Chapter 15
Contamination and soils

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Contents

List of tables

List of figures

15. Contamination and soils

Chapter 15 describes the geological and soil environment of the Moorebank Intermodal Terminal (IMT) Project (the Project) and the potential sources of contamination from former and current land uses on the Project site. This chapter also assesses the suitability of the Project site for the proposed future land use as an IMT and identifies the necessary mitigations and remediation actions required to facilitate the construction of the IMT.

This chapter addresses the Commonwealth Department of the Environment (DoE)'s Environmental Impact Statement (EIS) Guidelines and the Secretary for the NSW Department of Planning & Environment (NSW DP&E)'s Environmental Assessment Requirements (NSW SEARs) in respect of contamination and soil impacts of the Project (refer to Table 15.1).

Table 15.1 Relevant Commonwealth EIS Guidelines and NSW SEARs

Requirement	Where addressed
Commonwealth EIS Guidelines under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	
No specific requirement	N/A
NSW SEARs under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)	
Soils and contamination – including but not limited to:	
• Potential land contamination and identification of the need for remediation having regard to the ecological and human health risks posed by existing and past land uses on and adjoining the site.	Potential land contamination and need for remediation are described in this chapter. Ecological and human health risks are described in Chapters 13 – *Biodiversity* and Chapter 25 – *Human health risks and impacts* respectively.
• Where remediation is required, presentation of remediation options.	Section 15.2 and 15.4
• Natural soil constraints including potential for acid sulfate soils.	Section 15.2
• Taking into account the *Acid Sulfate Soils Manual* (ASSMAC), Managing *Land Contamination: Planning Guidelines - SEPP 55 Remediation of Land* (DUAP), relevant Australian Standards, Commonwealth guidelines and codes of practice.	Section 15.3.1 and 15.5.1.

15.1 Site rehabilitation

Prior to the Project commencing, site rehabilitation works are required to reduce the environmental, health and safety risks on the Project site. The site rehabilitation works, which are subject to a separate EPBC referral (2014/7152), are to be undertaken as part of the Commonwealth's existing obligations for environmental stewardship of the land. A plan of the indicative layout of the site rehabilitation works is included in Figure 8.1 in Chapter 8 – *Project development phasing and construction*.

The scope of the site rehabilitation works is described in section 8.1.2 in Chapter 8 and includes decontamination activities as follows:

- decontamination and demolition of eight buildings identified as including asbestos containing material;

- remediation of previously identified contamination hotspots, including underground storage tanks, as identified in the *Moorebank Intermodal Terminal Preliminary Remediation Action Plan* (RAP) (refer to Volume 5B – Technical Paper 5 – *Environmental Site Assessment (Phase 2)* and shown in Figure 15.1; and
- decontamination and site stabilisation of the plant and equipment operation training area on the western side of the Project site, known as the 'dust bowl' (identified as Area 11 on Figure 15.1).

On 9 May 2014, the proposed site rehabilitation works were declared (under delegation from the Commonwealth Minister for the Environment) not to be a 'controlled action' and therefore not subject to further assessment under the EPBC Act. This EIS therefore excludes consideration of the site rehabilitation works.

15.2 Assessment approach

As shown in Figure 1.1 in Chapter 1 – *Introduction,* the Project site comprises:

- the main IMT site (which is the land to the east of the Georges River, currently occupied by the Department of Defence (Defence); and
- the rail connection (including the Georges River) from the main IMT site to the Southern Sydney Freight Line (SSFL), including the three rail access options (northern, central and southern) as proposed within the Project concept.

Phase 1 and Phase 2 Environmental Site Assessments (ESAs) have been prepared for the main IMT site and these are included in Technical Paper 5 – *Environmental Site Assessment (Phase 2)* in Volumes 5A and 5B of this EIS. Section 15.2.1 describes the assessment approach used to prepare the Phase 1 and Phase 2 ESAs for the main IMT site. In addition, Phase 1 ESAs have been prepared for each of the three rail access options and these are appended to the Phase 2 ESA (refer Appendix C – E in Technical Paper 5 – *Environmental Site Assessment (Phase 2)* in Volume 5B). The process for preparing these Phase 1 ESAs is described in section 15.2.2.

15.2.1 Main IMT site

The ESA investigations were completed in accordance with the requirements of the NSW *Contaminated Land Management Act 1997* (CLM Act). The ESAs, which include both Phase 1 and 2 assessments for the main IMT site, incorporate the results of a number of previous studies as well as field work and targeted soil and water sampling.

The Phase 2 ESA investigation has been undertaken in general accordance with the following guidelines:

- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;
- Australian Standard AS4482.1 (2005) *Guide to the investigation and sampling of sites with potentially contaminated soil* – Part 1: Non-volatile and semi-volatile compounds;
- NSW EPA (2000a) *Guidelines for Consultants Reporting on Contaminated Sites*;
- NSW DECC (2006) *Guidelines for the NSW Site Auditor Scheme* (2nd Edition);
- NSW DECC (2007b) *Guidelines for the Assessment and Management of Groundwater Contamination*;

- DUAP (1998) SEPP 55 – Managing Land Contamination;
- National Environment Protection Council (NEPC) 2013, *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)* (NEPM);
- NSW EPA (1995) *Sampling Design Guidelines*; and
- NSW EPA (1994) *Guidelines for Assessing Service Station Sites*.

The Phase 2 ESA was originally prepared in 2011 but has been updated in accordance with the *National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013* (No. 1) (NEPM), released in 2013. The updated Phase 2 ESA has been reviewed by an independent site auditor accredited by the NSW Environment Protection Authority (EPA) under the CLM Act to provide certainty in the non-statutory sign off of the Phase 2 ESA and conclusions relating to the feasibility of the proposed future use of the IMT site. The audit recommendations have been included in the revised Phase 2 ESA.

Fieldwork was conducted between 24 January and 10 February 2011 to ascertain the potential extent of onsite contamination, and potential soil, sediment and groundwater impacts.

Soil samples were taken from 40 test pits, 22 soil boreholes (of which 21 boreholes were converted into groundwater monitoring wells), 10 hand auger and seven sediment sampling locations throughout the IMT site. Soil samples were collected from:

- the ground surface (0–150 millimetres (mm)) in unpaved areas;
- a depth of 0.3 to 0.5 metres (m) below ground level (BGL), at a depth of 1.0 m BGL and then at 1.0 m intervals until the borehole/test pit termination depth;
- areas where visual observation of potentially asbestos containing materials (ACM) or fragments were made; and
- where visual or olfactory evidence and changes in rock characteristics were noted.

Twenty-one groundwater monitoring wells were drilled to depths between 9 and 16 m. After development, monitoring wells were left for a minimum of 7 days and were gauged and sampled in accordance with standard industry practice.

Surface water samples were obtained using a stainless steel bucket to collect a 5 to 10 litre (L) volume of water. Sediment samples were collected using a stainless steel trowel to deposit sediment into laboratory supplied containers.

In addition to the intrusive works, an unexploded ordnance (UXO) specialist contractor was engaged to undertake an assessment of potential UXO in the subsurface environment. A seismic refraction survey (SRS) was also undertaken by geophysical survey specialists with the objective of assessing the extent of fill at various locations across the main IMT site.

15.2.2 Rail access options

Phase 1 ESAs have been prepared for land on the western side of the Georges River, affected by the proposed rail access options. These are as follows:

- Phase 1 ESA of land affected by the northern rail access option, being Liverpool City Council (LCC) land (Lot 10 DP 881265);

- Phase 1 ESA of land affected by the central rail access option, being Commonwealth land (Lot 4 DP 1130937) referred to as the 'hourglass land'; and
- Phase 1 ESA of five parcels of land affected by the southern rail access option, being Lot 5 DP 833516, Lot 51 DP 515696, Lot 52 DP 517310 and Lots 103 and Lot 104 in DP 1143827.

These Phase 1 ESAs have been prepared in accordance with the requirements of the CLM Act. The scope of work comprised a review of aerial photographs, local government records, public registers and geological and hydrological information. The Phase 1 ESAs were also reviewed by an accredited site auditor to ensure their alignment with the requirements of the CLM Act.

A site walkover on land affected by the northern rail access option was undertaken in October 2012. A site walkover on land affected by the central rail access option was undertaken in May 2014, however, only part of the site was accessible. Parsons Brinckerhoff did not have the necessary landowners consent to access the Glenfield Landfill site and therefore a site walkover was not undertaken for the southern rail access option Phase 1 ESA.

Following selection of the preferred rail access option, a detailed Phase 2 ESA would be undertaken on the land affected by the relevant rail link. Results of the Phase 2 ESA would be provided as part of the Stage 2 State significant development (SSD) approval(s).

15.2.3 Approach to impact assessment

Construction of the Project is likely to be undertaken in a phased approach as outlined in Chapter 8 – *Project development phasing and construction.* However, as the Project phasing is indicative only, the contamination impacts have been considered on a worst case basis – being the combined development area for all Project development phases. The operational impacts of the Project have been assessed on the fully developed (i.e. Full Build) Project.

In addition, before construction of the IMT begins it is proposed to undertake initial site preparation activities including some soil remediation, building demolition, service disconnection, establishment of construction access and services and establishment of the conservation area. These works are referred to as the Early Works and are detailed in section 8.3. In respect to contamination, the Early Works development phase proposes to:

- demolish and remove existing buildings, structures and hazardous buildings, including asbestos contaminated buildings;
- undertake some contaminated land remediation including removal of unexploded ordnance (UXO) and explosive ordnance waste (EOW) (if found) and removal of an aboveground storage tank (AST); and
- remediation of an area known to contain asbestos, identified as Area 18 in Figure 15.1.

The impacts of the Early Works phase have been considered as part of the construction activities within this chapter as detailed in section 15.4.

15.3 Existing environment

15.3.1 Main IMT site

Historical land use

The majority of the main IMT site has been owned by the Australian Government since 1913 and has been used by Defence since the 1940s. Prior to World War II, development on the site was minimal, with little vegetation clearing.

In the surrounding areas, residential and industrial development has gradually increased since the 1970s. The Defence National Storage and Distribution Centre (DNSDC) has occupied land to the east of the main IMT site since the early 1950s.

The historical land use of the main IMT site has been ascertained from archival records and historical photos. A summary of aerial photos is provided in Table15.2. The historical use of land directly west of the Georges River is described in section 15.3.2 to section 15.3.4.

Table 15.2 Historical land use

Year	Main IMT site	Surrounding land use
1930	The northern part of the main IMT site (Moorebank Barracks site) was largely undeveloped. A small grid of buildings was located at the north-east of the site, with a small road bisecting the site east to west and a number of access tracks. The southern part of the site (Steele Barracks) was also largely vacant, with no visible buildings and limited clearing.	Much of the land south, east and west of the site remained undeveloped, with remnant bushland predominant. The Georges River had a more significant meandering shape in 1930 than at present. Farmland was established north of the site, and in some locations of the Georges River. Development on the DNSDC site had commenced, with 12 large rectangular buildings present.
1956 (southern part of main IMT site)	The basic road layout of Steele Barracks had been established, and development of the site was ongoing. Numerous buildings were established throughout the centre and west of the site. The western part of the site was cleared, and playing fields established to the south of the site.	Residential development was occurring west of the Georges River. Land clearing had commenced south of the site. The DNSDC site was now largely the same as its current configuration.
1961 (northern part of the main IMT site)	A large building (former Pickles Auction Yard building) was established on the main IMT site, with warehousing and residential barracks established on the Moorebank Barracks site.	Industrial land use had commenced north-east of the site. Further residential development was developing west of the Main South Rail Line. A number of ponds and tributaries had been established on the western bank of the Georges River.
1965	Ongoing development was now largely dedicated to the north of the main IMT site. The centre of the Steele Barracks site had been extensively developed, with some further clearance to the south-west. A large excavated area to the north of the site may have been used for waste fill.	Clearing had commenced along the current alignment of the East Hills Rail Line. Quarrying had commenced south-west of the main IMT site, at the current location of the Glenfield Landfill.

Year	Main IMT site	Surrounding land use
1970	The excavated area at the north of the site had now been revegetated. An east to west drainage line was established across the Moorebank Barracks site. The area of the site west of the Georges River appears to be sparsely vegetated with open spaces and areas thought to resemble ponds, fairways and green associated with a golf course.	
1975 (southern part of the main IMT site)	The Royal Australian Engineers Golf Course was now established.	A large building was under construction on the ABB site. Further residential development continued west of the site.
1988 (northern part of the main IMT site)	A number of additional buildings were established across the Moorebank Barracks site. A new pond was developed at the north of the site.	Construction of the M5 Motorway had begun. Industrial development of the surrounding area continued. Further residential development continued west of the site.
1994	A number of buildings at the centre of Steele Barracks were demolished, and the area returfed with sparse tree planting. Additional barracks and administrative buildings were present, in the current configuration of the site. Moorebank Barracks was largely unchanged, except for the addition of a number of buildings.	The construction of the M5 Motorway was complete. The East Hills Rail Line was now under construction. Additional buildings had been constructed on the DNSDC site. Clearing and subdivision were apparent within the current suburb of Wattle Grove.
Present	A number of buildings in the far north-east of the main IMT site have been removed, and the area revegetated. Generally, however, both Moorebank and Steele Barracks remain in the same layout as for the previous 20 years.	The density of development in the surrounding area has increased, with development of residential communities at Wattle Grove and the industrial and warehousing precincts north of the M5 Motorway.

Geology and soils

The surface geology of the main IMT site comprises Quaternary and Tertiary alluvium consisting of silt, sand and gravels from Quaternary fluvial deposition. The *Penrith 1:100,000 Series Geological Series Sheet 9030* (Department of Mineral Resources 1991) indicates dark grey to black Ashfield Shale of the Wianamatta Group, which is typically black to dark grey shales and laminates from the Triassic period. This is underlain by Triassic Hawkesbury Sandstone in the north-western area of the main IMT site, comprising mainly medium to very coarse grained quartz sandstone. The Ashfield Shale strata dips towards the north-west.

The soil landscape consists of Quaternary and Tertiary terraces of the Nepean River and the Georges River. The soils comprise poorly structured orange to red clay loams, clays and sands with the potential for the presence of ironstone nodules. Soils are saturated at depths of between 7 m and 15 m BGL.

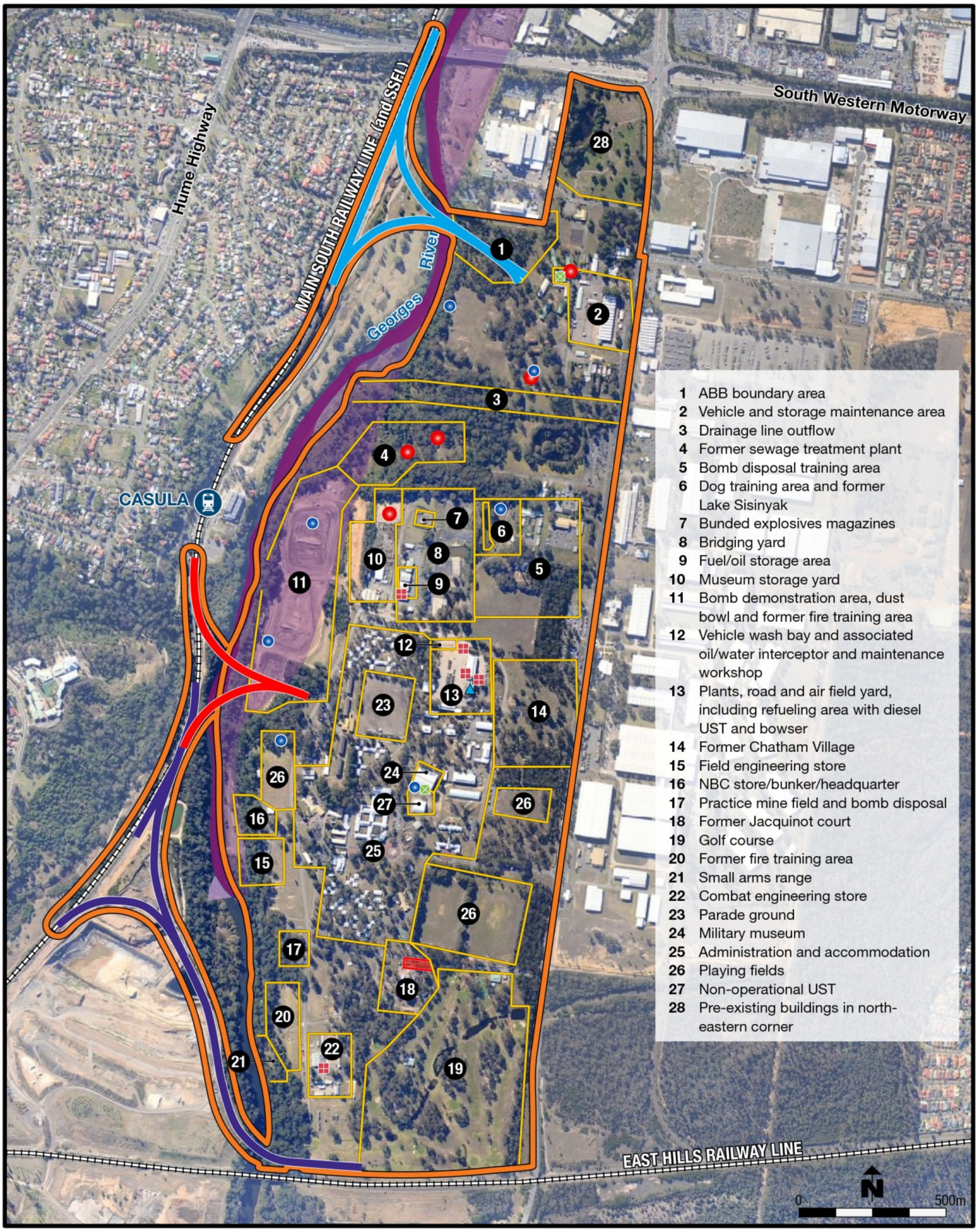
Fill material was used during site establishment and construction works throughout the history of development on the main IMT site; however, the volumes of fill on site are not significant. Fill depths generally range between 0.5 and 1 m BGL, with maximum depths of over 3.2 m BGL at certain locations, including at the site of the former sewage treatment plant as shown in Figure 15.1. Fill material on site includes sands, gravels and clays, as well as building demolition materials such as concrete, bricks, metals and plastic. Asbestos cement fragments have also been detected in surface soils on the main IMT site. Figure 15.1 identifies where asbestos has been found on site.

Acid sulfate soils

It is likely that the main IMT site includes land with potential acid sulfate soils (ASSs). ASSs are soils that contain iron sulphides, which produce sulphuric acid when exposed to oxygen in air. The alluvial soils associated with the Georges River contain iron sulphides and have varying levels of acid generating potential. A review of the ASS risk maps (CSIRO 2012) showed an extremely low probability of ASS for the majority of the IMT site; however, there is a high probability of ASS occurring along the banks of the Georges River, on the western side of the main IMT site (refer Figure 15.1).

Soil testing found soils with acid generating potential are present in some locations on the main IMT site. As such, subsurface material may pose an acid generation risk if exposed to oxygen during development.

Based on the sample collection and laboratory analysis for ASS, some results were reported to be above the adopted assessment criteria that were derived with reference to the *Acid Sulfate Soils Management Advisory Committee (ASSMAC) Assessment Guidelines* (1998), indicating that soils may have the potential to be acid generating. Groundwater at the site has previously been gauged between 5.2 m to 9.1 m BGL. It is considered that ASS may exist below the water table, particularly within the Georges River corridor where there is a high potential for ASS based on the CSIRO Australian Soil Resource Information System ASS Risk maps (http://www.asris.csiro.au/index_ie.html).



- Project site boundary
- Northern rail access option
- Central rail access option
- Southern rail access option
- CLM investigation area
- Suspected asbestos impacted soil mound

Acid sulfate soils

- High probability
- Low probability
- Extremely low probability

- Known acid sulfate soil location
- Operational UST
- Non-operational UST
- Operational AST
- Asbestos detected

Figure 15.1 Existing environment

Potential sources of contamination

Based on the history of the main IMT site, there is potential for contamination to have occurred as a result of the military training facilities, demolition and reconstruction of buildings, and the use and storage of potentially harmful chemicals such as fuels.

The potential sources of contamination on the IMT site include:

- buried wastes and waste stockpiles from onsite demolition activities over time;
- leaks from the storage/use of hazardous chemicals as well as fuels and waste oils in areas like the bridging yard and engineering workshops;
- building waste containing hazardous materials such as asbestos within above ground structures;
- residual contamination from long-term use of the site as a military training facility for activities like munitions training, bomb disposal and small arms firing ranges;
- ongoing site operations including the use of heavy earthmoving plant and equipment; and
- residual contamination from the detonation of explosives used in military training operations.

Potential offsite sources of contamination include the following:

- ABB site (to the north-west): An online search of the NSW Office of Environment and Heritage (OEH) contaminated land record database returned eight notice records (three former and five current) for the ABB site, which indicate that chemical wastes such as polychlorinated biphenyl (PCB) are present on the site. Based on the relatively high hydraulic conductivity of alluvial sands beneath the site, and the inferred groundwater flow direction, there is the potential for contaminated groundwater to migrate from the ABB site onto the IMT site.
- DNSDC (to the east): Contamination impacts have been identified in groundwater sampled from monitoring wells on the western boundary of the DNSDC site. Chemical wastes include total recoverable hydrocarbons (TRHs), benzene, toluene, ethylbenzene and xylene (BTEX) compounds and elevated dissolved heavy metals (including cadmium, copper, zinc, nickel and lead) (HLA Envirosciences 2003).
- Moorebank Business Park (north of the DNSDC site): The business park comprises commercial premises including showrooms and warehousing. However, due to the recent redevelopment of the site, this area is unlikely to present a potential offsite source of contamination.
- Glenfield Landfill (to the south-west): This is an active landfill and waste transfer facility, which has the potential to cause environmental impacts associated with the flow of potentially contaminated groundwater within and beneath the waste fill towards the Georges River.

Potential soil contamination

Sampling during the Phase 2 ESA comprised 22 bores holes, 40 test pits, 10 hand auger locations and 7 sediments samples. This soil sampling found the following contaminants on the site:

- TRHs;
- BTEX compounds;
- polycyclic aromatic hydrocarbons (PAH);
- dichlorodiphenyldichloroethane (DDD);
- dichlorodiphenylchloroethylene (DDE);
- chlordane;
- bis(2-ethylhexyl)phthalate;
- di-n-butyl phthalate;
- perfluorooctanoic acid (PFOA);
- perfluorooctanesulfonic acid (PFOS);
- asbestos;
- pesticides; and
- volatile organic compound (VOCs) and semi volatile organic compound (SVOCs).

Based on the sampling results, a number of areas (refer to Table 15.3) on the Project site were identified as containing contamination levels above the level of acceptable risk identified in the Phase 2 ESA (based on the NEPM).

Table 15.3 Overview of specific soil contamination identified

Contaminant	Location (refer to Figure 15.1)	Vertical extent detected (m BGL)	Rationale for remediation
TRH	Vehicle maintenance yard (Area 2)	0.0–1.8	Soil results showed marginal and localised exceedances of the commercial land use HSLs for TRH fractions C_6 to C_{10} and petroleum hydrocarbon management limits (PHML) (NEPM 2013).
	Dust bowl (Area 11)	0.0–1.7	One soil sample exceeded the commercial land use HSLs for TRH fractions C_6 to C_{10} and C_{10} to C_{16} and for PHML TRH fractions C_{16} to C_{34} and C_{34} to C_{40} (NEPM 2013).
	Plant, roads and airfield yard (Area 13)	0.0–1.6	One soil sample exceeded the commercial land use HSLs for TRH fractions C_6 to C_{10} and C_{10} to C_{16} and for PHML TRH fractions C_{16} to C_{34}.
	Fire training area (Area 20)	0.0–1.5	One soil sample exceeded the commercial land use HSLs for TRH fractions C_6 to C_{10} and C_{10} to C_{16} and one sample exceeded the HSLs for TRH fractions C_{10} to C_{16} and for PHML TRH fractions C_{16} to C_{34} (NEPM 2013).
Metals	Bridging yard near grit blasting facility (Area 8)	0.0–0.5	One sample exceeded the adopted health investigation level (HIL) for lead.
PFOA and PFOS	Dust bowl (Area 11) *Note that this area is being remediated as part of the site rehabilitation referral works and is therefore excluded from this EIS.*	0.0–0.5	Concentrations of 0.0059 mg/kg of PFOA and 0.418 mg/kg of PFOS were detected. No assessment criteria available.
Asbestos	Museum storage yard, former STP, vehicle maintenance yard, dust bowl and north of drainage line (Areas 10, 4, 2, 11 and 3)	0.0–0.5	A total of 68 samples were analysed for asbestos in soil. Chrysotile and amosite asbestos fibres were detected in eight samples.
Acid sulfate soils (ASS)	Presented in Figure 15.1	Various (0.4, 1.0, 2.0 and 13.0).	Nine samples were tested for ASS. Five had percentages of potential S_{POS} equal to or above the adopted criteria indicating that sulfidic materials are present in soils. Total – potential acidity values were above the assessment criteria for five samples. Based on these results, it was considered that subsurface materials encountered may pose an acid generation risk if exposed to oxygen during redevelopment. As the water table impedes oxidation of potential iron sulfides in the subsurface, dewatering/lowering of the groundwater table during redevelopment may result in oxidising conditions at depth.

Source: Based on Table 2.7 RAP (Appendix F in Technical Paper 5 – *Environmental Site Assessment (Phase 2)* in Volume 5B)

Notes: S_{POS} = measure of potential sulfidic acidity

Based on the findings of the Phase 2 ESA, a preliminary RAP has been prepared for the main IMT site and is included in Appendix F in Technical Paper 5 – *Environmental Site Assessment (Phase 2)* in Volume 5B. The RAP identifies specific areas of soil contamination requiring remediation as part of Project works. Table 15.2 in the RAP identifies the locations requiring remediation and specifies the rationale for remediation, as outlined in the RAP. The RAP is provisional and the final RAP would be developed by the Project contractor prior to construction.

Remediation of Area 11 (the 'dust bowl') would be undertaken as part of the site rehabilitation works, which are subject to a separate referral and therefore have not been considered further as part of this EIS. In addition, several hydrocarbon storage tanks including underground storage tanks (USTs) and one AST are present within the main IMT site. The removal of USTs would also be undertaken as part of the 'site rehabilitation works'. This includes both operational and non-operational USTs as identified on Figure 15.1. The removal of the AST would be undertaken during the Early Works development phase.

As discussed in the Phase 2 ESA, based on the potential onsite contamination, including areas identified in Table 15.3, there is no evidence to suggest that the contamination identified in soils and groundwater on site has affected, or is likely to affect, the established riparian vegetation as no evidence of plant stress was noted. The chemical concentrations identified in onsite soils are not considered to pose significant risk to onsite ecological receptors.

Explosive ordnances

Artefacts of military origin and EOW were generally found within active and former training areas of the main IMT site such as the explosive ordnance disposal area, dog training area, practice mine detection area, demolitions training area and open areas such as the sports ground/ovals and golf course, as shown in Figure 15.1.

A review of the Defence National UXO database found that the site is not in an area with potential risk of UXO. Although the site has been used historically to train engineers, a number of ordnance items were detected during the Field Validation Survey (FVS) investigation, including blank and empty fired cartridge cases and a number of small arms ammunition (SAA) projectiles.

The main findings from the FVS are that:

- other than propellant/primers in unfired/misfired SAA blank cartridge cases, the site does not have the potential to contain remnant UXO or explosive ordnance (EO) containing high explosive or other energetic material;
- the open areas of the site contain EOW, particularly blank ammunition, as a result of close training activities over a long period of time;
- heavily vegetated areas have a higher potential for remnant EOW from close training activities than the open areas assessed during field validation survey, as training in vegetated areas is common, but clean-up of spent EOW is more difficult due to vegetation cover; and
- despite the identification of a grenade training component during the site survey, based on a review of historical documents and aerial photographs, there is no evidence to suggest the existence or likely location of a formal grenade range.

Ground and surface water contamination

Groundwater was encountered within the underlying shallow alluvial aquifer and flows generally west towards the Georges River. Groundwater conditions are also discussed in Chapter 16 – *Hydrology, groundwater and water quality*.

Analytical groundwater results for the main IMT site indicate elevated concentrations of contaminants in groundwater. Typical contaminants detected on the site include:

- TRH;
- BTEX;
- dissolved heavy metals;
- trichloroethene (TCE);
- PAHs;
- polychlorinate biphenyls (PCBs);
- VOCs and SVOCs;
- formaldehyde; and
- anionic surfactants.

Field parameters such as pH, electrical conductivity, temperature and dissolved oxygen were collected at each groundwater and surface water sampling location. This is also discussed in Chapter 16 – *Hydrology, ground water and water quality.*

Elevated concentrations of copper nickel and zinc were reported as being marginally above the adopted assessment criteria within the collected surface water samples. Concentrations were generally similar in surface water sampled across the IMT site.

Chlorinated hydrocarbons have been identified in groundwater at the north-western area of the IMT site, referred to as Area 1, as shown in Figure 15.1. The Phase 2 ESA notes that there are no potential onsite sources of chlorinated hydrocarbons, and that the contamination is likely to be attributed to an offsite source. However, due to the relatively high hydraulic conductivity of alluvial soils in the area, the proximity of the TCE affected groundwater to the Georges River and the inferred direction of groundwater flow, offsite migration of contaminated groundwater may be occurring.

The Phase 2 ESA identified specific areas of groundwater contamination, which require remediation in accordance with the RAP. Table 15.4 provides an overview of identified groundwater contamination with reference to area locations presented in Figure 15.1.

Table 15.4 Overview of specific groundwater contamination identified

Contaminant	Detections	
TRH C_6–C_9	Groundwater monitoring well MW_BHB2 (340 µg/L), located in the ABB boundary area, was found to have elevated concentrations of TRH C_6–C_9.This detection is considered likely to be associated with chlorinated hydrocarbon compounds detected in this area.	
TRH C_{10}–C_{36}	Detected in 16 of the 39 groundwater samples analysed at concentrations between 50 and 820 µg/L.	
Metals *(The most elevated metals concentrations were generally reported in groundwater beneath the Plant Roads and Airfield Yard)*	Cadmium	Dissolved cadmium detections ranged from 0.1 to 1.5 µg/L. The maximum cadmium concentration was reported in groundwater sampled from monitoring well PB_MW09 in Area 13 (Plant, roads and airfields yard). Of the 13 detections, 8 exceeded the adopted assessment criteria (0.2 mg/kg).
	Copper	Dissolved copper detections generally ranged between 1 and 7 µg/L. Elevated concentrations of dissolved copper were reported in groundwater sampled from wells PB_MW06 (37 µg/L) in Area 10 (museum storage yard) PB_MW09 (56 µg/L) located in Area 13 (plant, roads and airfield yard) and MW083 (maximum concentration of 79 µg/L) in Area 20 (former fire training area (FTA). Of the 25 detections, 21 exceeded the adopted assessment criteria (1.4 µg/L).
	Lead	The maximum concentration of dissolved lead (114 µg/L) was reported in groundwater sampled from monitoring well MW083 located in Area 20 (former FTA). Of the 16 detections, 8 exceeded the adopted assessment criteria of 3.4 µg/L.
	Nickel	Dissolved nickel detections ranged from 1 to 168 µg/L. The maximum nickel concentration was reported in groundwater sampled from monitoring well PB_MW19 in Area 13 (PRA yard). Of the 32 nickel detections, 17 were above the adopted assessment and 7 of these were reported for groundwater samples collected from monitoring wells in Area 13 (plant, roads and airfield yard).
	Zinc	Dissolved zinc detections ranged from 5 to 408 µg/L. The maximum concentration was reported in groundwater sampled from PB_MW19 in Area 13 (plant, roads and airfield yard). Of the 30 zinc detections, 28 were above the adopted assessment criteria (8 µg/L).
PAH	The most elevated PAH detections were reported in groundwater sampled from well PB_MW14 in Area 27 (non-operational UST), where benzo(a)pyrene (0.7 µg/L), fluoranthene (0.3 µg/L) phenanthrene (0.4 µg/L) and pyrene (0.2µg/L) were reported. Naphthalene (0.4 µg/L) was detected in groundwater sample MW083 located in Area 21 (small arms range). All other detections were either below the laboratory PQL or below the respective site assessment criteria.	
VOCs	Of 31 samples analysed for VOC, the following detections were reported: • Chloroform (TCM) in groundwater sampled from well PB_MW18 (6 µg/L) located in Area 2 (vehicle storage and maintenance). • Cis-1,2-dichloroethene in groundwater sampled from well MW_BHB2 (22 µg/L) located in Area 1 (ABB boundary). • TCE in groundwater sampled from well MW_BHB2 (297 µg/L) and of TCE MW_BHB4 (18 µg/L) both located in Area 1 (ABB boundary). • All other VOC compounds were reported below the laboratory detection limit. However, the PQL for vinyl chloride was an order of magnitude above the Australian Drinking Water Guideline of 0.3 µg/L; therefore, vinyl chloride (a breakdown product of TCE) may also be present in groundwater.	
Formaldehyde	Two samples were analysed for formaldehyde. In groundwater from MW009 (Area 16) concentrations were reported at 200 µg/L. Formaldehyde was also detected in sample PB_MW15 (Area 22) at a concentration of 100 µg/L. Concentrations were below the Australian Drinking Water Guideline (500 µg/L).	

Contaminant	Detections
PFOA and PFOS	Five groundwater samples were analysed for PFOA and PFOS to establish whether residual AFFF used in fire training activities was present in groundwater. PFOA was detected in three groundwater samples from BHA-1 (0.91 µg/L), MW083 (1.4 µg/L) and MW108 (0.17 µg/L) and PFOS was detected in four groundwater samples from BHA-1 (1.57µg/L), MW083 (23.2µg/L) MW108 (0.43 µg/L) and PB_MW07 (0.07 µg/L). BHA-1 and MW108 are located within the dust bowl and former FTA, MW083 is located within the southern small arms range and PB_MW07is located in the bridging yard.
PCBs	All reported concentrations were below the laboratory PQL for all eight groundwater samples that were analysed for PCBs.

Source: Based on Table 2.8 RAP (Volume 5B)

15.3.2 Northern rail access option

The northern rail access option affects Liverpool City Council (LCC) owned land on the western side of the Georges River. Details of this land are provided below.

Historical land use

From the historical land use records reviewed as part of the Phase 1 ESA, it appears the land was used as farmland from the 1930s to 1950s, prior to being converted to a golf course in the mid-1990s. More recently a cycleway and footpath have been constructed in a north-south direction on the eastern part of the land. In addition, a road (Powerhouse Road) has been constructed along the western boundary of the northern rail access option site, providing access to the Casula Powerhouse. The land is now used as public open space.

The now decommissioned Casula Powerhouse was built in 1953 and fuelled by oil and coal. The Powerhouse was decommissioned in 1976 and remained disused until 1994, when it was redeveloped as a multi-arts facility.

Geology and soils

The *Penrith 1:100,000 geological series sheet 9030* (Department of Mineral Resources 1991) shows that the underlying geology comprises silts, sands and clays from quaternary fluvial deposition underlain by Tertiary clayey sand and clay. The alluvial deposits overlay shales of the Wianamatta Group, which are typically black to dark grey shales and laminates from the Triassic period.

Acid sulfate soils

A review of the ASS risk maps from the online CSIRO Australian Soil Resource Information System (http://www.asris.csiro.au/index_ie.html) showed a low probability of ASS across land within the northern rail access option.

Potential soils and water contamination

Based on the review of available information, there is limited potential for contamination to exist. However, there is the potential for buried waste and tipped waste (to include ACM, imported fill, and potential aerial deposition of contaminates from the roadway and former Casula Powerhouse.

In addition, due to the previous use of the site as a public golf course, there may be the potential for contaminants associated with the application of fertilisers and pesticides.

15.3.3 Central rail access option

The central rail access option affects Commonwealth land to the west of the Georges River, known as the hourglass land.

Historical land use

The land has been heavily vegetated since the 1970s. Before then it appears to have been used as farmland.

Geology and soils

The geology and soil makeup of land within the central rail access option has been found to be the same as that for the northern rail access option. That is, the underlying geology comprises silts, sands and clays from Quaternary fluvial deposition underlain by Tertiary clayey sand and clay.

Acid sulfate soils

A review of the ASS risk maps from the online CSIRO Australian Soil Resource Information System (http://www.asris.csiro.au/index_ie.html) showed an extremely low probability of ASS across land within the central rail access option.

Potential soils and water contaminations

The Phase 1 ESA concludes that there is limited potential for onsite contamination sources to exist with the exception of uncontrolled fill that may have been deposited on the site. However, the Glenfield Landfill located immediately south of the site and hydraulically up gradient has the potential to cause contamination that may migrate beneath the site via groundwater.

15.3.4 Southern rail access option

The southern rail access option affects five parcels of land within the Glenfield Landfill site. The Phase 1 ESA provides the following details.

Historical land use

Excavation, quarrying and filling have been the dominant activities on the site since the 1970s. Prior to this the site appears to have been open farmland, with the eastern boundary comprising overgrown shrubs and trees. Development of the site appears to have commenced around 1965, with the majority of the site disturbed and access roads constructed. Historical records show that the site has remained generally unchanged since the 1970s and today the site is used for landfill purposes, with excavation and quarrying activities well established.

Geology and soils

The underlying geology and soils for the southern rail access option are consistent with those for the northern and the central rail access options. However, due to the nature of known historical quarrying and landfilling activities, it is anticipated that the surficial geology (up to 30 m in depth) has been significantly disturbed and reinstated with fill material.

Acid sulfate soils

A review of the ASS risk maps from the online CSIRO Australian Soil Resource Information System (http://www.asris.csiro.au/index_ie.html) showed an extremely low probability of ASS across land within the southern rail access option. Considering that the land has been extensively reworked during its life as an operational landfill, the potential for acid sulfate soils is considered to be low.

Potential soils and water contaminations

Considering the historical and ongoing use of the land as a waste disposal facility, there is a high potential for contamination to exist on land within the southern rail access option. This includes contaminated fill, soils, groundwater, leachate and generation of landfill gases.

15.4 Impact assessment

A number of potential sources of contamination exist within the main IMT site. Contamination risks are considered to be most relevant within the construction stages of the Project; however, during Project operation, a number of potential contamination risks will remain. A discussion of the potential activities resulting in contamination and the contamination pathways on the main IMT site is provided in section 15.4.1.

The potential impacts resulting from the construction and operation of the proposed rail access options are identified in section 15.4.2.

15.4.1 Impacts on the main IMT site

Construction activities

Activities undertaken during the Early Works and the Project's construction phases have the potential to release existing sources of contamination into the surrounding environment.

As discussed in section 15.5, the Project's RAP has identified a number of contaminated areas that would require remediation prior to the development of the Project. In particular, the remediation of an asbestos soil mound, located in the south-eastern portion of the Project site adjacent to Jacquinot Court (Area 18), would be undertaken as part of Early Works. Remediation of the other sites as identified in Table 15.3 and Figure 15.2 would be undertaken during subsequent phases of the Project.

In addition to site remediation there are a number of potential construction activities that may result in contamination or opportunities for contamination. These include:

- *Earthworks and ground penetration*: It is anticipated that activities involving surface excavation or ground penetration would provide opportunities for the release and movement of contaminants, posing a potential contamination risk. These activities would involve surface scraping and topsoil removal, earthworks during both the demolition and removal of existing buildings and infrastructure, and the establishment of new infrastructure.

- *Removal of USTs and AST:* Removal of USTs would primarily be undertaken as part of the site rehabilitation works and is therefore excluded from this EIS. However, there is a very low potential that USTs (and associated contamination) could be identified during future excavation works. Removal of the AST would be undertaken as part of Early Works.

- *Stockpiling:* During the progressive construction of the Project, construction and demolition materials would need to be stored on site, creating a potential contamination risk for the surrounding environment.
- *Vegetation clearing*: A number of currently vegetated areas within the main IMT site would require clearing, disturbing the existing soil profile and posing a potential contamination and erosion risk.
- *Storage and usage of fuels:* The use and transfer of fuels and oils within machinery and storage tanks creates the opportunity for site contamination through spills and seepage.

Given the size and scale of the Project, it is anticipated that construction activities such as earthworks and ground penetration would take place across the majority of the main IMT site to varying degrees, including in areas containing existing undiscovered or unremediated contamination. Mitigation and management is required during construction (refer to section 15.5).

Operational activities

Potential activities during the Project's operation that may result in contamination or opportunities for contamination include:

- *Storage and usage of fuels*: The use and transfer of fuels and oils within machinery and storage tanks is a normal part of the operation of the Project that would create opportunities for contamination through spills and seepage.
- *Maintenance of underground utilities*: Maintenance works requiring ground disturbance creates the potential for oxidation of acidic soils, liberation of contaminations and erosion.
- *Minor earthworks*: During the operation of the Project, it is likely that minor construction activities would be required at times, resulting in stockpiling of construction materials and wastes which poses a contamination and sedimentation risk.

Contamination pathways

The construction and operational activities identified above pose a potential contamination risk if uncontrolled. Throughout the Project's construction and operation, it is anticipated that the primary transport pathways for contaminants and sediment within the main IMT site would include:

- leaching and migration of contaminants vertically into underlying groundwater systems;
- surface water flows to the Georges River and Anzac Creek;
- lateral migration of contaminated water through preferential pathways such as drainage lines or geological features;
- soil to human exposure routes (i.e. direct contact with soils (dermal contact, ingestion and inhalation));
- groundwater to human exposure routes (i.e. direct contact with surface water or groundwater via pumping to other areas of the site or abstraction of potentially contaminated groundwater from the identified registered bores);
- soil to dust to human exposure routes (dermal contact, ingestion and inhalation due to dust migration); and

- vapour migration from soil or groundwater.

Soil and water contamination impacts

As part of the Phase 2 ESA, an indicative risk assessment was conducted to provide an evaluation of the potential risks to human health and adjacent water bodies (such as the Georges River) from contamination within soils and groundwater. Table 15.5 below identifies a number of potential impacts that could result from the contamination exposure pathways identified above, if mitigation and remediation techniques detailed in the RAP and discussed in this chapter were not employed.

Table 15.5 Potential contamination exposure scenarios

Source media	Chemicals of potential concern	Exposure scenario	Receptor
Soil	TRH C_6–C_{10}	Inhalation of chemical vapours volatilised into a shallow excavation trench.	Maintenance workers.
	TRH C_6–C_{10}	Inhalation of chemical vapours volatilised into an indoor commercial space.	Commercial workers.
	Perfluorinated compounds, heavy metals	Direct contact with affected soil or dust generated from soil.	Maintenance workers (utility and landscape).
	Asbestos	Inhalation of asbestos fibres.	Construction workers and maintenance workers.
Groundwater	TRH C_{10}–C_{36}, perfluorinated compounds, dissolved heavy metals	Direct dermal contact with or ingestion of contaminated groundwater (via abstraction wells).	Potential onsite and offsite users of groundwater.
	TCE, DCE, VC	Inhalation of chemical vapours volatilised into an indoor commercial space.	Commercial workers.
	TCE, DCE, VC	Inhalation of chemical vapours volatilised into a shallow excavation trench.	Maintenance workers.

Source: Based on Table 13.1, Technical Paper 5 – *Environmental Site Assessment (Phase 2)* in Volume 5A

It is clear from Table 15.5 that the presence and in particular, removal of onsite contamination poses potential human health risks, particularly for maintenance and construction workers. However, these risks can be adequately managed through the implementation of the mitigation measures identified in section 15.5 as well as the implementation of the construction environmental management plan (CEMP).

Section 13.4 of the Phase 2 ESA provides a detailed discussion of the potential human health impacts of the Project. The most significant potential contamination impacts on the main IMT site are discussed below:

- *Contamination of soils*: Soils may be contaminated by fuels, oils and other chemical substances stored and used during the construction and operation of the Project. In addition, hazardous materials such as asbestos and buried contaminated material or fill may be present within the main IMT site, and could cause further contamination to soils when disturbed or relocated.

- *ASS*: Existing ASSs have the potential to be liberated into the surrounding soil and water environments. In addition, potentially acidic soils may oxidise and develop into ASSs through ground disturbance and/or changes in water levels.

- *Erosion and sedimentation*: Across the main IMT site, erosion may occur in surrounding cleared vegetation, stockpiled materials, drainage lines and earthworks. As a result, there is the potential for sedimentation of water bodies and the surrounding Georges River and Anzac Creek.

- *Groundwater contamination*: The local groundwater environment within the main IMT site may be contaminated through Project related activities. Seepage of contaminated runoff, leakages from fuel and oil storage tanks, and acidification of soils all have the potential to affect the local groundwater environment.

In addition, groundwater impacted with TCE was detected in the north-west of the main Moorebank IMT site in January 2011. The reported concentrations of TCE in groundwater sampled from the existing wells in this area were lower than those reported during previous investigations, indicative of a generally declining trend in contaminant concentrations. However, as contamination can naturally attenuate over time and given the time elapsed since January 2011, it is recommended that further groundwater monitoring of wells in the ABB boundary area (referred to as Area 1 in Figure 15.1) is undertaken, in order to evaluate the current concentrations of chlorinated hydrocarbon compounds and evaluate if additional action is likely to be required to manage contaminated groundwater in this area (refer to section 15.5).

Results of the indicative risk assessment indicate that provided the management and mitigation measures outlined in section 15.5 are followed, there should be no ecological or human health risks associated with contamination impacts at the IMT site.

15.4.2 Impacts resulting from rail access

The Phase 1 ESAs prepared for the three rail access options identify the potential for contamination on the land affected by each of the three proposed rail alignments. Based on the findings in the Phase 1 ESAs the following exposure pathways have been identified:

- *Northern rail access option:* There is limited potential for contamination to exist; however, if contamination were to exist in the subsurface, the key exposure pathways would likely be:
  > via direct contact with soils, surface water or groundwater (dermal contact, ingestion and inhalation) by construction/utility workers, site users and future land users;
  > through the migration of airborne dust to onsite and offsite receptors; and
  > uptake via dermal contact, ingestion and inhalation.

- *Central rail access option:* There is limited potential for onsite contamination sources to exist. As with the northern rail access option, if contamination were to exist in the subsurface, the key exposure pathways would likely be:
  > via direct contact with soils, surface water or groundwater (dermal contact, ingestion and inhalation) by construction/utility workers during site redevelopment;
  > through the migration of airborne dust to offsite receptors; and
  > uptake via dermal contact, ingestion and inhalation.

- *Southern rail access option:* There is a high potential for contamination to exist under this option including contaminated fill, soils, groundwater, leachate and generation of landfill gases. The key exposure pathways would likely be: via direct contact with soils, surface water, groundwater, leachate and landfill gases (via dermal contact, ingestion and inhalation) by construction/utility workers, site users and potentially future land users.

15.5 Management and mitigation

The Phase 2 ESA concludes that the IMT site is considered suitable for industrial commercial use, subject to implementation of the RAP measures and management controls during the construction and operation of the IMT. The RAP includes specific methods proposed to address known site contamination, and details a range of proposed remediation approaches and technologies that would be used as part of the ongoing management on the Project.

The location of the rail connection between the SSFL and the IMT site would be confirmed during the detailed design phase and would be based on one of the three rail options proposed in this EIS. Once the preferred rail alignment is known, it is recommended that a Phase 2 soil and groundwater investigation be conducted to confirm the presence of site contamination and to confirm the potential exposure pathways along the selected rail connection corridor. The mitigation measures for each of the three rail access options are identified in section 15.5.2.

15.5.1 Main IMT site

Site remediation

In accordance with the RAP, a number of contamination 'hotspot' locations within the main IMT site have been identified as requiring specific remediation to address existing contamination.

These locations are shown in Figure 15.2 and include:

- Area 2 – removal of visibly impacted soils in vehicle maintenance yard;
- Area 8 – removal of surficial soils in the bridging yard;
- Area 18 – removal of fill mound adjacent to Jacquinot Court; and
- Area 20 – removal of visibility impacted soils in vehicle maintenance yard.

In addition, areas impacted by UXO/EOW, fuel storage infrastructure (including the AST) and other asbestos affected areas across the main IMT site would also be remediated in accordance with the RAP (refer to Figure 15.2). The TRH exceedances in Area 13 are attributed to the USTs; this area would be remediated as part of the site rehabilitation works (not included in this EIS) when the USTs are removed.

The Project's phasing is indicative only at this stage and would be confirmed by the selected contractor. Once this occurs, the preliminary RAP would be updated and details would be provided in relation to the timing for the remediation activities (including the remediation of the hotspot areas). The exception is the Early Works development phase, during which it is proposed to undertake remediation of Area 18, demolition and removal of asbestos contaminated buildings, removal of UXO/EOW and removal of the AST.

Table 15.6 outlines the soil remediation methodologies that may be utilised throughout Early Works and the following construction phases of the Project. Remediation risk management across the main IMT site may comprise implementation of one or a combination of the remedial management measures.

On terms of groundwater contamination, additional investigations are proposed to augment the existing data to inform additional controls and remediation strategies, as identified in the sections below. In addition, TCE has been identified in groundwater in the north-western area of the IMT site (Area 1). The Phase 2 ESA concludes that the potential vapour risks associated with the TCE plume are negligible, based on theoretical input values. However, should the final design of the IMT include construction activities within Area 1, then further assessment of potential vapour intrusion risks during and after construction may be required.

Table 15.6 Proposed soil remediation methods and technologies

Remediation methodology	Description	Advantages	Disadvantages	Suitability to the Project site
Ongoing site management	Containment and monitoring can be considered a risk management technique for contamination that is neither destroyed nor removed from the site. Commonly ongoing management involves an ongoing monitoring program to assess the contaminant conditions at the site and provide assurance that no changes are occurring that may have an impact on sensitive receptors.	Ongoing site risk management is considered appropriate for sites where contamination presents a low or minimal risk to human health and/or the environment and the risk of offsite migration is negligible. Risk management is a method that could be economical in dealing with the contamination that may be present in areas of heterogeneous fill.	Though risk management may reduce costs in the short term, an annual allowance would be required for ongoing monitoring. Some ongoing liability associated with contamination may remain.	Yes. This approach may be appropriate for certain areas of the IMT site, where there is limited evidence of high risk contamination and where the proposed end use is not sensitive.
Onsite bioremediation	Excavated soils are thoroughly broken down and aerated, mixed with microorganisms and nutrients, stockpiled and aerated in above ground enclosures.	Cost effective if soils are utilised on site. Lower disposal costs. Limited requirement to import fill material to site. Retains material on site.	Significant area of site required to land farm material. Undefined remediation timeframe. Potential odour issues. Uncertainty of success, particularly for heavy-end hydrocarbons. Not suitable for metals contamination.	No, however bioremediation and subsequent reuse may become appropriate options should volumes greater than 250 m^3 of material be generated during underground storage tank removal works.
In-situ treatment	In-situ treatment of impacted soils within the smear zone and saturated zone using in-situ treatment methods such as soil vapour extraction (SVE), steam stripping or injection of oxygen releasing compounds.	Minimal disturbance to the site (no excavation). Cost effective for large scale site remediation projects of light end petroleum hydrocarbons. Potential to simultaneously remediate dissolved phase hydrocarbons in site groundwater (if present).	Not applicable to the kind of contamination encountered at the site. Expensive establishment costs. Potential for odour issues. Requires detailed design, pilot trials and management.	No.

Remediation methodology	Description	Advantages	Disadvantages	Suitability to the Project site
Consolidation and/or capping	Risk minimisation approach where impacted soils are managed onsite by capping the ground surface with a clean, impermeable layer. The base of the cap would be clearly marked with a geotextile to indicate that workers could potentially be exposed to contamination below the marker, which would then trigger additional health, safety and environmental controls.	Effectively removes risk by eliminating exposure pathways. Avoids costs associated with haulage and disposal.	Importance of capping materials. Contamination would remain in situ allowing potential offsite migration of contamination and further impacts on groundwater. Land use limitations. Requirement for an Environmental Management Plan.	Yes, for some areas dependent on proposed end use.
Excavation and off-site disposal	Excavate impacted materials. Transport directly to a licensed landfill facility.	Impacted material removed immediately. No storage or treatment issues. Reduced vapour/odour issues as impacted materials removed from site. Minimal design and management costs.	Transfer of waste to another location. High costs associated with the haulage and disposal (and importation of clean fill for backfilling if required). Waste classification of all materials required prior to disposal. Sustainability issues related to disposal to landfill.	Yes, only in areas where contaminant hotspots have been identified in previous investigations or where ACM material is found to be present. For other fill materials, excavation and offsite disposal would only be considered a last resort.
Excavation and onsite treatment/processing	Excavate materials and segregate specific components of the waste mass, for appropriate processing.	Relatively fast. Aligns with the sustainability principles by reducing offsite disposal to landfill, recycling of metal and wood components of fill (where suitable) and increasing reuse of suitable material onsite.	Cost of processing materials for use as sub grade. May require some additional testing (including Toxicity Characteristic Leaching Procedure (TCLP)) to validate material prior to reuse. Storage or treatment problems associated with processed materials that are subsequently found to be unsuitable for reuse. This strategy may result in cross contamination if processing material containing asbestos fibres, fragments.	Yes

Remediation methodology	Description	Advantages	Disadvantages	Suitability to the Project site
Natural attenuation	Allowing the contaminants to biodegrade naturally following removal of the contamination source.	No remedial excavation of site. Retains materials on site. Sustainable, cost effective remediation method.	Slow process. Potential for contamination to further impact on the groundwater aquifer and nearby environmental receptors. Unlikely to improve the geotechnical characteristics of contaminated fill.	No

Source: Based on Table 4.1 RAP (Volume 5B)

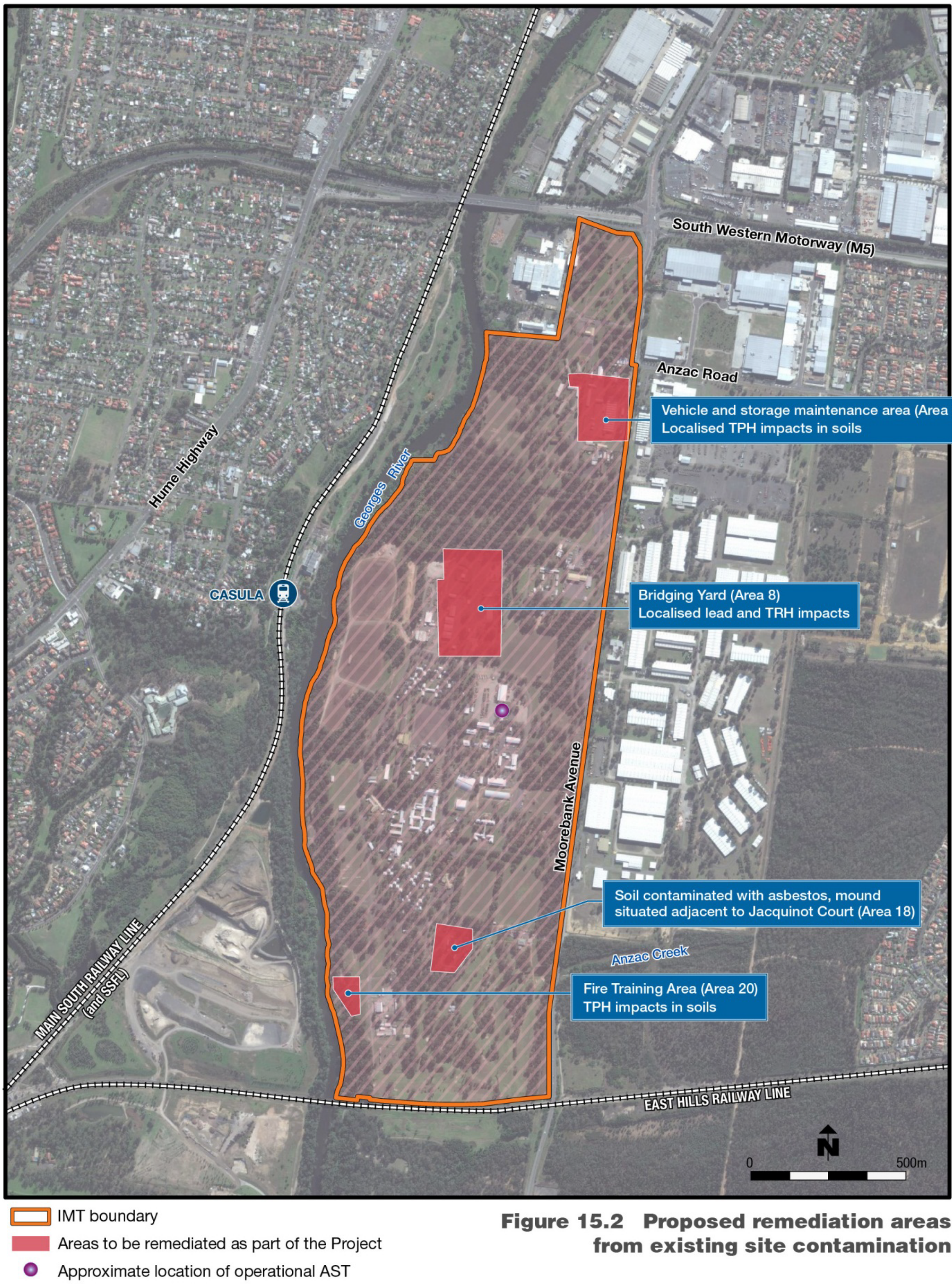


Figure 15.2 Proposed remediation areas from existing site contamination

Acid sulfate soil remediation

Whether a particular land use activity will contribute to any acidification hazard will depend on the extent of soil disturbance, and the depth of occurrence of ASS materials. Further investigation of ASS is recommended within the RAP. Should further investigations confirm the presence of ASS, an ASS management plan (ASSMP) should be developed and implemented in accordance with ASSMAC Guidelines (1998).

Contamination contingency measures

Should any additional contaminated or potentially contaminated material be discovered during any of the pre-construction or construction works, additional remediation would be required. The following contamination and soil mitigation and management measures would be implemented prior to/or during construction of the Project, in accordance with the remediation goals and strategy outlined in the RAP:

- Before construction, a remediation program would be implemented in accordance with the RAP applicable to each stage of development. The program will have been formally reviewed and approved by the Site Auditor under Part 4 of the CLM Act.
- A CEMP would be prepared by the contractor for all excavation and remediation works and would include requirements for decontamination facilities at the site.
- Before or during remediation works, further investigation would be undertaken to address identified knowledge gaps. Additional investigations include:
  - Further testing of soils to confirm the presence of ASSs. If ASS are detected a management plan should be developed in accordance with the ASSMAC Assessment Guidelines (1998), with active ongoing management through the construction phases, and offsite disposal would need to be in accordance with the NSW *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (2009).
  - Further testing of surface water quality to gather data to inform management of dewatering/discharges anticipated to be required. Further groundwater monitoring would be undertaken on the main IMT site and would be used to inform the remedial approach for groundwater, if contamination is detected.
  - Further testing of residual sediments to gather data to information the management of sediments likely to be disturbed/dewatered during construction.
  - Further testing of groundwater beneath the north-western area of the IMT site (adjacent to the ABB) to inform any additional control, management or remediation measures required.
- Ground penetrating radar (GPR) or similar techniques would be carried out to locate and document all existing and underground tank infrastructure across the Project site.
- A management tracking system for excavated materials would be developed to ensure the proper management of the material movements at the site, particularly during excavation works.

Construction and operation control measures

During the excavation and removal of contaminated soil, the following process would be followed:

- Contaminated soil/fill material present in these areas will be 'chased out' during the excavation works based on visual, olfactory and preliminary field test results.
- Excavated soil is to be temporarily stockpiled and sampled and analysed for waste classification purposes. Following receipt of waste classification results, the material should be transported to an offsite waste disposal facility as soon as practicable to minimise dust and odour issues through storage of materials on site.
- Stockpiled soils would be stored on a sealed surface and the stockpiled areas are to be securely bunded using silt fencing to prevent silt laden surface water from entering or leaving the stockpiles or the IMT site.
- All excavation works should be undertaken by licensed contractors, experienced in remediation projects and the handling of contaminated soils.

During the removal of any ACM, the following additional processes would be undertaken:

- All asbestos removal, transport and disposal must be performed in accordance with the Work Health and Safety Regulation 2011 (WHS Regulation).
- The removal works would be conducted in accordance with the *National Occupational Health and Safety Commission Code of Practice for the Safe Removal of Asbestos*, 2nd Edition [NOHSC 2002 (2005)](NOHSC 2005a).
- An appropriate asbestos removal licence issued by WorkCover would be required for the removal of ACM.
- Environmental management and WHS procedures would be put in place for the asbestos removal during excavation to protect workers, surrounding residents and the environment.
- Temporary stockpiles of ACM would be covered to minimise dust and potential asbestos release.
- An asbestos removal clearance certification would be prepared by an occupational hygienist at the completion of the removal work. This would follow the systematic removal of ACMs and any affected soils from the site and validation of these areas (through visual inspection and laboratory analysis of selected soil samples).
- Asbestos fibre air monitoring would be undertaken during the removal of the ACMs and in conjunction with the visual clearance inspection. The monitoring would be conducted in accordance with the *National Occupational Health and Safety Commission Guidance Note on the Membrane Filter Method For the Estimating Airborne Asbestos Fibre, 2nd Edition* [NOHSC 3003 (2005)](NOHSC 2005b).

For management of stockpiles the following mitigation processes would be undertaken:

- All stockpiles would be maintained in an orderly and safe condition. Batters would be formed with sloped angles that are appropriate to prevent collapse or sliding of the stockpiled materials.

- Stockpiles would be placed at approved locations and would be strategically located to mitigate environmental impacts while facilitating material handling requirements. Contaminated or potentially contaminated materials would only be stockpiled in unremediated areas of the site or at locations that did not pose any risk of environmental impairment of the stockpile area or surrounding areas (e.g. hardstand areas).
- Stockpiles would only be constructed in areas of the site that had been prepared in accordance with the requirements of the RAP included in Volume 5B. All such preparatory works would be undertaken prior to the placement of material in the stockpile. Stockpiles must be located on sealed surfaces such as sealed concrete, asphalt, high density polyethylene or a mixture of these, to appropriately mitigate potential cross contamination of underlying soil.
- The stockpiles of ACM would be covered with a waterproof membrane (such as polyethylene sheeting) to prevent increased moisture from rainwater infiltration and to reduce wind-blown dust or odour emission.
- Before the reuse of any material on site, it would be validated so that the lateral and vertical extent of the contamination is defined.

Removal of EOW and UXO

Investigation and removal (if required) of EOW and UXO is to be undertaken during the Early Works development phase. However, before the Early Works phase, and in accordance with the requirements of the RAP, a UXO management plan would be developed for the Project site. This plan would detail a framework for addressing the discovery of UXO or EOW to ensure a safe environment for all project staff, visitors and contractors. Further details on EOW and UXO investigation and removal are provided in section 7.5 of the RAP.

Waste management

Where required, contaminated materials and wastes generated from the Project remediation and construction works would be taken to suitable licensed offsite disposal facilities. Four facilities in particular have been identified as being capable of receiving the waste types and volumes from the Project. These are identified in Table 15.7.

Table 15.7 Waste disposal facilities

Waste disposal facility	Location
Blacktown Waste Services	Blacktown
Erskine Park Landfill	Erskine Park
Horsley Park Waste Management Facility	Horsley Park
SITA Landfill Kemps Creek	Kemps Creek

Parsons Brinckerhoff recently contacted these facilities to determine their capacity to accommodate the volume of contaminated material generated by the site rehabilitation works (as part of EPBC referral 2014/7152). All four facilities contacted stated that the anticipated volume of contaminated material would be significantly less than the overall receiving capacity of each facility. While the exact quantity and nature of material required for offsite disposal as part of the Early Works and subsequent Project development phases is not yet known, given the recent response of the waste facilities, it is considered that there would be sufficient capacity to accommodate the generated waste.

In addition, there are a number of other facilities within the surrounding area of the Project site that could also accommodate waste from the Project if required. These are identified in Table 15.8.

Table 15.8 Example waste disposal facilities

Waste disposal facility	Location
SITA Belrose Resource Recovery Centre	Belrose
SITA Chullora Resource Recovery Park	Chullora
SITA Camellia Resource Recovery & Treatment Facility	Camellia
SITA Wallgrove Road Landfill	Eastern Creek
SITA Wetherill Park Resource Recovery Centre	Wetherill Park
Veolia NSW Construction Depot	Banksmeadow
REMONDIS Australia St Marys	St Marys
Transpacific Landfill	Badgerys Creek
Cleanaway Waste Services	Moorebank
Transpacific Liquid or Hazardous Waste	Revesby

15.5.2 Rail access options

At this time Phase 1 ESAs have been undertaken for each of the rail access options. While a Phase 1 ESA is sufficient to indicate the potential for contamination based on past and existing land use, it is not suitable for developing a detailed remediation action plan or mitigation strategy. It is recommended that further investigations be undertaken for the selected rail access option during Stage 2 SSD approval(s) as follows:

- Northern rail access option: it is recommended that an intrusive soils and groundwater investigation be undertaken to gather data on soil and groundwater quality so that management and/or remediation options can be evaluated.
- Central rail access option: it is recommended that a comprehensive site walkover be completed to verify fill mounds and/or depressions. If evidence of contamination is observed then targeted intrusive soil and groundwater investigations may be required.
- Southern rail access option: it is recommended that a targeted intrusive investigation be undertaken to gather data on soils and groundwater quality so that management and/or remediation options can be evaluated.

This approach has been acknowledged by the independent site auditor accredited by the EPA.

Where contamination is identified, management and mitigation would be developed broadly in line with the remediation practices described in the RAP and summarised in section 5.5.1 above. Contamination exposure pathways during the construction and operation of the selected rail access option, as identified in section 15.4.2, would need to be managed by implementing good health and safety practices during any future works to avoid contact with potentially contaminated soils and groundwater. Such measures would need to be detailed in a CEMP prepared for the rail construction works.

15.6 Summary of key findings

As previously noted in section 15.1, prior to the Project commencing, site rehabilitation works are to be undertaken at the Project site and these are the subject of a separate EPBC referral (2014/7152). Therefore the assessment undertaken for this Project focused only on the contamination issues that would exist following completion of the site rehabilitation works.

The Phase 1 and Phase 2 ESAs prepared for the main IMT site and rail access connection options have identified potential sources of land/water contamination on the Project site including buried/stockpiled wastes; leakages and loss of containment of hazardous materials/fuels; contamination from past land uses; and offsite contamination sources (ABB site, Glenfield Landfill, etc.). Early Works and construction activities have the potential to release existing sources of contamination into the surrounding environment. Therefore, some site rehabilitation works are proposed prior to construction of the Project, as detailed in the Project's RAP. While the removal of onsite contamination poses potential human health risks, these risks can be managed through the implementation of mitigation measures as detailed in the Project's CEMP. Other construction activities, including earthworks, vegetation clearing, ground penetration and storage and usage of fuels, have the potential to result in liberation of existing sources of contamination, or generation of new contamination. In terms of the rail access connection options, the ESAs have identified the following:

- There is limited potential for contamination within the northern and the central rail access connection alignments.
- There is a high potential for contamination to exist in the southern rail access connection option alignment, including contaminated fill, soils, groundwater, leachate and generation of landfill gases.

During operation, potential activities that may give rise to contamination or opportunities for contamination include minor earthworks, storage and use of fuels, and maintenance of underground utilities. Table 15.9 identifies summaries the key impacts of the Project during Full Build for the three rail access options, without mitigation.

Table 15.9 Summary of contamination impacts at Full Build, without mitigation, for each rail access option

Impact	IMT layout and associated rail access connection option		
	Northern	**Central**	**Southern**
Operation of the IMT			
Potential activities that may give rise to contamination or result in liberation of exiting sources of contamination (e.g. storage of fuels, maintenance of underground utilities and minor earthworks)	•	•	•
Rail access options	-	-	-
Development of land through the Glenfield Landfill which has high potential for contamination	-	-	•

Key: • = impact, - = no impact

Overall the Project site has been found to be suitable for industrial commercial use, subject to management and mitigation including:

- remediation of contamination 'hotpots' as identified in the RAP;
- further investigation of the depth and occurrence of ASS materials;
- implementation of contamination contingency measures as detailed in the CEMP;
- further contamination investigations for the selected rail access connection option, as part of the Stage 2 SSD approval;
- measures for storage/treatment/transportation of any hazardous materials, contaminated soil, and asbestos etc.