Chapter 11

Soils and water

11 Soils and water

11.1 Introduction

This chapter summarises the potential impacts to soils and groundwater, including potential contamination impacts, associated with the construction and operation of the proposal. This chapter does not assess surface water (other than the interactions between groundwater and surface water) and flooding impacts, which are summarised in **Chapter 12 Hydrology and flooding.** Nor does it assess aquatic biodiversity impacts – they are summarised in **Chapter 21 Biodiversity**.

A Soils and Water Assessment Report has been prepared and included as **Technical report F**. Geotechnical and contamination investigations have also been carried out, including:

- Detailed site (contamination) investigation (Technical report G)
- Factual Geotechnical Investigation Report (Technical report G1)
- Remediation Action Plan (RAP) (Technical report G2).

The methodology for the soils and water assessment involved:

- A review from public sources of information and spatial data sets to determine the existing conditions for soil, geology, topography, groundwater and contamination
- A review of the onsite geotechnical and contamination investigations to assess contamination on the site
- An assessment of the proposal's impacts on groundwater and development of mitigation measures.

The methodology for the DSI involved:

- A desktop review of readily available site history information
- Intrusive investigations, including boreholes, test pits and the installation of groundwater and gas wells
- Laboratory analysis of contaminants
- An assessment of potential contamination pathways using a conceptual site model.

11.2 Existing environment

The existing environment conditions relevant to the soils and water assessment were determined by reviewing publicly available sources of information and completing site investigations.

11.2.1 Land use

The site has an industrial and agricultural history, having previously been used for poultry production. Site features include large poultry sheds, multiple workshops and storage buildings, and an at-grade car park at the south-eastern boundary. There is an overland flow path channel along the eastern boundary of the site, which flows towards a farm dam near the eastern boundary. The site has been subject to a history of cut and fill and has different ground levels across the site.

The nearest residential area is about 1km to the south of the site in Horsley Park, with the Minchinbury residential area located around 3km to the north-west. Horsley Park Public School is over 2km south of the site and a childcare centre is within the Eastern Creek industrial area, about 1km to the west of the site.

The site is bounded by the Westlink M7 Motorway to the west, with the Eastern Creek industrial area located farther west. The SUEZ Eastern Creek Waste Management Centre comprising the now-closed landfill site and operational organics recycling facility is located to the north and north-east, with the operational Global Renewables waste management facility located immediately to the east. To the south, the site is bounded by the Warragamba Pipeline Corridor, with the Austral Bricks facility located farther south.

11.2.2 Topography

The site is moderately sloping from about 62m above height datum (AHD) at the south-western corner to 52m AHD along the north-eastern boundary.

11.2.3 Soils and geology

The site is underlain by Bringelly Shale of the Wianamatta Group. The Bringelly Shale is anticipated to be over 100m thick in this area and is overlain locally by Quaternary Deposits of various types and artificial fill.

Site investigations carried out have confirmed the following site conditions:

- The fill on the site is likely to consist predominantly of silty clay and clay. The presence of debris in the fill mix indicates that it is likely to have been placed in an uncontrolled manner. Reviewing historic imagery, it is likely that the fill was placed between 1986 and 2004.

  Although fill is present across much of the site, there are two main fill zones on the site that contain plastic, brick, concrete fragments and charcoal. These areas are located in the south-east portion of the proposal site and adjacent to the farm dam in the central east portion of the proposal site. The fill depth varies from 1.2m up to 5.7m.

- The proposal site has deposits of quaternary floodplain alluvium of soft consistency. These deposits, predominantly clay, are overlaying the residual soils in the north-east corner of the site with red-brown colouration.

- Residual soils with depths up to 2m below ground level are observed over most of the proposal site, particularly in the locations where fill and alluvial soils are present. The residual soil is typically grey mottled orange in colouration and is predominantly formed by a clay material with a firm to stiff consistency and medium plasticity.

- The bedrock level in the area is 3 to 6m deep. Igneous rock bodies occur in the vicinity of the proposal site, the largest being Prospect Picrite. Although not being mapped, it is possible that basaltic sheet-like rock bodies formed in the fracture of the existing igneous bodies, known as dykes, may be present beneath the site area.

- There are no mapped geological structural features or lineaments affecting the site. The only adjacent geological structure is 1km to the west of the site, which seems to be isolated. The Penrith Basin Syncline runs north west to south east and is mapped 2.8km to the north of the proposal site.
  This confirms that the bedrock dips to the north east.

A review of the NSW Acid Sulfate Soil Risk Map shows that the site is not mapped in an area likely to have ASS. However, testing has shown that there could be potential ASS.

11.2.4 Groundwater and groundwater users

Onsite investigations showed that groundwater depth across the site ranges from 0.1m below ground level at the eastern boundary to 5.7m below ground level at the southern boundary, 47.5m above height datum (AHD) to 55.3m AHD.

Permeability tests indicate very low permeabilities onsite, with limited potential for groundwater flow to be transmitted through the rock mass.

A search of registered groundwater bores confirmed that there are no known groundwater users within the proposal site. There are eight registered groundwater bores recognised within 3km of the proposal site. These bores are used as monitoring wells, and none are known as drinking water sources.

The nearest surface water receptors to groundwater are Reedy Creek, located 450m to the north west of the site, and Eastern Creek, located around 800m to the east of the site. Prospect Reservoir is located 2km to the east of the proposal site.

Although the National Groundwater Dependent Ecosystem (GDE) Atlas (BAP 2016) shows potential GDE mapped on the site, field surveys indicated that these features comprise exotic grassland only and that there are no GDEs on the proposal site (refer to **Technical report Q Biodiversity Development Assessment Report**).

11.2.5 Existing contamination at the proposal site

11.2.5.1 Desk top review

A desktop review of the proposal site history and site investigations in 2015, 2019 and 2020 has been carried out. This is reported in the due diligence investigations **(Technical report G3)** and a DSI **(Technical report G).**

The 2015 and 2019 investigations comprised drilling of 40 boreholes, 7 of which were converted into combined soil, gas and groundwater monitoring wells. An additional 17 surface samples targeting locations near and within buildings and 6 surface water samples from standing water bodies at the site were taken.

Additional testing as a part of the DSI in 2020 comprised the drilling of four additional boreholes, which were converted into groundwater wells and the excavation of 15 test pits.

The testing locations are shown on **Figure 11.1** below.

Figure 11.1: Testing locations

11.2.5.2 Soil testing results

Section 8.1 of the DSI (**Technical report G**) explains the site assessment criteria (SAC) for assessing the contamination of soils. The health investigation levels (HIL) and health screening levels (HSL) are scientifically based, generic assessment criteria designed to be used to assess the potential human health risk from chronic exposure to contaminants. Ecological investigation levels (EIL) and ecological screening limits (ESL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems.

The soil testing indicated no results above the adopted health-based investigation criteria, except for lead at one location and asbestos in soil within an elevated fill platform in the south east of the site.

Lead levels of 3,700mg/kg were found in a 2019 sample (S12) (**Figure 11.2**). This represents an exceedance of 2,200mg/kg above the NEPC (2013) standard of 1,500mg/kg. This exceedance was associated with high levels of lead contained in paint samples from the nearby buildings and is not considered to be representative of the soils across the site.

The soil testing also indicated exceedances of ecological based criteria for copper, zinc, benzo(a)pyrene and total recoverable hydrocarbons (TRH) in soils but did not exceed the HIL. Using statistical software, the exceedances of EIL are not considered statistically significant.

Potential asbestos containing material (ACM) was observed in 11 samples at eight locations, primarily associated with the raised fill platform and surrounding areas in the southern section of the site. **Table 11.1** summaries the asbestos HSL exceedances. The HSL for bonded ACM is 0.05% w/w (weight for weight), and for fibrous asbestos (FA) and asbestos fines (AF) the HSL is 0.001% w/w.
The testing locations which had elevated asbestos are shown in **Figure 11.2**

Table 11.1: Summary of asbestos HSL exceedances

Sample	Level of asbestos (% w/w)		
	No visible surface asbestos	Bonded ACM	FA and AF
TP03/0–0.4	Detection in near surface soils	<0.05	<0.001
TP04/A1 / TP04/0–0/4		<0.05	<0.001
TP10/0–0.5 / TP10/A1		0.084	<0.001
TP14/A1 (TP14/0–0.2)		0.056	-

Figure 11.2: Identified contamination at the proposal site

11.2.5.3 Groundwater and surface water results

Groundwater and surface water testing was carried out in 2019 and 2020. The samples collected as part of the 2019 investigation were compared to the Australian and New Zealand Environment and Conservation Council (ANZECC) Fresh Water Guidelines 2000. These standards have since been superseded, and the most recent water quality samples collected as part of the 2020 investigation were compared to the Australia New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality 2018.

The results from the testing of groundwater and surface water samples indicated exceedances against the site assessment criteria. The results are shown in **Table 11.2** and **Table 11.3**.

These exceedances are indicative of regional groundwater quality, rather than an onsite or offsite contamination source.

Table 11.2: Summary of exceedance of ANZECC standards detected in groundwater and surface water samples taken in 2019.

Parameter	ANZECC standard (mg/l)	Sample type	Sample	Range of values which exceed the standard (mg/l)
Ammonia	0.9	Groundwater	BH201, BH204	1.3 to 1.7
		Surface water	SW01	1.1
Cadmium	0.0002	Groundwater	BH201	0.0004
Copper	0.0014	Groundwater	BH201, BH208, BH213, BH2, BH4	0.002 to 0.009
		Surface water	SW01, SW02, SW03, SW04, SW05, SW06	0.002 to 0.011
Lead	0.0034	Surface water	SW02, SW03, SW05	0.004 to 0.006
Zinc	0.008	Groundwater	BH201, BH208, BH213, BH4	0.012 to 0.0.59
		Surface water	SW01, SW02, SW03, SW04, SW05, SW06	0.012 to 1.5

Table 11.3: Summary of exceedances of ANZG (2018) detected in groundwater and surface water samples taken in 2020.

Parameter	ANZG standard (mg/l)	Sample type	Sample	Range of values which exceed the standard (mg/l)
Ammonia	0.9	Groundwater	ABH02, BH204	1.4 to 4.1
Total chromium	0.0045	Groundwater	ABH02, BH204	0.004 to 0.005
Copper	0.0014	Groundwater	ABH01, ABH02, BH2, BH201, BH204, BH208, BH213	0.002 to 0.016
		Surface water	SW01, SW02, SW03, SW04, SW05, SW06	0.002 to 0.056
Manganese	1.9	Groundwater	ABH03, BH4, BH213	2.1 to 17
		Surface water	SW03, SW04	1.9 to 3.6
Zinc	0.13	Surface water	SW06	1.5

11.2.5.4 Gas testing results

Landfill gas monitoring results indicated zero to low gas flow rates produced from the monitoring wells in addition to low measured levels of landfill gases. Soil vapour samples collected also indicated minor detectable concentrations all below site assessment criteria for contaminants. Given the low test results in groundwater and the groundwater flow direction, it is unlikely that these concentrations are attributable to the nearby waste facilities to the east and north.

11.2.5.5 Summary of contamination results

The DSI concludes that the proposal site is considered to have a low water and vapour contamination risk and a low to moderate risk for soil contamination, primarily in the form of soil asbestos.

11.2.5.6 Salmonella

The proposal site history indicates that the site has been used for mixed-use commercial and industrial activities, including a poultry factory farm in the 1970s. A Biosecurity Direction dated 24 January was given to the previous site owner 2019 from the Department of Primary Industries (DPI) about the presence of Salmonella onsite. The current site owners worked with DPI to resolve the Salmonella problem following current procedures. The applicant has since received a letter from DPI dated 26 May 2020 which confirmed the site is now considered a ‘resolved premise’ and the Biosecurity Direction has been revoked.

11.3 Assessment

The following section summarises the potential impacts on soil and groundwater in construction and operation of the proposal. Potential impacts in construction include erosion and sediment impacts, contamination impacts and impacts to the quality and quantity of groundwater flow. The assessment considers any impacts to groundwater quality, flow and recharge in operation of the proposal.
Chapter 10 Waste management provides further detail on how excavation and demolition waste will be managed onsite.

11.3.1 Construction impacts

11.3.1.1 Erosion and sediment impacts

As described in **Chapter 3 Proposal description**, the construction of the proposal will include some soil disturbance activities including:

- Clearing of land and vegetation removal
- Excavation and trenching
- Internal road works
- Stockpiling.

The management for the disposal or reuse of excavated soil has been assessed in **Chapter 10 Waste management**.

These construction activities have the potential to increase the erosion of soil on the site and generate sediment laden runoff which in turn has the potential to impact the surrounding environment, including Reedy Creek, Eastern Creek and the related aquatic communities. The overall site erosion hazard is high, given the presence of dispersive soils and soil characteristics which exhibit high erodibility. These soil characteristics will need to be considered as part of the Construction Environmental Management Plan (CEMP).

A preliminary Sediment and Erosion Control Plan has been prepared for this proposal and is included in Appendix B of **Technical report H Hydrology and Flooding Assessment Report**. Strategies outlined in the preliminary plan include:

- Shaker pads at construction access points
- Sediment fences
- Sediment basins
- Cut-off drains
- Check dams.

An updated Sediment and Erosion Control Plan will be prepared as part of the CEMP before construction starts and will include a detailed description of the overall approach and site-specific erosion and sediment control measures, including:

- Proposed phasing of works
- Location of shaker pads and construction access points
- Location of sediment fences
- Size and location of cut-off drains and check dams
- Size and location of sediment basins, including any interim basins
- Location of stormwater discharge points and where applicable, pump rates from sedimentation basins
- Proposed groundwater management strategies, in particular for building bunker excavation
- Proposed water quality and quantity monitoring strategies during construction
- Details of a proposed strategy for post-construction rehabilitation of the site.

11.3.1.2 Acid sulfate soils

The site is not mapped in an area likely to have ASS. However, testing has shown that there could be potential ASS. Regular testing and characterisation of soils in areas of potential disturbance will be carried out to quantify sulphides and the measures needed to mitigate risk of ASS production. Mitigation measures will be included as part of spoil management in the overarching CEMP, or if considered to be a medium to high risk, an ASS management sub-plan may be required as part of the CEMP.

11.3.1.3 Contamination impacts

The DSI (**Technical report G**) found existing contaminants onsite as outlined in the existing environment in **Section 11.2.** Construction activities, including the demolition of buildings and the excavation of soil, have the potential to mobilise these contaminants.

Mobilised contaminants can impact nearby human and environmental receptors via the following potential contamination pathways:

- Ingestion and dermal contact
- Inhalation of dust and or vapours
- Surface water runoff
- Leaching of contaminants and vertical migration into groundwater
- Lateral migration of groundwater providing base flow to water bodies
- Direct contact with ecological receptors.

Asbestos

The site testing and investigations confirmed that many of the existing buildings onsite contain confirmed or potential asbestos containing materials. Following demolition, the soils surrounding these buildings can become contaminated with asbestos. A detailed hazardous building materials survey and appropriate removal of these materials will be conducted before demolition according to appropriate standards and regulations. Where asbestos contamination is known to be present, mitigation measures such as the use of appropriate protective equipment will be used for construction workers. A procedure for the management of known and potential contamination is outlined in the Remediation Action Plan (RAP) as **Technical report G2**.

Once the RAP is applied, the procedures will render the site suitable for the proposed construction and eliminate any ongoing risk of asbestos contamination.

Gas

Soil gas field readings and laboratory results suggest that migrating gases from adjoining sites are not likely to present a hazardous risk to the proposal.
The relatively impermeable sub-surface profile of clay and shale provides an effective buffer to soil gas migration, should such gases be generated from neighbouring sites. Additional soil gas monitoring will be carried out as part of the RAP.

11.3.1.4 Groundwater impacts

The geotechnical and hydrogeological site investigation encountered a shallow groundwater table at 0.1m to 5.7m below ground level (BGL). As the investigation only reached a maximum depth of 25m BGL at the site with bores screened to a depth of 15m BGL, further understanding of groundwater systems at depth are largely unknown. Nevertheless, given that the bunker will only reach at maximum depth of 15m BGL, only the shallow groundwater system encountered in the investigation will likely be impacted.

An analysis of groundwater drawdown was modelled for a 90-day period after excavation of the bunker. The model shows that drawdown will occur locally at the excavation and reduce to 0.1m drawdown 120m away from the excavation, at which, impacts associated with drawdown are considered negligible. Given that the waste bunker will be excavated at least 200m from the nearest site boundary, impacts associated with groundwater drawdown beyond the site are considered negligible.

Potential mobilisation of contaminants

The potential for mobilisation of contaminants as a result of groundwater drawdown is limited, due to the low permeability of the shales and overlying clay deposits. As a precaution, the groundwater will be monitored and tested in construction.

Impacts on nearby surface watercourses

Any alteration to groundwater conditions or quality due to the construction activities are not expected to impact nearby surface watercourses such as Reedy Creek, Eastern Creek and Prospect Reservoir.

Calculations have been carried out to determine the time taken for groundwater flow to reach Reedy Creek. Even in highly favourable water flow conditions, which do not exist at the site, it has been estimated that it would take at least 75,000 years for contaminants in groundwater to reach the closest downgradient watercourse, Reedy Creek.

Given Prospect Reservoir is upgradient of the site, there will be no groundwater flow from the proposal site

Impacts on nearby groundwater users

There are eight groundwater monitoring wells recognised within 3km of the proposal site. There will be no impact on these wells given that they are either upgradient from the site or are located sufficiently far away from the site.

Management of groundwater

Groundwater will be pumped from the excavation areas in construction. This groundwater will be stored onsite and tested. If suitable, the groundwater will be reused onsite where needed. If not suitable for reuse, the water will be taken offsite for disposal to a licenced facility. The details of water management in construction will be included in the CEMP.

11.3.2 Operation impacts

11.3.2.1 Impacts to groundwater quality

Surface water and stormwater is intrinsically linked to groundwater. Stormwater runoff can result in impacts to groundwater quality if not managed appropriately. The low permeability of the underlying geology means that there is limited potential for surface contamination to reach groundwater. The proposal will be serviced with enough sewer and stormwater infrastructure as outlined in **Chapter 12 Hydrology and flooding**, and any impacts to groundwater quality from surface runoff will be avoided.

The proposal will include the use and storage of hazardous materials. These are assessed in **Chapter 14 Hazard and risk**. Based on this assessment, all hazardous materials can be managed appropriately to avoid any spills or leaks. The risk of hazardous materials impacting stormwater runoff and groundwater quality is considered low.

11.3.2.2 Groundwater flow and recharge of shallow groundwater

The proposal is designed to be built in the southern area of the site, over predominantly existing hardstand areas. Any additional impermeable surface will be limited. There are unlikely to be any impacts to groundwater recharge as a result of reduced permeable surface on the site.

The proposed waste bunker will be impermeable and will divert shallow groundwater flow (if any) around the outside extents of the bunker. Given that the groundwater is shallow and variable across the site, it is unlikely that this will have any material impact. There are no groundwater users near the site which would be impacted. Overall, the impacts on groundwater flow from the waste bunker are negligible.

11.4 Mitigation

The proposed measures to mitigate, manage and monitor soils and water impacts are outlined in **Table 11.4.**

Table 11.4:Soils and water mitigation measures

ID	Impact	Mitigation
Design embedded mitigation measures		
SW1	Contamination risk to groundwater and soils	All waste storage and the waste bunker will be designed to avoid leaching of any contaminants into the groundwater or soils.
Construction mitigation measures		
SW2	Erosion and sedimentation	As part of the CEMP, an Erosion and Sediment Control Plan (ESCP) will be prepared and applied, outlining measures for the prevention of erosion and sedimentation in construction.
SW3	Erosion and sedimentation	Sediment basins in the ESCP would be designed to account for dispersive soils. Visual observation would be maintained in excavation for evidence of high-salinity soils (visible salt crystals and other evidence), and if found, these would be removed and placed in covered stockpiles.
SW4	Contaminated soils	Where relevant, contaminated surface soils and fill material will be stripped, waste classified and disposed offsite at a licensed facility, as per NSW EPA Waste Classification Guidelines.
SW5	Acid sulfate soils	Regular testing and characterisation of the ground in areas of potential disturbance would be carried out to quantify sulphides and the neutralisation required to mitigate the risk of acid sulfate soil production.
SW6	Contamination risk	A draft Remediation Action Plan (RAP) has been prepared and will be applied to render the site suitable for the proposal. The RAP will include: • Hazardous building materials survey • Removal of all hazardous building materials • A continued soil and soil gas monitoring
SW7	Impact on groundwater quality	Encountered groundwater will be monitored regularly throughout the construction period. Monitoring would assess any changes to background groundwater quality conditions from those previously recorded, to recognise contaminant level trends and any groundwater impacts.
SW8	Impact on surface water quality	A surface water monitoring program will be applied to demonstrate the effectiveness of erosion control and sediment control measures and help with construction site management.
Operation mitigation measures		
SW9	Impact on groundwater quality	Given the proximity of the site to landfill, ongoing monitoring of groundwater quality will be carried out.