Chapter 12

Hydrology and flooding

12 Hydrology and flooding

12.1 Introduction

This chapter summarises the existing hydrological conditions, including the risk of flooding across the study area and the potential impacts associated with construction and operation of the proposal. Hydrology is the study of the occurrence of water, its properties, its distribution and circulation, and its effects on the surrounding environment. The scope of this assessment includes a description of the existing surface water features and conditions on the site, stormwater quality and management, a water balance which categorises areas of stormwater collection, storage and reuse, and a flood impact assessment.

A Hydrology and Flooding Assessment Report was prepared and is included as **Technical report H.**

A Soils and Water Assessment Report (**Technical report F**) was also prepared for this EIS. That report assesses the potential impacts to soils and groundwater, including potential contamination impacts associated with the construction and operation of the proposal. Aquatic ecology is assessed in the Biodiversity Development Assessment Report (BDAR) included as **Technical report Q.**

The methodology for the hydrology and flooding assessment involved:

- Setting up the study area, including the site, upstream and downstream catchments
- Reviewing topographical survey data and flood data for the site and upstream catchment area
- Reviewing water quality monitoring records for Reedy Creek (downstream of the proposal site)
- Reviewing site investigation results for surface water quality sampling from the onsite farm dam and overland flow path
- Using MUSIC modelling software to assess the effectiveness of water quality management measures
- Completing a flood impact assessment
- Completing a site water balance assessment
- Consulting with WaterNSW and Blacktown City Council (BCC).

12.2 Existing environment

12.2.1 Stormwater drainage and catchment

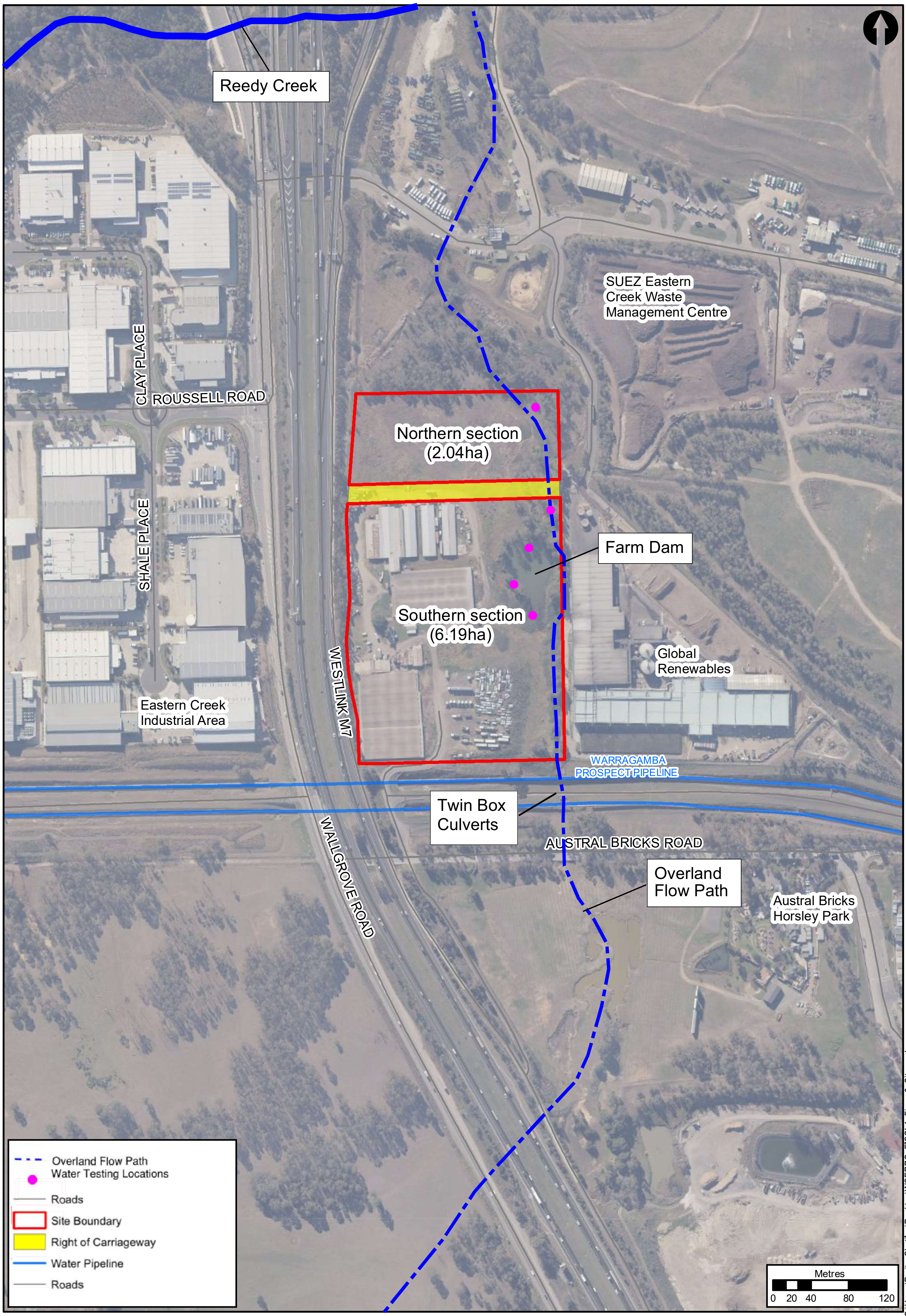
The site is bounded by the Westlink M7 Motorway to the west, with the Eastern Creek industrial area located farther west. The SUEZ Eastern Creek Waste Management Centre, comprising the now-closed landfill site and operational organics recycling facility, is located to the north and north-east. The operational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

The site is located within the Hawkesbury Nepean Catchment area. The internal catchment for the proposal site generally drains from south to north and west to east. The site is sloping from the south-west (highest point) to the north eastern area of the site where the farm dam is situated. A stormwater overland flow path enters the site via twin culverts to the south and passes through the site along the eastern boundary to the north which eventually discharges to Reedy Creek about 450m north west of the site (as shown in **Figure 12.1**) A review of aerial photography and topographical data found that the overland flow path drains to the proposal site via an upstream catchment area of about $1.2km^2$.

A site inspection was also carried out which indicated that the overland flow path is separate from the farm dam. However, mixing of flows may still occur during major storm events. From the farm dam spillway, the densely vegetated overland flow channel conveys flows northwards then north-west, eventually flowing into Reedy Creek.

A separate open stormwater drain is located within the M7 WestLink Motorway property boundary which collects and conveys stormwater from the section of the M7 WestLink Motorway adjacent to the proposal site. This drain has been designed such that stormwater does not discharge to the proposal site. Small areas of hard standing adjacent to the western boundary, comprising about 5% of the site, are graded to the west, conveying overland flows into the open drain serving the M7 Westlink Motorway. This open drain flows north and discharges into Reedy Creek.

There is minimal piped stormwater drainage within the site, with building downpipes discharging to the adjacent surface.



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12.1: Existing stormwater features and site water quality test locations

12.2.2 Water quality

BCC monitored water quality during a six-month testing period, from 2008 to 2009, on Reedy Creek 450m north-west (downstream) of the proposal site. The samples were tested against the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines. The results indicated relatively poor water quality with values outside of the ANZECC water quality guidelines for each test.

As part of the detailed site investigation (DSI) for this EIS (included in **Technical report G**), water quality was tested focussing on the overland flow path and farm dam. **Figure 12.1** shows test locations. The results indicated high nutrient content in the water, with dissolved oxygen and total phosphorus falling outside of the ANZECC water quality guidelines range for all samples taken (see **Table 12.1**). High-nutrient contents could come from agricultural or industrial activities in the upstream catchment area draining to the site.

Table 12.1: Site water quality test results.

Sample	Date	Electrical conductivity (mS/cm)	Dissolved oxygen (% saturation)^	pH	Total phosphorus (mg/L)
ANZECC water quality guideline trigger value^		**0.125–2.2**	**85–110**	**6.5–8.0**	**0.025**
SW01	28-02-20	0.98	79	7.9	0.2
SW02	28-02-20	0.42	77	7.5	0.4
SW03	28-02-20	1.2	77	7.8	0.2
SW04	28-02-20	0.42	73	7.6	0.3
SW05	28-02-20	0.46	80	7.4	0.4

^Dissolved oxygen % saturation values calculated based on sample results and an estimated temperature of 20°C.

12.2.3 Flooding

Flood mapping on the BCC GIS MapsOnline portal shows that the proposal site is not within the flood plain of Reedy Creek or Eastern Creek. The site-specific flood investigation carried out as part of the Flood Impact Assessment (see Appendix A of **Technical report H Hydrology and Flooding Assessment**), concluded that the overland flow path that runs along the eastern boundary of the site experiences some flooding. In all modelled events, flooding is shown to mix between the overland flow path and the farm dam at the proposal site. Flooding is also shown to be present at the Global Renewables Limited (GRL) site to the east.

BCC is also conducting a flood investigation for Eastern Creek, including the Reedy Creek floodplain. In response to a request for flood information at the site, on 20 April 2020 BCC sent preliminary flood maps for the 1% annual exceedance probability (AEP) and Probable Maximum Flood (PMF) events from this investigation. It showed flooding along the overland flow path which incorporated the farm dam.

12.2.4 Riparian corridor

Based on the NSW Office of Water Guidelines for Riparian Corridors on Waterfront Land, NSW Map data (SixMaps) and the Strahler System for classifying streams, the overland flow path through the site is not a defined water course and the preservation of a riparian corridor at the site was not considered necessary. It is noted however, that the Biodiversity Development Assessment Report (BDAR), included as **Technical report Q**, does classify the overland flow path as an unmapped first ordered stream, in line with the Strahler stream classification (DoI, 2018). Although no watercourses are mapped for the proposal site, an overland flow path exists within low-lying areas adjacent to the eastern property boundary. This overland flow path is referred to as a stream in the BDAR.

Based on the Strahler System classification, both Reedy Creek and Eastern Creek would be defined as third-order watercourses. The riparian corridors associated with these creeks are at least 450m from the proposal site and are not impacted by the proposal.

12.3 Assessment

The construction and operation of the proposal has the potential to impact on the existing hydrology and flooding environment through the construction of new surfaces which change the way water moves through the site and the contamination of stormwater. The following sections assess these potential impacts.

12.3.1 Construction impacts

12.3.1.1 Water quality

Water quality can be impacted during construction works from sediment and erosion impacts and dewatering of sedimentation basins.

Careful planning during construction regarding clearing, excavation, stockpiling, and filling works will be necessary to effectively manage impacts from site runoff and will be managed as part of a Construction Environmental Management Plan (CEMP) for the site.

A preliminary sediment and erosion control plan has been prepared for this proposal and is included in Appendix B of **Technical report H**. A detailed Soil and Water Management Plan, including updated sediment and erosion controls, would be developed for construction, with reference to relevant guidelines, in particular, Managing Urban Stormwater Soils and Construction Volume 1 (Landcom, 2004). The contractor will be responsible for monitoring the quality of stormwater discharged from the site construction area via sedimentation basins. Water quality in the overland flow path, including at the site discharge point, will also be monitored regularly throughout construction. The exact quality of construction stormwater is unknown. These uncertainties will be resolved through testing of the stormwater in the detention basins and implementation of appropriate disposal or reuse methods through the management plans.

The existing farm dam on the site will be decommissioned during construction, which involves dewatering of the dam into the existing environment. This process can result in the discharge of suspended solids into the receiving environment with the potential to impact on the quality of surface water. This will be managed through the preparation of a Dewatering Management Plan as part of the CEMP and overall construction planning, which would be used to determine the dewatering method, monitoring, and what actions would be taken in response to the construction surface water quality monitoring program. The management plan would include:

- Implementation of the construction surface water quality monitoring program to manage and limit the discharge of suspended solids into the receiving environment
- Identification of discharge points for stored water and sediments. Where possible stored water will be spread across the site and used for dust suppression
- Sampling of sediment samples to determine the associated contamination risk. If contaminants are identified, remediation strategies will be defined to minimise impacts on the receiving environment
- Control measures to follow during dewatering to release/rehome native aquatic fauna and remove of potential exotic fauna.

Impacts to aquatic fauna from dewatering of the farm dam are discussed in **Chapter 21 Biodiversity**.

Erosion and sediment control measures for the overland flow path realignment would be finalised by the appointed contractor, and would likely include:

- Timing of works to avoid wet periods
- Installation of temporary rock check dams in the realigned flow path and downstream
- Bank stabilisation with geofabric materials
- Placement of sediment fencing downstream of works boundary
- Planting of vegetation as early as possible and attention to promote establishment.

12.3.1.2 Flooding

The creation of temporary drainage onsite will be important to safely manage site stormwater runoff and minimise the risk of flooding during construction.

All construction compounds and main construction access tracks would be located outside of the existing 1% AEP flood extent areas recognised in the existing conditions flood risk assessment for the proposal (refer to Appendix A of **Technical report H**).

12.3.1.3 Water demand

A preliminary assessment of the likely water demand during the construction phase has been completed. Construction and application of the proposed facility is anticipated to extend over 3 ¼ years (39 months).

Major water usage on site arises from:

- Construction staff (potable water)
- Construction staff (non-potable water)
- Water to support earthworks and road construction, including dust control and embankment conditioning
- Washdown of concrete trucks, trucks and other plant before leaving site
- Miscellaneous usage.

The average monthly water use is estimated to be 630m^3, with a maximum of 1,240m^3 and minimum of 30m^3. The total expected water demand for construction is about 22,500m^3 (22.5ML).

It is anticipated that the existing WaterNSW water connection would be used during early stages of construction until the permanent Sydney Water connection has been installed. Water collected in sediment basins could be reused for dust suppression on the construction site.

12.3.2 Operation impacts

12.3.2.1 Stormwater quality and management

To assess the water quality performance of the stormwater management strategy for the proposal, MUSIC modelling software has been used. MUSIC can be used to determine if proposed changes to land use can meet mandated water quality objectives[1]. The proposed water quality treatment devices for the proposal include gross pollutant traps, a bioretention and onsite detention (OSD) basin and the revegetation of the overland flow path. These water-sensitive urban design elements will enable the proposal to meet BCC pollutant reduction targets. Indicative locations of the stormwater management features are shown in **Figure 12.2**.

[1] CRC, 2002.

Figure 12.2: Stormwater management features

The MUSIC model for the site was developed based on fixed rainfall and evapotranspiration data for the BCC area and breaking the site into sub-catchments based on land use and site grading.

MUSIC modelling results were compared with BCC stormwater pollutant reduction targets and demonstrated compliance with these targets. The discharge from the proposed OSD basin in the north-east of the site will be monitored with permanent water quality monitoring devices. OSD basins serve as temporary storage for stormwater runoff, which means the runoff rate and volume can be controlled so that the receiving system is not overloaded during storm events. The water quality monitoring devices can be used to determine when maintenance will be needed. A summary of stormwater maintenance tasks can be found in **Technical report H**. Site runoff through each trunk drain will also pass through a gross pollutant trap before discharge to the basin.

A modified MUSIC model has also been used to calculate the Stream Erosion Index (SEI) to confirm compliance with BCC requirements. The stream erosion index suggests the potential for a development to cause erosion of the downstream waterway. The results found the SEI for the site to be acceptable.

To formalise the overland flow path through the site, the existing flow path will be realigned to run along the eastern boundary from south to north. To mitigate flooding impacts to the neighbouring GRL site, the short section of the overland flow path that passes into the GRL site will be removed and retained within the proposal site. Realignment will be completed early in the construction program, to reduce flood risk at the site during construction.

The overland flow path will be designed to match the capacity of the existing overland flow path through the site and kept separate from site stormwater runoff. Improvements will be made to the overland flow path through revegetation with planting of suitable native vegetation (in line with the Vegetation Management Plan) and development of a low-flow design to distribute water quality benefits to downstream watercourses. An indicative cross-section of the overland flow path is shown in **Figure 12.3**.

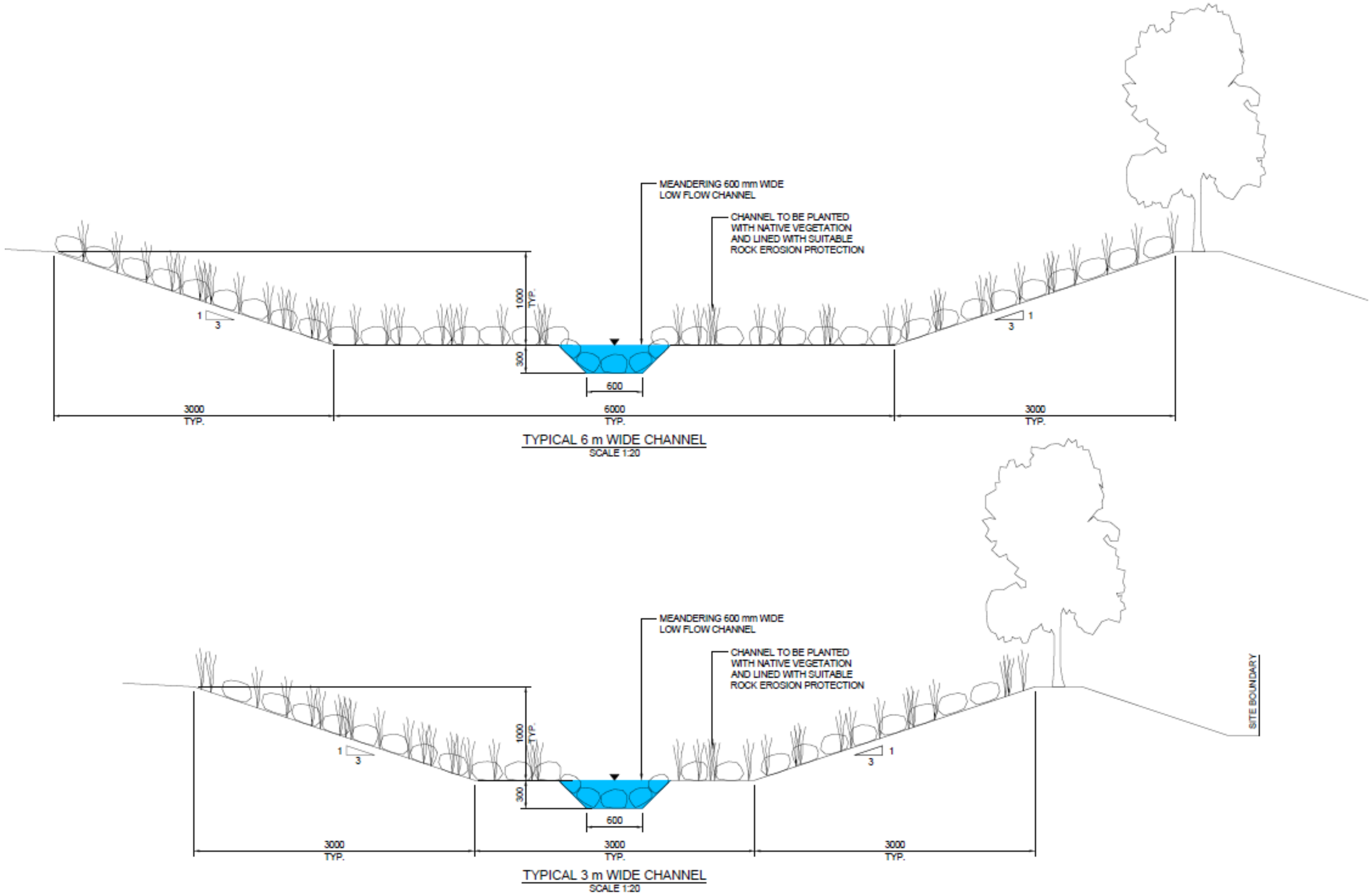

Figure 12.3: Cross-section of proposed overland flow channel (indicative and subject to detailed design)

Two interconnected basins are proposed to manage site stormwater runoff, to be located at the north-east area of the southern part of the proposal site. The site stormwater runoff will be conveyed to these basins via the site drainage network. This will include overflow from the two 100kL rainwater tanks when they are full.

The western portion of the basin will act as a bioretention water quality basin which is landscaped depressions or shallow basins used to slow and treat onsite stormwater runoff. The eastern portion will act as an OSD basin and include an outlet structure and emergency overflow spillway. Site stormwater runoff will be discharged from the OSD basin to the overland flow path.

During large rainfall events, stormwater from hardstand areas and roofs will drain to these basins, to avoid both offsite runoff and operation impacts. The pipe network will be designed for the 5% AEP critical storm event, with the major stormwater network incorporating kerbs, gutters and surface drains designed for the 1% AEP event.

Impacts related to runoff from sensitive areas such as ammonia tanks, diesel refuelling area and electrical substation, where there is a risk of spills of chemicals or hydrocarbons, will be bunded to prevent an overflow outside the proposal site. These areas will be regularly inspected, monitored and maintained. It is also recommended that sensitive areas have oil and water separators installed, including shut-off valves.

12.3.2.2 Flooding

A flood impact assessment has been completed to assess potential flooding impacts both on the proposal site and on offsite properties as a result of the proposal. A hydraulic model (TUFLOW) was developed to assess stormwater flow and flood conditions to inform the design of the realigned overland flow path and other site earthworks, and to mitigate any increases in flood risk at neighbouring sites.

Flood risk is expressed as an Annual Exceedance Probability (AEP) which refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage with a large flood which may be calculated to have a 1% chance to occur in any one year, described as 1% AEP. The flood risk assessment considered the 5% AEP, 1% AEP and a worst-case 1% AEP climate change scenario.

The flood assessment assessed both on- and offsite impacts, as a result of the proposal under each of these scenarios. It also assessed the Probable Maximum Flood (PMF) event which is only considered in the context of developing emergency safety evacuation measures in response to an extreme flood, rather than assessing offsite impacts.

Flood modelling has demonstrated that the overland flow path and proposed changes to the site topography will not result in an increase in flood levels at neighbouring properties for flood events up to and including the 1% AEP and will not increase flood hazard at adjacent properties for events up to and including the PMF. Further, under the PMF scenario assessed, the western portion of the site is shown to remain flood-free, so evacuation from the facility due to PMF would not be necessary.

As such, the proposal will not materially impact the flood risk at neighbouring properties.

12.3.2.3 Water balance

A site water balance has been completed to estimate the annual potable water demands, sewage discharges and stormwater runoff from the site. It is noted that the main source of water demand is for the EfW process. and measures have been incorporated into the design to reuse process water as much as possible. Water consumption has been optimised such that water is wholly consumed by the EfW process, with water lost to a combination of steam or quenching of the Incinerator Bottom Ash (IBA). No remaining process water is discharged to sewer. The only water discharged to sewer would be through daily use of bathrooms and kitchens in the administration building and visitor and education centre and general washdown of the facility.

A summary of the results of the site water balance is included in **Table 12.2.**

Table 12.2: Proposal site water balance

Water source/demand	Average annual total (kL)	
	Inflow	Outflow
Rainfall on site	50,000	
Rainwater used for process		12,000
Stormwater discharge from site		32,000
Stormwater infiltration and evapotranspiration on pervious areas		6,000
Potable water supply	281,000	
Potable water used for process		272,000
Discharge to sewer		9,000

12.4 Mitigation

Table 12.3 describes the mitigation measures that will be applied to address potential hydrological and flooding impacts associated with the proposal.

Table 12.3: Hydrology and flooding mitigation measures

ID	Impact	Mitigation measures
Construction mitigation measures		
HF1	Water quality	As part of a Soil and Water Management Plan (part of the CEMP), the contractor will be responsible for monitoring the quality of stormwater discharged from the site construction area via sedimentation basins. Water quality in the overland flow path through the site, including at the site discharge point, will also be monitored constantly throughout construction.
HF2	Erosion, sediment and pollution control	As part of a Soil and Water Management Plan (part of the CEMP), during the construction phase all works or activities are to be carried out in line with Managing Urban Stormwater: Soils and Construction (The Blue Book).
HF3	Quality of stormwater runoff and downstream environmental impacts	As part of a Soil and Water Management Plan (part of the CEMP), a sediment control plan and strategy covering cut-off drains, shaker pads, check dams and sediment basins will be developed. This will improve the quality of stormwater runoff from the site and minimise downstream environmental impacts.
HF4	Water quality associated with farm dam dewatering	As part of the CEMP, a Dewatering Management Plan would be prepared before the decommissioning and dewatering of the farm dam. The Plan will describe the dewatering method, monitoring of water quality and measures to minimise risk to water quality in the overland flow path.
HF5	Water demand	As part of the CEMP, arrangements will be developed for the reuse of stormwater collected in sediment basins for site activities such as dust suppression, to minimise potable water demand for construction activities.
HF6	Flood impacts on neighbouring properties during construction	Locate site facilities and construction access tracks away from the existing overland flow path and recognised 1% AEP flood extent. This will offer a level of flood immunity to these facilities and minimise flood impacts on neighbouring properties. The construction site layout will be confirmed through the CEMP.

ID	Impact	Mitigation measures
Operation mitigation measures		
HF7	Water quality	In line with BCC water sensitive urban design (WSUD) principles and the stormwater pollutant reduction targets, water quality impacts associated with the proposal will be mitigated through: • The bioretention basin with a permanent pond depth and filtration media which will be planted with suitable nutrient-removing vegetation. It will also be installed with permanent water quality monitoring devices. • Site runoff through each trunk drain will pass through a gross pollutant trap before discharge to the basin. • Oil and water separators, including shut-off valves.
HF8	Water quality	During site operations it is proposed to permanently monitor stormwater discharge at the outlet from the OSD basin. As all site stormwater runoff from the development area will be directed to the basin, this will enable the quality of runoff from the site to be monitored effectively. The permanent testing will monitor a range of parameters representative of general water quality, including: • Dissolved oxygen (DO) • Turbidity • pH • Total suspended solids • Total nitrogen • Total phosphorus.
HF9	Downstream flooding impacts	Stormwater runoff from the proposal site will be controlled by an OSD basin and the overland flow path will be realigned and revegetated to minimise offsite flooding impacts.
HF10	Runoff and chemical and hydrocarbon spills	Runoff from sensitive areas with the potential to cause spills of chemicals or hydrocarbons will be contained by bunding, and runoff will pass through oil and water separators.
HF11	Water demand	Rainwater harvesting of main building roof runoff for reuse in the EfW plant process, to reduce reliance on potable water.