings and trenches.	High

18.3.2 Potential to generate contamination

If inadequately managed, construction activities have the potential to result in the contamination of soil due to:

- accidental spills and leaks of fuel, oils, and other potentially contaminating substances, from plant and equipment or mishandling of dangerous goods stored on site
- inadequate handling of contaminated materials and excavated waste
- mobilisation of contaminants during demolition of structures, including buildings and services, which contain potentially contaminating substances such as asbestos and leaded paint.

The potential contamination of surface soils due to the above activities could affect groundwater through leaching, and/or surface water due to mobilisation of contaminated run-off.

These potential impacts would be mitigated by implementing the measures provided in section 18.6. Hazardous materials surveys would be undertaken prior to the stripping and demolition of any buildings and structures. Hazardous materials would be removed and disposed of in accordance with relevant legislation, codes of practice, and Australian Standards. Mitigation measures are provided in Chapter 19 (Hazards and risks) to minimise the potential impacts of transport and handling dangerous goods and hazardous materials.

To avoid potential cross contamination of soils, the reuse of materials for fill or other purposes would be subject to testing in accordance with relevant guidelines prior to use. Where materials are deemed unsuitable for reuse, or where there is a surplus of reusable material (e.g. fill), this would be managed in accordance with the management hierarchy and measures provided in Chapter 22 (Waste and resource use).

18.3.3 Soil impacts

Soil erosion and sediment transport

Construction would temporarily expose the natural ground surface and sub-surface through the removal of vegetation, general excavation and soil disturbance, and the removal of hardstand surfaces including roads and footpaths.

Excavation and ground disturbance activities would expose and disturb soils, which if not managed adequately, could result in:

- erosion of exposed soil and stockpiled materials
- exposure of soil containing sulfidic material to oxygen, resulting in the production and mobilisation of sulfuric acid
- increases in salinity levels in soil
- potential for localised changes to landform such as earth embankments and cut or fill areas which could impact local hydrology
- dust generation resulting in air quality impacts
- mobilisation of contaminated sediments and contamination of surface water runoff, with resultant potential for environmental and human health impacts.

The potential for dust impacts is considered in Chapter 20 (Air quality). The potential for soil erosion impacts would be minimised by implementing a soil and water management plan, which would be prepared and implemented as part of the CEMP in accordance with the Blue Book or the *Best Practice Erosion & Sediment Control* (International Erosion Control Association (Australasia), 2008) (IECA Manual), as relevant (see section 18.6).

Acid sulfate soils

The exposure of acid sulfate soils to oxygen during disturbance can lead to the generation of sulfuric acid. The subsequent acidic leachate can then lead to mobilisation of heavy metals such as aluminium and iron into water bodies. Drainage from acid sulfate soils may affect water quality and can impact aquatic organisms.

Acid sulfate soils may be encountered during excavation for track infrastructure and utility works, and during piling for bridge piers. Additionally, dewatering for piling or excavation near the Parramatta River could result in the localised drawdown of the groundwater table, which could temporarily expose potential acid sulfate soils to air.

Further investigations would be undertaken within areas of medium and high acid sulfate soil potential during further design development.

Soils excavated or exposed from potential acid sulfate soils areas would be subject to the provisions of an acid sulfate soil management plan developed in accordance with the *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 1998). Once acid sulfate soils have been treated, depending on the results of testing, they could either be reused on site, or disposed of at an appropriate facility.

Soil salinity

Excavation would be undertaken in areas with moderate salinity. In addition, construction may disturb soils in areas with unidentified salinity potential.

High salinity soil can reduce or preclude vegetation growth and produce aggressive soil conditions, which may be detrimental to concrete and steel. Impacts may also occur as a result of the erosion and off-site transport of saline sediments, resulting in impacts on the receiving environment.

The potential for impacts due to the presence of saline soils is considered low. Any potential impacts would be temporary and managed by implementing standard best-practice erosion and sediment control measures.

18.3.4 Need for remediation

Construction has the potential to impact the contaminant management infrastructure and systems that are currently in place in the following locations/areas:

- Camellia:
  - Parramatta Light Rail stabling and maintenance facility – the integrated capping system
  - a section of the former Sandown Line and 13A Grand Avenue Camellia – the asbestos containment cells
- Sydney Olympic Park:
  - Woo-la-ra landfill and leachate collection drain located west of Hill Road
  - leachate rising main that crosses Hill Road north of the intersection with Holker Street,
  - landfill cap for the Kronos Hill landfill
  - leachate rising main on Australia Avenue.

Where the project has the potential to damage and/or remove these existing systems or impact their effectiveness, the controls and protocols outlined in the existing management plans would need to be implemented. The environmental management plans may require that a remediation action plan be prepared where potential disturbance is deemed to be substantial, and that the plan is approved by a site auditor. Within those areas of Sydney Olympic Park that are subject to maintenance of remediation notices under the *Contaminated Land Management Act 1997*, the remediation action plan(s) would need to be prepared in consultation with Sydney Olympic Park Authority.

Land located at 37A Grand Avenue, Camellia would be required to construct the project. Track infrastructure and bridge abutments would be constructed within 37A Grand Avenue, and the site would also be used as a construction compound location. Given the presence of existing soil and groundwater contamination, including hexavalent chromium contamination, this site would require remediation.

A remediation action plan would be prepared where the requirement for remediation arises under the CLM Act. The remediation action plan would need to need to consider clean-up and/or remediation strategies to ensure that the site is suitable for the proposed use (i.e., operation of light rail infrastructure). This includes ensuring that existing contamination within the project site does not pose an ongoing risk to maintenance workers and/or the environment. In accordance with the hierarchy of preferred remediation strategies in the *Contaminated Land Management Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2017) these strategies could include (in order of preference):

- on-site treatment of soil to destroy the contaminant or reduce the associated hazard to an acceptable level
- off-site treatment of the soil to destroy the contaminant or reduce the associated hazard to an acceptable level, after which the soil is returned to site

- consolidation and isolation of the contaminated soil on site by containment with a properly designed barrier
- removal of contaminated material to an approved site or facility, followed by replacement with clean fill (as required).

Where remediation is required, it would be undertaken in general accordance with the following:

1. Remediation action plan(s) would be prepared during detailed design by a suitably qualified environmental consultant, as defined in Schedule B9 of the NEPM, certified by either the Environment Institute of Australia and New Zealand (Certified Environmental Practitioner (Site Contamination)) or Soil Science Australia (Certified Professional Soil Scientist Contaminated Site Assessment and Management).
2. Remediation action plan(s) would be approved by a site auditor accredited under the site auditor scheme under the CLM Act.
3. The implementation of the remediation action plan(s) would be validated by a suitably qualified environmental consultant, who would document the validation in a validation report that would be reviewed by a site auditor.
4. The requirements for ongoing monitoring and maintenance of the reinstated systems, and any new structures constructed to manage existing contamination, would be documented in an environmental management plan(s) that would be prepared for the project site.
5. Following preparation and approval of the environmental management plan(s) the site auditor would prepare a Site Audit Statement confirming the suitability of the project site for the proposed development.

18.4 Assessment of operation impacts

18.4.1 Potential to encounter contamination

Day-to-day operation of the project would not expose site users (including users of the light rail infrastructure and workers), to potentially contaminated soil (or groundwater) if remediation is undertaken as described in section 18.3.4.

18.4.2 Potential to generate contamination

Operation has the potential to contaminate soil and groundwater from leaks and spills of fuel, oils and other hazardous materials during maintenance activities. However, the potential is considered to be low, given the likely scale and duration of maintenance activities.

This potential impact would be minimised by implementing procedures to handle dangerous goods and hazardous materials and manage spills similar to those used for other Transport for NSW infrastructure.

18.4.3 Soil impacts

Soil erosion and sediment transport

There is potential for recently disturbed soils to be susceptible to erosion, particularly during initial periods of landscaping and re-establishment of vegetation. This may occur in areas where planting is proposed, including adjacent to disturbed areas, along embankments, and in the reinstatement of temporary ancillary facilities where topsoil is settling and vegetation is establishing.

Temporary soil stabilisation may be required immediately following construction to prevent potential erosion, topsoil loss or soil migration. This is particularly likely to be required following severe storms. A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas (see section 13.7). The strategy would include requirements for ongoing monitoring following the establishment of these areas.

Operation is not likely to result in any significant impacts on soils, topography or geology. The risk of soil erosion during operation would be minimal, as all areas impacted during construction would be sealed or rehabilitated and landscaped to prevent soil erosion from occurring. Maintenance activities involving ground disturbance would be undertaken in accordance with Transport for NSW's standard operating procedures.

Acid sulfate soils

Operation would not impact on acid sulfate soils. Maintenance activities would be unlikely to involve ground disturbance activities of sufficient depth to encounter acid sulfate soils.

Soil salinity

Operation is not expected to impact the salinity levels of the project site. Maintenance activities would be unlikely to involve ground disturbance activities of sufficient magnitude to increase water infiltration resulting in erosion and off-site transport of saline sediments, particularly with the implementation of standard erosion and sediment control measures.

18.5 Cumulative impacts

Cumulative contamination and soil impacts may result from the disturbance of soils, including contaminated soil, and discharge of contaminated groundwater from other projects occurring simultaneously close to the project. This could result in the erosion and transport of soils and contaminated sediments into surface water bodies.

The environmental assessments prepared for Sydney Metro and for other projects occurring near key areas of environmental concern in Camellia and Sydney Olympic Park included assessment of contamination and provided management measures. These projects are not expected to generate significant new contamination during construction. However, they are all likely to encounter and disturb existing contamination from past land uses that would require investigation, management, remediation and/or disposal.

The potential for cumulative impacts due to erosion and sedimentation would be managed by implementing standard erosion and sedimentation control measures. As such, it is not expected that the project would have a substantial cumulative impact on erosion and sedimentation.

Provided that projects constructed concurrently with the project are completed in accordance with the conditions of approval and any environment protection licence conditions, cumulative contamination and soils impacts are expected to be minimal.

18.6 Mitigation and management measures

18.6.1 Approach to mitigation and management

The impact assessment has been undertaken based on the results of desktop research as well as the results of a preliminary intrusive site investigation. A contamination investigation across the project site is currently underway, and will provide further information on contaminants present, their concentration in soil and groundwater, and their coverage across the project site. These additional sampling results would be used to inform further actions and decisions in relation to the need for remediation of areas. A site auditor accredited under the site auditor scheme under the CLM Act would be engaged to review the scope and results of this further assessment, and confirm it is fit for purpose.

The assessment identified that if the existing contamination issues across the project site are not adequately managed during construction (including protecting existing contamination management systems), the project would have the potential to impact the receiving environment and sensitive receivers. Construction would also have the potential to expose and disturb soils which could also impact the receiving environment.

Soil impacts during operation are not predicted to be significant and no specific mitigation and management measures are proposed.

Managing contamination during construction

A remediation action plan would be developed for the site at 37A Grand Avenue, Camellia and for any other sites determined to require remediation following further investigation. The plan(s) would outline the remediation strategy to be implemented during construction to ensure that the existing site contamination does not pose an ongoing risk to maintenance workers, the community and/or the environment.

Where there are existing remediation systems in place in Camellia and Sydney Olympic Park, the controls and protocols outlined in the existing management plans would be implemented. Any maintenance activities during operation would also be undertaken in accordance with these management plans. The existing environmental management plans may require a remediation action plan(s) to be prepared, which would describe how these systems would be managed during construction, or how these systems would be reinstated such that they continue to operate effectively after construction is finished. The remediation action plan(s) would also include detailed information regarding any new structures required to manage existing contamination such that they do not pose an ongoing contamination risk.

Where contaminated material or groundwater is encountered whether known or unknown, the project would be required to treat and/or dispose of this material or water. Contaminated material would be managed in accordance with the following hierarchy of the treatment methods, where reasonable and feasible:

- contaminated soils and sediments:
  - treatment on site and reuse within the project site (for example as part of landscaping or as fill elsewhere along the alignment where suitable)
  - treatment on site and disposal to an appropriately licenced facility
  - storage of contaminated material on site with remediation works such as capping implemented in accordance with a remediation action plan
- contaminated water:
  - treatment on site and reuse within the project site (for example for dust suppression)
  - treatment on site and discharge to surrounding environment
  - treatment on site and discharge to sewer under a trade waste agreement
  - treatment on site or off site and disposal to an appropriately licenced liquid waste facility.

The preferred methods to manage contamination would be confirmed following further geotechnical and contamination investigations and would be defined in the waste management plan. Further information on the waste and resource management plan is provided in Chapter 22 (Waste and resources). The preferred method would be assessed on a case-by-case basis.

Any groundwater encountered during works within the locations of the engineered landfills in Sydney Olympic Park (see Figure 18.8) would be managed in accordance with the dewatering management strategy (see mitigation measure W16 in section 17.6), which would include options for treatment and disposal of leachate.

Managing other potential soil impacts

Other potential impacts during construction would be managed in accordance with the CEMP. As described in section 17.6, the CEMP would include a soil and water management plan, which would define the processes, responsibilities and erosion and sediment control measures that would be implemented during construction (in accordance with the Blue Book and/or IECA Manual, as relevant). Further information on the CEMP is provided in Chapter 23 (Approach to environmental management and mitigation).

18.6.2 List of mitigation measures

Measures that will be implemented to address potential soils and contamination impacts risk are listed in Table 18.15.

Table 18.15 Soils and contamination risk mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Investigation of data gaps	CS1	Additional investigations will be undertaken to inform the design, construction planning, and preparation of remediation action plan(s) (RAP(s)) (if required). The investigations will include further characterising the existing contamination status of the project site. The results of site investigations will be assessed against the criteria contained with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPC, 2013) to determine the need for any remediation. An independent site auditor accredited under the site auditor scheme under the CLM Act will review the scope and results of the further investigation, including any recommendations for further assessment, and provide a written opinion on the contamination risk and the appropriateness of the reports and any proposed recommendations.	Design
Management of contaminated sites	CS2	Where the project has the potential to affect the remediation systems in the stabling and maintenance facility, and the asbestos containment cells at 13A Grand Avenue and the former Sandown Line, the controls and protocols outlined in the existing long-term environmental management plan will be implemented such that the systems continue to operate effectively.	Design
	CS3	Where the project has the potential to affect the leachate management systems in Sydney Olympic Park, negotiation will be undertaken with Sydney Olympic Park to understand the extent of the potential interaction and controls and protocols outlined in the existing management plan will be implemented such that the systems continue to operate effectively.	Design

Impact/issue	Ref	Mitigation measure	Timing
	CS4	Where the potential for disturbance of existing remediation systems in Camellia and Sydney Olympic Park is not consistent with the existing management plans, a remediation action plan(s) will be prepared in consultation with the landowners and NSW EPA. The plan(s) will describe how these systems will be managed during construction, and/or how these systems will be reinstated such that they continue to operate effectively after construction is complete.	Design
	CS5	Where a remediation action plan(s) is/are determined to be required following further investigation at 37A Grand Avenue, Camellia and any other areas within the project site, it will be prepared and implemented in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999.* The remediation action plan (s) will be reviewed by an independent site auditor (accredited under the site auditor scheme under the CLM Act), to certify the appropriateness of the plan(s) and that the site can be made suitable for the proposed use.	Design
Demolition of structures containing hazardous materials	CS6	Hazardous materials surveys will be undertaken to inform construction planning.	Pre-construction
Potential impacts of soil disturbance	CS7	The soil and water management plan (mitigation measure W9) will detail processes, responsibilities and measures to manage potential soil impacts during construction, including potential impacts associated with the presence of existing contamination, stockpile management, saline soils and acid sulfate soils.	Pre-construction, construction
Potential impacts of contaminated sediment disturbance	CS8	Physical controls (such as sediment curtains) will be implemented during works within the Parramatta River to minimise the disturbance and migration of contaminated sediments.	Pre-construction, construction
Disposal of contaminated soil and groundwater	CS9	The preferred methods to manage and dispose of contaminated materials and groundwater will be confirmed following further geotechnical and contamination investigations and incorporated into the waste management plan (mitigation measure WR3).	Pre-construction
Landfill gas intrusion	CS10	Protocols to address and manage the potential for landfill gases along Hill Road and in Sydney Olympic Park will be developed and implemented during construction. The protocols will consider confined and/or enclosed spaces and appropriate controls as required (e.g. forced ventilation) and will include appropriate occupational monitoring.	Pre-construction, construction
Acid sulfate soils	CS11	An acid sulfate soils management plan will be prepared as part of the soil and water management plan in accordance with the *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 1998). The plan will define the process and measures to manage actual and potential acid sulfate soil and sediment disturbed during construction. The plan will include a summary of available acid sulfate soil information relevant to the project site and identify any further soil/water analysis required as a precursor to implementing the management plan. Acid sulfate soils will be disposed off-site (where required) in accordance with the *Waste Classification Guidelines - Part 1: Classifying waste* (NSW EPA, 2014a) and *Part 4: Acid sulfate soils* (NSW EPA, 2014b).	Pre-construction, construction

Impact/issue	Ref	Mitigation measure	Timing
Stockpile management and handling	CS12	Temporary storage and containment systems for the stockpiling of contaminated material during construction will be designed to be impervious to the materials stored, resistant to fire (where required), prevent cross contamination of clean fill, covered to prevent contact with rainfall (when required), and managed and maintained to prevent any release of liquids and contaminated run-off to stormwater drains, waters and land.	Pre-construction, construction
Management of previously unidentified contaminated material	CS13	The discovery of previously unidentified contaminated material will be managed in accordance with an unexpected contaminated finds procedure, which will be included in the soil and water management plan.	Pre-construction, construction
Contamination during operation	CS14	Spills and leaks of vehicles or maintenance plant and equipment will be managed in accordance with Transport for NSW's standard operating procedures.	Operation
	CS15	Ongoing management and monitoring measures will be implemented for any areas where minor, residual contamination remains following construction.	Operation