Flooding Impact Assessment

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Sydney Water
IN.P0001436

Quakers Hill WRRF Advanced Treatment Upgrade
17 September 2025

Flooding Impact Assessment

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Executive summary

Sydney Water is planning to upgrade the Quakers Hill WRRF to accommodate forecast growth in the catchment and treat water to more stringent water quality requirements that are being introduced in an update to the site's environment protection licence. The upgrades, referred to as the Quakers Hill WRRF Advanced Treatment Upgrade project (ATU project), are also important to ensure high quality feedwater for a potential future Purified Recycled Water (PRW) Treatment Plant and meeting health and environmental requirements. The ATU project includes expanding the secondary wastewater treatment process and installing an advanced water treatment plant (AWTP) within the existing Quakers Hill WRRF site to provide ultrafiltration, reverse osmosis and chemical dosing. During operation, before the planned PRW Treatment Plant comes online, treated water would be discharged to Breakfast Creek. A new pipeline would be built to transport brine (produced as a byproduct of filtration processes) to the Northern Suburbs Ocean Outfall Sewer (NSOOS) at Seven Hills.

This report has been prepared to support the review of environmental factors (REF) for the ATU project. The objective of the study is to investigate and address the potential impacts of the project on existing flooding conditions during the construction and operational phases.

Existing environment

The proposed advanced water treatment plant would be located within the Quakers Hill WRRF site. The Quakers Hill WRRF site is located on the northern bank of Breakfast Creek to the south of the Westlink M7 Motorway and is surrounded by residential development. The Quakers Hill WRRF site is located upstream of the confluence of Breakfast Creek and Eastern Creek and is bound by the Westlink M7 Motorway to the north, Quakers Hill Parkway to the west, Breakfast Creek to the south and Quakers Road to the east.

The flooding in Breakfast Creek is the primary cause of mainstream flooding at the Quakers Hill WRRF site. Flooding may also be influenced by high tailwater levels downstream of the WRRF site caused by flooding in Eastern Creek, South Creek, or the Hawkesbury River. Only a small portion of Quakers Hill WRRF located adjoining the bank of Breakfast Creek is subject to flooding in a 5% annual exceedance probability (AEP) storm. The proposed location of the AWTP is not flooded in the probable maximum flood (PMF) event due to an existing bank around the intermittently decanted aerated lagoons. Although the proposed secondary treatment location is not flooded in a 5% AEP storm, the site is subject to flood depths of up to 0.2 metres along the southern corner in a 1% AEP storm. The proposed location of the secondary treatment is subject to flood depth of up to 1.8 metres in the PMF event which has an AEP of about 1 in 1,000,000.

Overland flooding of the Quakers Hill WRRF site is primarily caused by the catchment area of the WRRF itself. The site also receives minor external inflows through the main road entrance on Quakers Road and from an open channel drain on Melrose Avenue. The proposed location of the AWTP is not subject to flooding in the PMF event. The proposed location of the secondary treatment is however subject to flood depths of up to 0.15 metres along the existing access road in a 5% AEP and 1% AEP storms. The proposed secondary treatment location is subject to up to 2.05 metres depth of ponding in the PMF event.

Impacts during construction

An assessment was carried out into the flood related impacts associated with the construction activities that are proposed within the Quakers Hill WRRF and the construction work areas and ancillary facilities associated with the brine pipeline. Table 8-1 in Section 8 of this report lists each ancillary facility and work area, as well as their level of flood affectation and potential impacts on existing flood behaviour. Figure B-1a to Figure B-1d show the extent to which mainstream floods of varying magnitude affect each construction work area. Figure B-2a to Figure B-2d show the extent to which overland flooding of varying magnitude affect each construction work area.

The key findings of the assessment of flood related impacts during construction can be summarised as follows:

- There is a low risk of flooding associated with the construction work areas and ancillary facilities that would be located within Quakers Hill WRRF. Work areas and ancillary facilities associated with the proposed brine pipeline construction are subject to flooding conditions that would be considered hazardous during storms as frequent as 5% AEP.
- Work areas and ancillary facilities located in areas of high flood hazard pose a safety risk to construction personnel and plant. It is therefore recommended that the location and layout of the ancillary facility sites be reviewed to confirm how flood risks will be managed, or if alternative locations need to be considered.
- Site facilities, stored materials and perimeter fencing associated with a number of the ancillary facilities have the potential to obstruct the conveyance of floodwater or displace floodplain storage. The ancillary facilities where there is the greatest potential for impacts correspond to those where high hazard flooding conditions are identified. The potential for the ancillary facilities to impact on flood behaviour in existing development will therefore need to be taken into consideration when reviewing the suitability of the location and layout of the ancillary facilities.

Impacts during operation

Potential impacts of flooding on the project

The level of flood immunity to the proposed works located within the Quakers Hil WRRF would be maintained under post-developed conditions.

Potential impacts of the proposed modification on flood behaviour

The proposed permanent works for the project have the potential to exacerbate flooding conditions in adjacent land, which would be primarily due to:

- an increase in the rate and volume of runoff from proposed works within the Quakers Hill WRRF site, which has the potential to impact on both mainstream and overland flooding patterns within the site and downstream of the site
- minor permanent works, which have the potential to impact on overland flood behaviour.

An assessment was carried out of the impact that the above changes associated with the proposed modification would have on both mainstream and overland flood behaviour, the findings of which are presented in Section 9 of this report.

The assessment found that once constructed, the proposed permanent works would generally have up to 0.01 metres impact on the depth of inundation in adjacent land for storms with AEPs up to 1% in intensity. Flood levels at 26 properties would increase between 0.01 and 0.02 metres due to overland flooding for storms with AEPs up to 1% with climate change in intensity.

In the PMF event, the maximum increase in flood levels at Breakfast Creek were estimated at 0.03 metres. Flood levels at 18 properties would increase up to 0.04 metres due to overland flooding. Flood levels on the section of the Westlink M7 Motorway between Quakers Hill Parkway and Quakers Road are increased up to 0.03 metres. However, it is to be noted that both the east and west bound lanes of the impacted section of the Westlink M7 Motorway are subject to more than 1.5 metres depth of inundation in the existing case.

The assessment found that while the project would have only a minor impact on flow velocities and hence scour potential in the drainage lines that are located outside of the Quakers Hill WRRF site, there is the potential for a localised increase in scour potential due to localised increased in flow velocities at the outlet of the drainage structures within the Quakers Hill WRRF site.

During detailed design, scour protection and energy dissipation measures would be incorporated into the design of the drainage outlets where required to manage localised increases in flow velocity.

Given the relatively minor increases in peak flood levels and the depth of inundation that are attributable to the project, there would also be only minor changes in the extent of inundation for all events up to the PMF. The assessment found that the change in duration of both mainstream and overland flooding would be less than one hour in the vicinity of Quakers Hill Parkway between a 5% AEP and the PMF event.

The assessment found minor changes in both mainstream and overland flood hazard due to the project. However, areas subject to changes in low flood hazard (i.e. H1 and H2) to high hazard (i.e. H3, H4, H5 and H6) due to the project are generally small and isolated. The small and isolated areas of increased flood hazard from low to high would have no adverse impacts on personal safety and damage to property.

The assessment found that a 1% AEP storm with 20% increase in rainfall intensities due to future climate change will increase 1 % AEP flood levels under the existing climate up to 0.20 metres within the Quakers Hill WRRF site.

The majority of the proposed works for the project within the Quakers Hill WRRF are located on lands which are not subject to flooding in a 5% AEP flood event. Hence, the loss of floodplain storage and re-distribution of flood flows due to the project are expected to be minimal.

Flooding within the Quakers Hill WRRF site results from short duration storms up to 2 hours long. The project would have minor impacts on flood levels, minor increase in duration of inundation of less than 1 hour, and localised and isolated increase in flood hazard from low to high. In addition, roads adjoining most of the impacted properties are cutoff in the existing case. Hence, the project is expected to have minor impacts upon existing community emergency management arrangements.

Management of Impacts

Section 10 of this report sets out the environmental management measures which will be implemented during the detailed design, construction and operation of the project.

The key flood related objective of the project would be to ensure that it minimises adverse impacts to flood behaviour in areas outside the Quakers Hill WRRF site. Section 8.2 provides an initial indication of the potential impacts on flood behaviour due to construction activities. Further investigations need to be carried out during detailed design utilising more detailed site layout and staging diagrams. Table 10-1 in Section 10 contains a range of potential measures which would be implemented in order to reduce the impact of construction activities on flood behaviour.

Table 10-1 identifies the specific measures which would be incorporated into the detailed design to mitigate residual operational flooding risk. If there are any major updates made to the 50% concept design assessed in this study, permanent works for the project would be designed to minimise adverse flood impacts on:

- Adjacent land during storms up to the 1% AEP in intensity
- critical infrastructure, vulnerable development or increases in risk to life due to a significant increase in flood hazard for events up to the PMF.

The nature and extent of flood impacts, and the scope of mitigation measures required, would be subject to further assessment during detailed design.

Contents

Tables

Figures

Acronyms and abbreviations

Term	Meaning
1D	One-dimensional
2D	Two-dimensional
Afflux	Increase in flood level as a result of obstruction to flow.
AHD	Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.
AEP	Annual Exceedance Probability. The probability that an event of a given size will be equalled or exceeded in a given year. In this study AEP has been used consistently to define the probability of occurrence of flooding.
ARI	Average Recurrence Interval. The inverse of the AEP expressed as a return period. For instance, the 1% AEP is equivalent to the 100-year ARI event.
ARR	Australian Rainfall and Runoff. Guidelines prepared by the Institute of Engineers Australia for the estimation of design floods. Reference is made to the 1987 or the 2019 versions of ARR, as specified.
ARR 2019 Version 4.1	Australian Rainfall and Runoff released in 2019.
ARR 2019 Version 4.2	Australian Rainfall and Runoff released in 2024.
AWTP	Advanced water treatment plant
Catchment	The land area draining through the mainstream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CEMP	Construction Environmental Management Plan. A site-specific plan developed for the construction phase to ensure that all contractors and sub-contractors comply with the environmental conditions of approval and that the environmental risks are properly managed.
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to, construction work areas, sediment basins, material stockpile and laydown areas, parking, maintenance workshops and offices, and construction compounds.
Conveyance	The transport of flood water downstream.
CSS	Catchment Simulation Solutions Pty Ltd
DEM	Digital elevation model
DFE	Defined flood event
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
FBC	Final business case
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.

Term	Meaning
Flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
Flood hazard	A flood that has the potential to cause harm or conditions with the potential to result in loss of life, injury and economic loss.
Flood liable/ flood prone land	Is synonymous with flood prone land i.e. land susceptibility to flooding by the probable maximum flood event. Note that the term flooding liable land covers the whole floodplain, not just that part below the flood planning level (see flood planning area).
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
Flood planning area	The flood planning area is the area within which developments may be subject to flood related development controls. The flood planning area is calculated as the area lower than the flood planning level.
Flood planning level	The combination of the flood level from the DFE and freeboard selected for floodplain risk management purposes.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the flood planning level is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.
HDD	Horizontal directional drilling
Hydraulics	The study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
IFD	Intensity Frequency Duration. Describes rainfall in terms of intensity (typically mm/hr), frequency (e.g. ARI) and duration of the storm.
JSJV	Jacobs SMEC Design Joint Venture (for the M7-M12 Integration Project)
km	Kilometres
km^2	Square kilometres
LEP	Local environmental plan
LGA	Local government area
LiDAR	Light Detection and Ranging

Term	Meaning
Local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
mm	Millimetres
m/s	metres per second. Unit used to describe the velocity of floodwaters.
m^3/s	Cubic metres per second or "cumecs". A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time. 1 m^3/s is equal to 86.4 ML/day.
ML/day	Megalitres per day. A unit for measurement of flows or discharges.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
NSOOS	Northern Suburbs Ocean Outfall Sewer
Overland flow path	The path that floodwaters can follow as they are conveyed towards the main flow channel or if they leave the confines of the main flow channel. Overland flow paths can occur through private property or along roads.
PMF	Probable maximum flood. The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
PMP	Probable maximum precipitation. The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to probable maximum flood estimation.
RCP	Representative Concentration Pathway. RCPs are prescribed pathways for greenhouse gas and aerosol concentrations, together with land use change, that are consistent with a set of broad climate outcomes used by the climate modelling community.
REF	Review of environmental factors
SBC	Strategic business case
TfNSW	Transport for NSW
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia.
WRRF	Water resource recovery facility

Terminology between ARI and AEP

In accordance with ARR 2019, AEP is the probability of an event being equalled or exceeded within a year and may be expressed as either a percentage (%) or 1 in X. For example, a 1% AEP event or 1 in 100 AEP has a 1% chance of being equalled or exceeded in any year.

Average Recurrence Interval (ARI) was a term used previously to define the probability of design flood events (ARR, 1987) and was defined as the average period between occurrences equalling or exceeding a given value. The use of terms such as “recurrence interval” and “return period” are no longer recommended as they imply that a given event magnitude is only exceeded at regular intervals such as every 100 years. The term ARI has only been applied when referencing documents developed prior to the release of ARR 2019.

1. Introduction

1.1 Background

This flooding impact assessment has been prepared to inform the review of environmental factors (REF) for the Quakers Hill Water Resource Recovery Facility (WRRF) Advanced Treatment Upgrade (ATU) project (the project). The project involves the development of an advanced water treatment plant (AWTP) at Quakers Hill WRRF, an upgrade of the site's existing secondary treatment infrastructure, and a pipeline to transfer brine from Quakers Hill WRRF to the existing Northern Suburbs Ocean Outfall Sewer (NSOOS) at Seven Hills. The location of the project is shown in Figure 1-1. Sydney Water is the proponent of the project.

This report describes the flooding behaviour under the existing and post-developed (design case) conditions and identifies potential impacts during both construction and operational phases, including the cumulative impacts resulting from the other active projects in the area. It also provides recommendations for avoiding or minimising these potential impacts.

1.2 Project overview

Upgrades to Sydney Water's Quakers Hill WRRF are required by 2028 to:

- Service industry growth and housing policies as current treatment capacity at the plant of 28 megalitres per day (ML/day) is expected to be exceeded in late 2028
- Meet environment protection licence limits that require reduced nutrient loads to the Hawkesbury-Nepean River (Sackville 2 zone)
- Provide high quality water treatment that enables a future purified recycled water (PRW) scheme and its introduction into Prospect Reservoir.

The ATU project is in the Blacktown local government area, in largely urbanised areas with a mix of residential, industrial, and recreational land uses. The key features of the ATU project are shown in Figure 1-2 and include:

- A secondary treatment process upgrade from the current 28 ML/day to 48 ML/day
- A new AWTP, including reverse osmosis, ultrafiltration and stabilisation
- A range of ancillary infrastructure such as new buildings, tanks, pipes, services and chemical storage
- Demolition and restoration of previously decommissioned structures
- A new brine pipeline to transfer the brine generated as a by-product of the reverse osmosis process into the existing wastewater network. The pipeline would:
  - Have flow capacity of up to 12.5 ML/day
  - Be about 8 kilometres (km) long and about 500 millimetres (mm) diameter
  - Be installed largely along shared paths, public parkland, and road corridors
  - Be mostly underground and built using open trench and trenchless methods
  - Be connected into Sydney Water's existing Northern Suburbs Ocean Outfall Sewer (NSOOS).

The AWTP is required to treat the wastewater to meet more stringent nutrient limits. However, it would also produce high quality water that could be further treated to produce PRW.

Sydney Water is preparing an REF for the ATU project. This report has been prepared to support that REF. PRW is not part of the scope of this assessment. Sydney Water is separately assessing the potential introduction of PRW in an environmental impact statement.

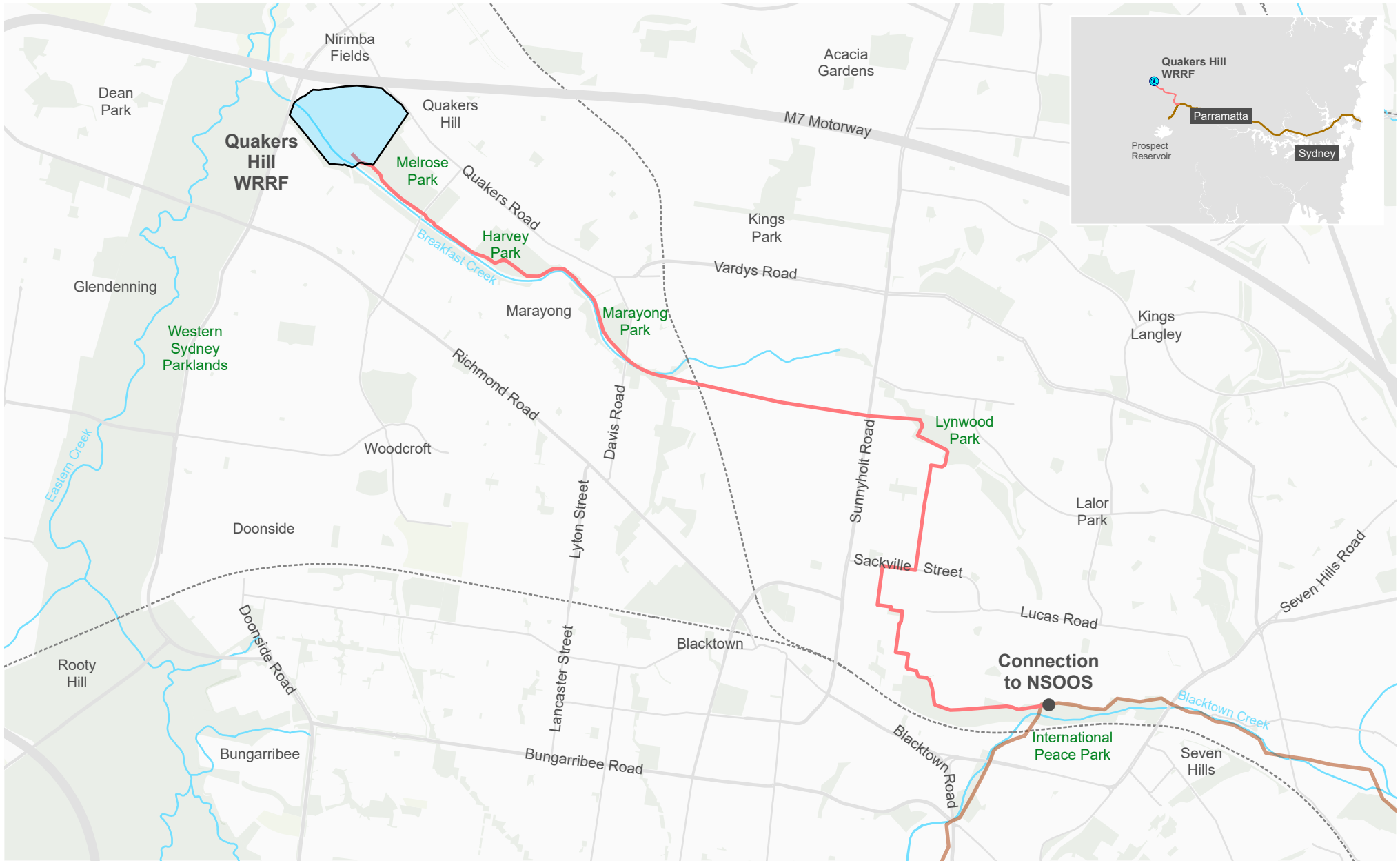
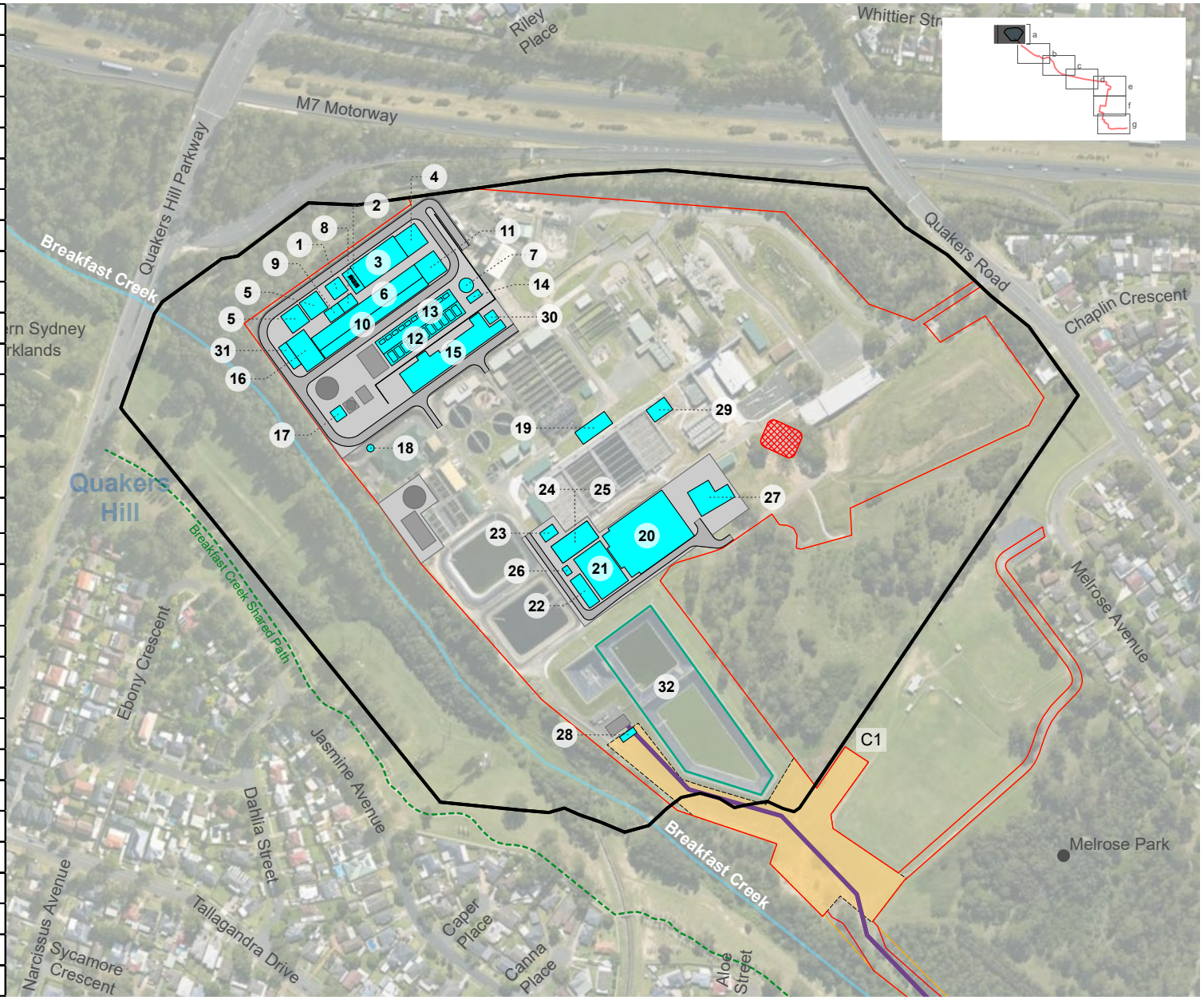


Figure 1-1 Overview of the proposed scheme

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

1	UF Feed Tank	AWTP Area
2	UF Feed Pumps	AWTP Area
3	UF Building	AWTP Area
4	UF CIP	AWTP Area
5	RO Feed Tank	AWTP Area
6	RO Building	AWTP Area
7	RO Permeate Building	AWTP Area
8	LP RO Pumps	AWTP Area
9	Cartridge Filters	AWTP Area
10	HP RO Pumps	AWTP Area
11	RO CIP	AWTP Area
12	Enhanced Treatment	AWTP Area
13	Enhanced Treatment Feed Pumps	AWTP Area
14	Service Water & RO Flush Pumps	AWTP Area
15	Chemical Dosing Area	AWTP Area
16	AWTP and PRW Switchrooms	AWTP Area
17	AWTP pH Correction & Stabilisation Standpipe	AWTP Area
18	AWTP Flow Splitter Tank	AWTP Area
19	Odour Control Facility	AWTP Area
20	Bioreactor	Secondary Treatment Area
21	MBR	Secondary Treatment Area
22	MBR Permeate Pumps	Secondary Treatment Area
23	MBR & Bioreactor Switchroom	Secondary Treatment Area
24	MBR & Bioreactor Switchroom	Secondary Treatment Area
25	Blower Room	Secondary Treatment Area
26	WAS/Scum Pumping Station	Secondary Treatment Area
27	MBR Pre-screen	Secondary Treatment Area
28	Brine Pump Station	Secondary Treatment Area
29	Cover existing sludge tank	AWTP Area
30	Clean Water Lab	AWTP Area
31	AWTP/PRW Transformers	AWTP Area
32	Existing Brine Storage Tanks	Secondary Treatment Area



Quakers Hill Water Resource Recovery Facility (WRRF)
Advanced treatment upgrade infrastructure
Plant access
Plant hardstand
Existing Brine Storage Tanks
Impact area
Impact assessment area
Exclusion area
Construction compounds
Watercourse
Shared path
Brine pipeline construction method
Open trench

Figure 1-2 Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

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Impact area
Impact assessment area
Construction compounds

Watercourse
Shared path

Brine pipeline construction method
Open trench
HDD pipe string

Figure 1-2b Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds

Watercourse
Brine pipeline construction method
Open trench

HDD
HDD pipe string

Figure 1-2c Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

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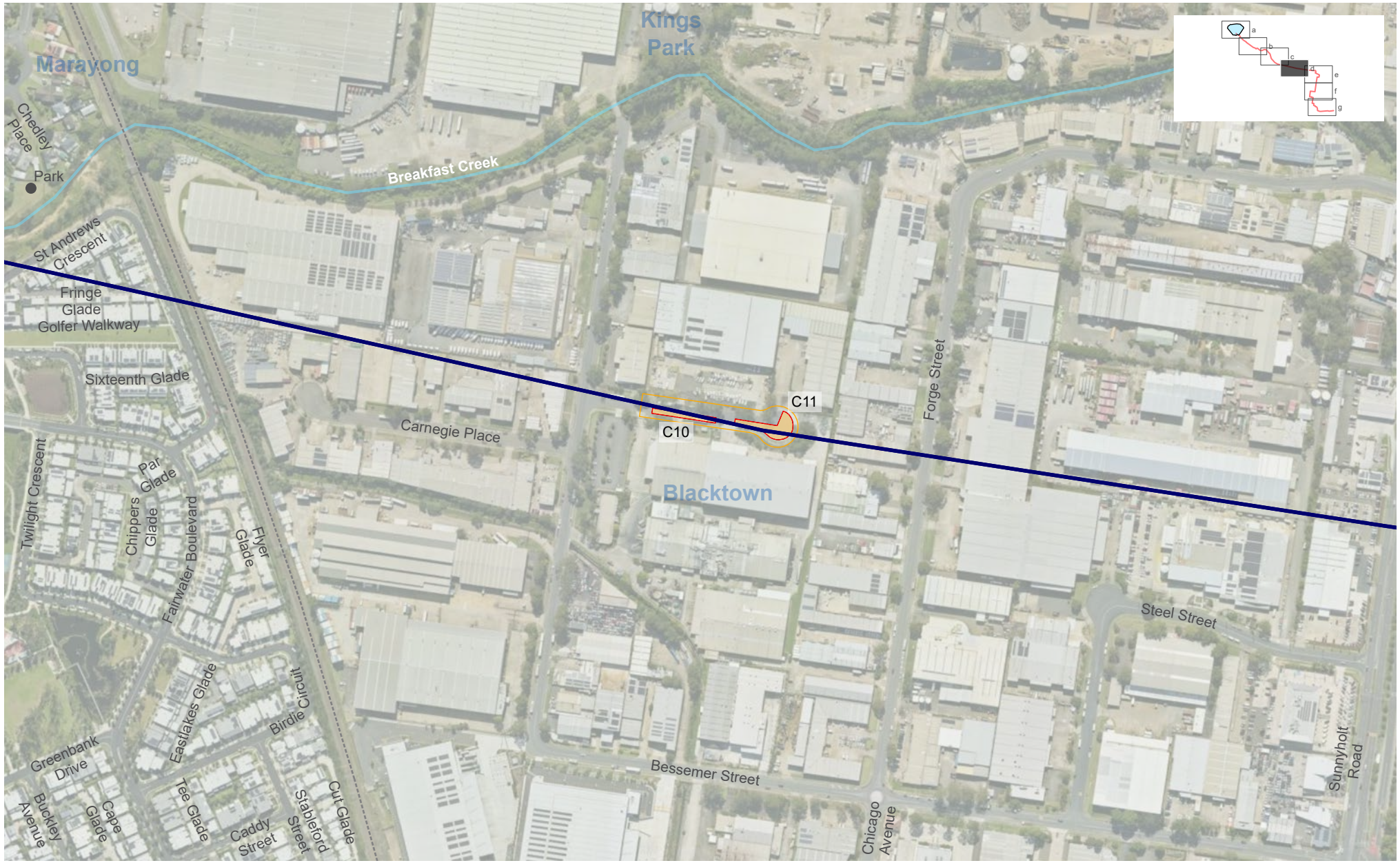

Impact area
Impact assessment area
Construction compounds
Watercourse
Brine pipeline construction method
HDD

Figure 1-2d Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds
Brine pipeline construction method
Open trench
HDD
HDD pipe string

Figure 1-2e Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds
Barometric loop
Brine pipeline construction method
Open trench
HDD pipe string

Figure 1-2f Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds
NSOOS pipeline
Watercourse
Brine pipeline construction method
Open trench

Figure 1-2g Indicative location of the secondary treatment plant upgrade, AWTP, brine pipeline and impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

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1.3 Purpose and scope of this report

The purpose of this flooding impact assessment is to:

- Assess the potential flood impacts of the ATU project on existing flood behaviour during construction and operation of the project
- Identify mitigation measures to reduce flooding impacts to an acceptable limit.

This assessment covers the AWTP and Secondary Treatment upgrade at the Quakers Hill WRRF and the Brine Pipeline from Quakers Hill to the Northern Suburbs Ocean Outfall Sewer.

1.4 Report structure

This report is structured according to the following sections:

Section 1	This section
Section 2	Legislation and policy context
Section 3	Assessment context: Assessment criteria and the assessment area of interest
Section 4	Existing environment: Description of the site, catchment description and flooding behaviour
Section 5	Available information: Description of the available data including data sources
Section 6	Existing case flood modelling: Description of the hydrologic and hydraulic modelling development for existing conditions
Section 7	Existing flooding characteristics: Detailed description of existing flooding characteristics, for the 1% annual exceedance probability (AEP) flood event and the probable maximum flood (PMF)
Section 8	Potential construction impacts: Assessment of potential construction phase flood impact
Section 9	Assessment of design case flood impact: Description of the proposed works and the resulting changes in flooding conditions. Climate change and flood immunity assessment and identification of mitigation measures
Section 10	Mitigation and management measures
Section 11	References.
Appendices	Appendix A – Existing case flood modelling
	Appendix B – Existing case flood mapping
	Appendix C – Design case flood modelling
	Appendix D – Flood impact maps – operational

1.5 Definition of the site

For the purposes of this report, the 'WRRF site' refers to the proposed Quakers Hill advanced treatment site upgrades. The brine pipeline is referred to separately.

2. Legislation and policy context

2.1 Legislation, policy and guidelines

Table 2-1 summarises the current legislative requirements and guidelines relevant to flooding considerations for the project.

Table 2-1 Legislation, policy and guidelines applicable to the project

Legislation, policy or guideline	Brief description and intent	Relevance to the project
Australian Rainfall and Runoff (ARR)	ARR is a national guideline document that is used for the estimation of design flood characteristics in Australia.	ARR provides guidance for flood estimation for the project.
NSW Government's Flood Risk Management Manual and supporting guides (Department of Planning and Environment, 2023a)	Provides guidelines on an approach to floodplain planning and management of flood risk in NSW.	The guidelines and manual are utilised by councils to prepare and implement floodplain risk management plans.
Controlled Activities – Guidelines for Watercourse Crossings on Waterfront Land (Department of Planning and Environment, 2022)	Watercourse crossings are a controlled activity under the *Water Management Act 2000*. The guidelines relate to the design and construction of watercourse crossings and ancillary works, such as roads on waterfront land.	Crossings have the potential to disrupt the hydrologic and hydraulic functions of a watercourse affecting local flooding conditions. The guidelines set out ways to minimise these impacts during design and construction. Sydney Water is exempt from applying for approval of controlled activities.
Blacktown Local Environmental Plan 2015, Blacktown Development Control Plan 2015	These documents set out controls in relation to local flood planning mainly to: ▪ Minimise flood risk to life and property associated with the use of land ▪ Allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a results of climate change ▪ Avoid adverse or cumulative impacts on flood behaviour and the environment ▪ Enable safe occupation and efficient evacuation of people in the event of a flood.	Blacktown Development Control Plan 2015 defines flood planning level (minimum floor level) for commercial and industrial buildings as the 1% AEP flood level plus a 0.3 metres freeboard.

3. Assessment context

3.1 Assessment criteria

Design criteria relating to flooding are the explicit goals relating to flood immunity that a project must achieve in order to be successful. Often a detailed risk assessment is undertaken to select flood immunity for different assets. The design criteria for the project are presented in Table 3-1.

Table 3-1 Design criteria

Flood immunity	
New non-habitable buildings	1% AEP + 0.5 metres
Critical infrastructure / electrical works	1% AEP + 0.5 metres

Performance criteria relating to flooding are used to measure impacts of a project on existing flood behaviour including increase in flood level, flow velocity, flood hazard, duration of inundation etc. The performance criteria proposed for the project are presented in Appendix A. Appropriate threshold levels for flooding impacts may vary depending on the catchment setting and presence and nature of existing development in the vicinity of the project site. The proposed performance criteria have been sourced from conditions of approval for a number of state significant infrastructure.

Table 3-2 Performance criteria

Flood impact criteria (up to and including 1% AEP event)	
Afflux (Change in flood level)	Buildings: 10 mm if flooded above floor Buildings/Open space: 50 mm if buildings not flooded above floor
Increase in flow velocity	Up to 10% increase
Change in duration of inundation	Up to 1 hour
Change in flood hazard	No change in low flood hazard categories (H1 and H2) to high hazard categories (H3 – H6)

3.2 Overview of methodology

The assessment methodology is summarised below:

- Obtain and review existing flood studies and models
- Develop new flood models, if required
- Update the existing flood models as basis to develop baseline (pre-development) case flood models
- Run the models to establish existing case flooding conditions including flood mapping for 5% AEP, 1% AEP, 1% AEP with climate change and PMF events. Flood mapping results will include flood depths, levels, velocities and flood hazard
- Update the existing conditions flood models to represent works for the operational phase of the project
- Run the models for the operational phase to assess post-development flooding conditions to check flood immunity (refer Table 3-1), determine flooding impacts for the modelled flood events in terms of changes in flooding conditions from the existing case
- Identify potential measures to mitigate flooding impacts, if required
- Assess residual flooding impacts based upon the performance criteria presented in Table 3-2 and identify strategies to address residual impacts

- Assess construction phase works based on the preliminary information on construction compound.

This assessment considers mainstream flooding from both Breakfast Creek and Eastern Creek, which are the main sources of flooding at the Quakers Hill WRRF site and surrounding area. Local overland flows in the vicinity of the WRRF site and along the brine pipeline are also considered with separate overland flow flood models.

3.3 Assessment area of interest

This flooding impact assessment investigates flooding in the vicinity of the WRRF site and proposed brine pipeline, as well as on a broader catchment scale to quantify the flood impacts across the floodplain both upstream and downstream of the WRRF site and proposed pipeline. The objective is to ensure the full spatial extent of impacts are identified.

4. Existing environment

4.1 Description of the site

The Quakers Hill WRRF site is located on the northern bank of Breakfast Creek to the south of the Westlink M7 Motorway. The site is an existing WRRF and is surrounded by residential development. The site is located upstream of the confluence of Breakfast Creek and Eastern Creek and is bound by the Westlink M7 Motorway to the north, Quakers Hill Parkway to the west, Breakfast Creek to the south and Quakers Road to the east.

The proposed brine pipeline extends from the Quakers Hill WRRF site to the existing NSOOS pipeline at the connection point near International Peace Park in Seven Hills. The brine pipeline includes sections of open trench construction and horizontal directional drilling (HDD) and has a total pipe length of approximately 7.7 km. Refer to Figure 1-1 for the site locality and surrounding features.

4.2 Catchment description

The Quakers Hill WRRF site is located within the Breakfast Creek catchment. The Breakfast Creek catchment is a part of the broader Eastern Creek catchment. The brine pipeline extends primarily along Breakfast Creek through to Lynwood Park. The brine pipeline then connects to the south and enters the Blacktown Creek catchment. The Blacktown Creek catchment is part of the broader Parramatta River catchment. The catchment areas to the WRRF site and contributing areas of the brine pipeline include:

- Breakfast Creek sub-catchment: 22.5 square kilometres (km^2) upstream of Eastern Creek confluence
- Eastern Creek sub-catchment: 57.5 km^2 upstream of the Breakfast Creek confluence
- Blacktown Creek sub-catchment: 8.0 km^2 upstream of International Peace Park.

The topography of these sub-catchments within the study area is shown in Figure 4-1.

Each of the sub-catchments are highly urbanised with a mix of residential, commercial, industrial and other urban land uses, and also contain areas of parklands, reserves and vegetation.

The watercourses in the vicinity of the Quakers Hill WRRF site are highly modified, including Breakfast Creek in the upstream direction and Eastern Creek in the downstream direction. The riparian corridor is well vegetated with remnant native vegetation and higher ecological values downstream from the WRRF site compared with upstream. The reaches of Eastern Creek near the project are within the Western Sydney Parklands and consist of similar remnant native vegetation.

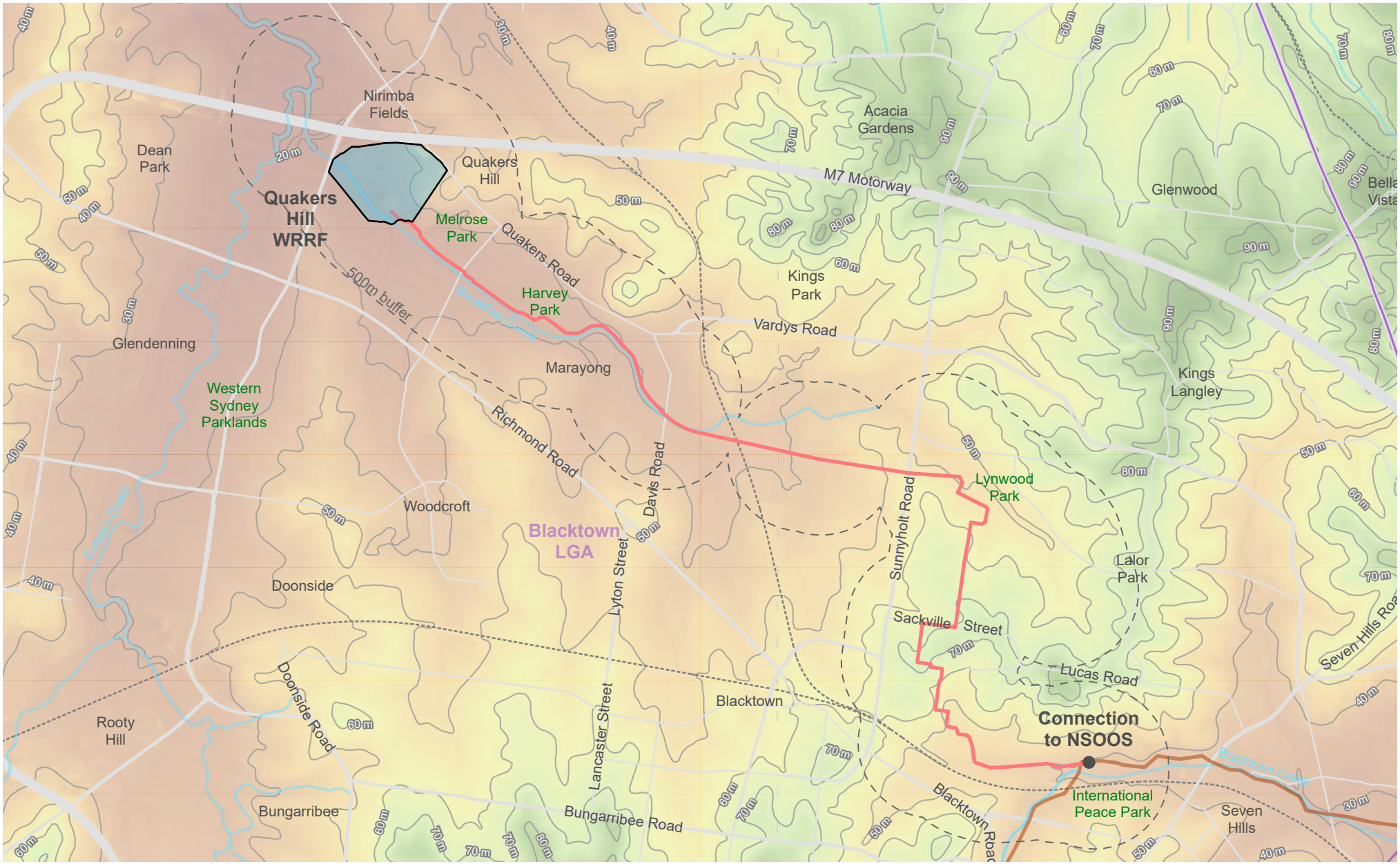
The brine pipeline runs along Breakfast Creek until Davis Road where an HDD pipe section is proposed to begin. The HDD section is proposed to end at Lynwood Park, where the pipe alignment turns south until it reaches Blacktown Creek where it connects to the NSOOS.

There are numerous existing waterway crossings and hydraulic structures over the water courses in the vicinity of the site and along the brine pipeline alignment, including:

- Breakfast Creek: Quakers Hill Parkway, Falmouth Road, Breakfast Road, Davis Road and Sunnyholt Road. T1 / T5 Rail bridge crossing
- Blacktown Creek: Prospect Highway.

4.3 Topography

A terrain map for the Quakers Hill WRRF site is shown in Figure 4-2. Altitudes within the site vary between 20 m and 46 m Australian Height Datum (AHD) as shown in Figure 4-2. The lowest altitude occurs along the main channel of Breakfast Creek and higher grounds are located at the north-east corner of the site.



Quakers Hill Water Resource Recovery Facility (WRRF)

Brine pipeline

NSOOS pipeline

Project 500m buffer

LGA boundaries

Parks and open space

10m contour

Elevation (m)

109.32

16.00

Figure 4-1 Topography and drainage

0 1 km

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024

Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

N

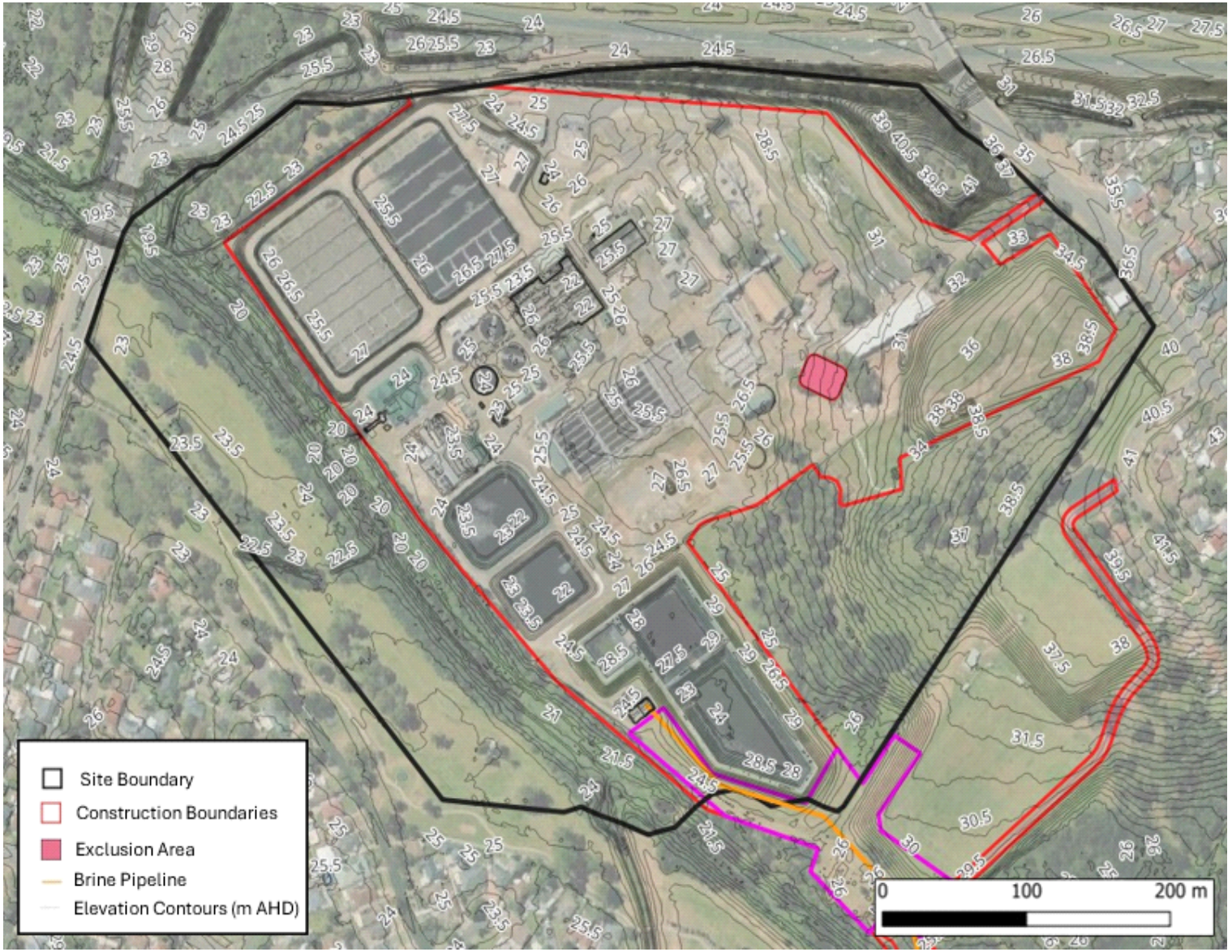


Figure 4-2 Terrain map – Quakers Hill WRRF site

4.4 Description of flooding

4.4.1 Causes of flooding

A summary of causes of flooding is provided below and is based on the review of existing studies presented in Section 5.1.

4.4.1.1 Quakers Hill WRRF site

Peak flooding at the Quakers Hill WRRF site is a combination of both:

- Mainstream flooding from Breakfast Creek, Eastern Creek, South Creek and the Hawkesbury River
- Overland flooding from local catchment stormwater runoff.

Mainstream flooding is the result of flood flows from the main catchments causing water levels to rise out of the waterways and inundate the adjacent floodplains. The flooding in Breakfast Creek is the primary cause of mainstream flooding at the Quakers Hill WRRF site. Flooding may also be influenced by high tailwater levels downstream of the Quakers Hill WRRF site caused by flooding in Eastern Creek, South Creek, or the Hawkesbury River. The 2024 Hawkesbury-Nepean River Flood Study Overview (NSW Reconstruction Authority, 2024) adopted a flood level of 30.6 metres Australian Height Datum (m AHD) at Windsor PWD gauge for the probable maximum flood (PMF) which implies that areas within the Quakers Hill WRRF site located below 30.6 m AHD are prone to flooding due to the PMF event occurring in the Hawkesbury River.

Overland flooding results from local runoff into surface flow paths causing inundation of areas as it drains to the receiving waterways. Overland flooding of the WRRF site is primarily caused by the catchment area of the site itself. The site also receives minor external inflows through the main road entrance on Quakers Road and from an open channel drain on Melrose Avenue.

4.4.1.2 Brine pipeline

Flooding along the brine pipeline alignment is a combination of both:

- Mainstream flooding from Breakfast Creek, Eastern Creek, South Creek and the Hawkesbury River
- Overland flooding from local catchment stormwater runoff.

Mainstream flooding from Breakfast Creek has the potential to interact with the brine pipeline alignment as it runs along top of bank of Breakfast Creek from the Quakers Hill WRRF site until Davis Road. Maintenance holes and air valves are located along the brine pipeline alignment, which include low profile above ground structures of up to 0.30 metres high. There are no large above ground structures associated with the brine pipeline in this area.

Overland flooding has the potential to interact with the brine pipeline where it runs south from Breakfast Creek to the NSOOS. There is also potential flood interaction with Blacktown Creek where the brine pipeline connects to the NSOOS. Maintenance holes and air valves are located along the brine pipeline alignment, which include low profile above ground structures of up to 0.30 metres high. The only large above ground structure associated with the brine pipeline is a barometric loop proposed at Billy Goat Hill Reserve. The majority of the brine pipeline alignment will run underground, which presents a very low risk of flood impact once operational as there will only be minimal above ground structures.

4.5 Flood history

Eastern Creek has a history of flooding, particularly due to its location within the Hawkesbury-Nepean floodplain, which is prone to flooding from heavy rainfall and the potential for water to "back up" from the

Hawkesbury River. Historic flood information across the Blacktown local government area is reported on in the Local Overland flow study (CSS, 2020). The largest contemporary historic events on record occurred in the 1980's and 1990's, however significant development throughout the catchment area including stormwater basins and subdivisions mean that the current catchment conditions are significantly altered. Council records of flooding 'black spots', which represent known flooding problem locations based on Council or local resident experiences, were reviewed as part of two datasets that represent the July 1992 flood and 2017 flood. These flooding black spots were reviewed and not found to be within the direct vicinity of the proposed project areas.

4.6 Emergency management

It is understood that Blacktown City Council works closely with NSW State Emergency Service (SES) to prepare and update flood plans for the Blacktown LGA. It is also understood that Council complies with the NSW Flood Prone Land Policy and Flood Risk Management Manual to collect and monitor flood information to better understand the flood risk.

The Blacktown City Flood Emergency Plan, endorsed by the Blacktown Local Emergency Management Committee in September 2023, is a sub plan of the Blacktown City Local Emergency Management Plan (EMPLAN). Volume 1 of the Plan sets out Blacktown City Council's level emergency management arrangements for prevention, preparation, response and initial recovery for flooding in Blacktown City LGA. Hazard and Risk information are provided in Volume 2 of the Plan, and NSW SES Response Arrangements are provided in Volume 3. Both Volume 2 and Volume 3 of the Plan are restricted documents as the documents contain sensitive operational information.

5. Available information

5.1 Existing flood studies

A number of flood studies have been undertaken in the catchment area of the Quakers Hill WRRF site and proposed brine pipeline. The most relevant recent flood studies are discussed below.

5.1.1 M7 - M12 Integration Project: Site wide flooding study design report (JSJV, 2024)

This report was prepared by the Jacobs SMEC Design Joint Venture (JSJV) for the M7 – M12 Integration Project for John Holland. The report summarises the flood study undertaken for the entire M7 – M12 Integration Project. Part of this study include the review and update of an existing Eastern Creek flood model provided by Transport for NSW which was updated by Lyall & Associates (2022) to inform the environmental impact statement for Westlink M7 Widening project. The Eastern Creek flood model represents mainstream flooding and was provided for usage by TfNSW. This flood model has been adopted to assess mainstream flood impact of the Quakers Hill WRRF site and brine pipeline. The flooding assessment undertaken for the project is based upon Australian Rainfall and Runoff 1987.

5.1.2 Hawkesbury-Nepean River Flood Study Overview (NSW Reconstruction Authority, 2024)

This study builds on the Hawkesbury-Nepean Valley Regional Flood Study published in 2019. The Hawkesbury-Nepean River Flood Study (2024 Flood Study) identifies areas in the valley affected by flooding from this river and assesses the potential impacts of climate change. The study accounts for flows from the entire 21,400 km^2 Hawkesbury-Nepean catchment, providing detailed flood information for the 190 km length of the Hawkesbury-Nepean River from Bents Basin near Wallacia through to Brooklyn. This overview describes how the 2024 Flood Study was developed, how it will be used, and some key findings. The 2024 Flood Study has adopted flood levels for a range of flood events at Windsor PWD gauge which are presented in Table 5-1. The steep increase in flood level from 20% AEP to PMF shown in Table 5-1 results from floodwaters from the catchment that back up behind natural choke points created by narrow sandstone gorges. This 'bathtub' effect results in deep, rapid and widespread flooding in the Hawkesbury-Nepean Valley.

Table 5-1. Adopted flood levels[1] in the Hawkesbury River at Windsor PWD gauge

Flood event	Flood level (m AHD)
20% AEP	9.9
5% AEP	13.8
1% AEP	17.3
0.2% AEP	20.2
PMF	30.6

[1] Source: https://www.ses.nsw.gov.au/sites/default/files/document/2024-hnr-flood-study-overview_lr.pdf (accessed 13 April 2025)

5.1.3 Westlink M7 Widening: Surface water and flooding impact assessment (Lyall & Associates, 2022)

This report documents the findings of an investigation which was undertaken to assess the surface water and flooding related issues associated with the construction and operation of the proposed modification of the project planning approval for the Western Sydney Orbital (now referred to as Westlink M7) to permit the addition of a trafficable lane in both directions within the existing median between Prestons and Oakhurst (the proposed modification). The hydrologic and hydraulic models for Eastern Creek that were relied on for the investigation were based on models that were developed as part of the following studies:

- Eastern Creek Catchment Hydrological Assessment (WMAwater 2013)
- Eastern Creek Hydraulic Assessment (Catchment Simulation Solution 2014).

WMAwater 2013 developed a XP-RAFTS hydrologic model of the Eastern Creek catchment, the discharge hydrographs from which were subsequently used as inputs to a TUFLOW hydraulic model that was developed as part of the Catchment Simulation Solutions (CSS) 2014 hydraulic assessment. The flood models that were developed as part of WMAwater 2013 and CSS 2014 assessments were updated for the purpose of the present investigation to more accurately define flood behaviour in the vicinity of the proposed modification. The location, level and dimensions of drainage pits, pipes and box culverts in the vicinity of the proposed modification were updated or added to the flood models using work-as-executed drawings of the Westlink M7 that were obtained from WSO Co. as well as GIS based pit and pipe data that was obtained from Blacktown City Council.

5.1.4 Local overland flow path study within existing urban areas of Blacktown City (CSS, 2020)

This flood study assesses local overland flooding within existing urban areas of the Blacktown LGA. The primary objective of the flood study was to model overland flooding of urbanised areas away from major watercourses. Flood modelling of major watercourses was excluded from this flood study. It documents existing overland flood behaviour across the study area for a range of design floods. Climate change is also assessed in accordance with ARR 2019 Version 4.1. The flood models developed as part of the flood study were made available by Blacktown City Council. These flood models have been adopted to assess overland flood impact of the Quakers Hill WRRF site and brine pipeline.

5.1.5 Eastern Creek Catchment Development Scenario Hydraulic Assessment (CSS, 2016)

This report documents the outcomes of investigations completed to quantify the potential impact that future development across the Eastern Creek catchment may have on existing flood behaviour. The report provides information on design flood behaviour for a range of potential future development scenarios including full development of Western Sydney Employment Area and North West Growth Centre.

Flood behaviour is quantified as part of the study using a TUFLOW hydraulic computer model that was originally developed as part of the '*Eastern Creek Catchment Hydraulic Assessment*' (CSS, 2014). The computer model was updated to reflect each potential development scenario, including updates to hydrology as well as landform changes. The resulting models were used to simulate a range of design floods for existing and potential future catchment conditions up to an including the PMF. A range of sensitivity simulations were also completed to quantify the impact that Hawkesbury-Nepean tailwater elevations, onsite detention (OSD) and climate change may have on flood behaviour.

This model has not been adopted for use in this project as the Eastern Creek models from Section 5.1.1 and 5.1.4 are more recent and considered the most up to date models at the time of this assessment.

5.1.6 Eastern Creek Hydraulic Assessment (CSS, 2014)

This study forms the hydraulic assessment for the Eastern Creek catchment and comprises the second stage in the development of the Floodplain Planning Study for Eastern Creek. It takes the flow information that was generated as part of the stage 1 hydrologic assessment undertaken by WMAwater (2013) and defines how these flows would be distributed across the catchment. It provides information on flood levels, depths and flow velocities for a range of design floods. It also provides estimates of the variation in flood hazard and hydraulic categories across the catchment and provides an assessment of the potential impacts of climate change on existing flood behaviour.

This study updated the XP-RAFTS model developed by WMAwater (2013) and generated inflow hydrographs across the Eastern Creek catchment for 50%, 20%, 10%, 5%, 2%, 1% and 0.2% AEP events as well as the PMF.

A dynamically linked one-dimensional (1D) and two-dimensional (2D) hydraulic model of the creek, floodplain and overland flow system was developed for the Eastern Creek catchment using the TUFLOW software. The 4 metres grid TUFLOW model extends across 73 km^2 of the Eastern Creek catchment. This includes the full length of Eastern Creek and its major tributaries that is contained within the Blacktown City Council local government area. A dynamically linked 1D network was embedded within the 2D domain to define areas that would not be well represented by the 4-metre grid (e.g., narrow creek channels). Hydraulic structures (e.g., bridges, culverts and weirs) were also represented as a separate 1D domain. Elevations were assigned to grid cells within the 2D domain based on the digital elevation model (DEM) derived from 2010 LiDAR data.

This model has not been adopted for use in this project as the Eastern Creek models from Section 5.1.1 and 5.1.4 are more recent and considered the most up to date modelling at the time of this assessment.

5.2 Flooding precincts

Blacktown City Council has defined flooding precincts based upon riverine and overland flooding to manage the existing and future flood risk for the Blacktown LGA (https://maps.blacktown.nsw.gov.au/, accessed 2 April 2025).

Flooding precincts defined for the Quakers Hill WRRF site include the following and are shown in Figure 5-1:

- Riverine low flood risk precinct
- Flood planning area: overland flow medium flood risk precinct
- Overland flow low flood risk precinct.

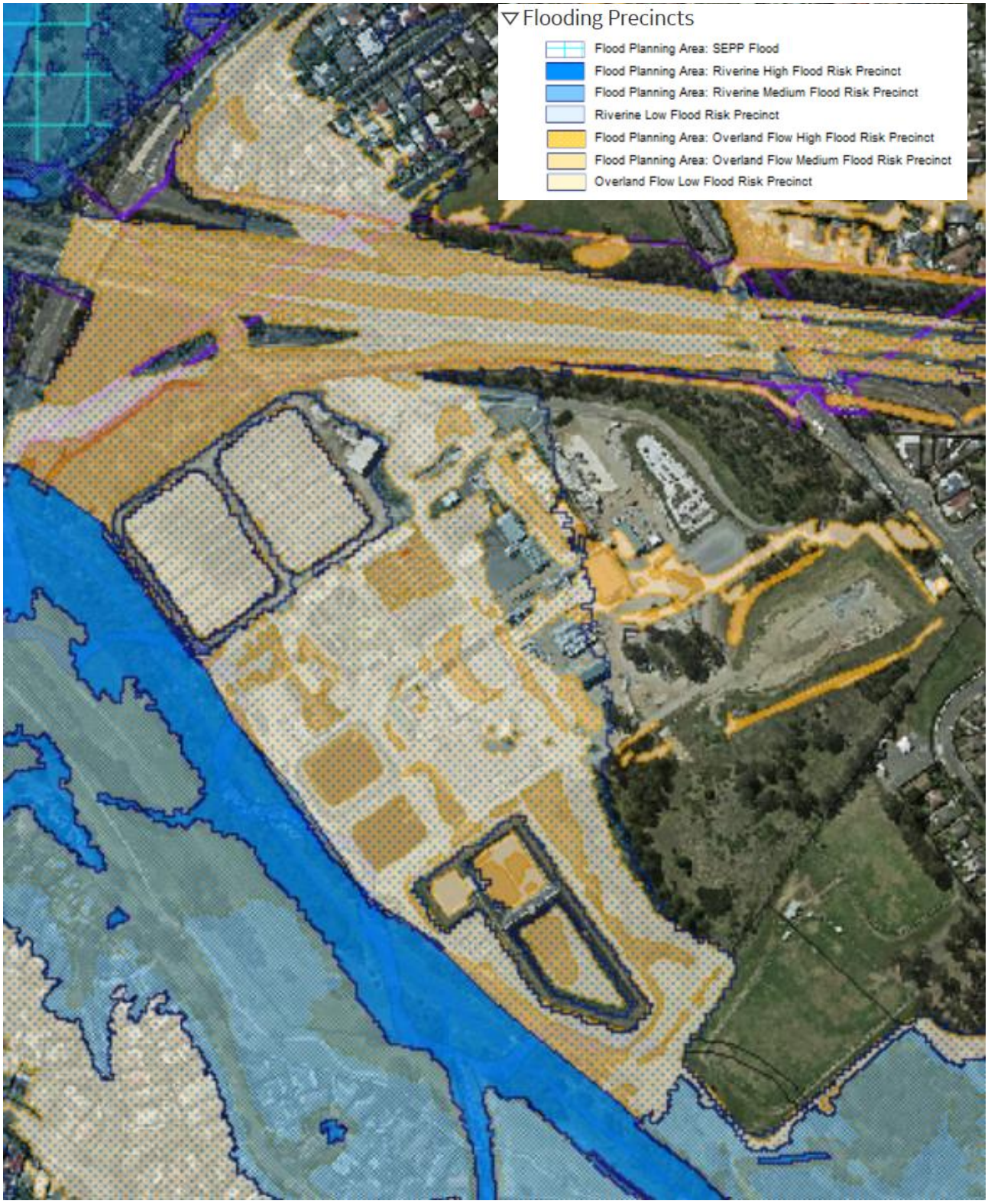


Figure 5-1 Flooding precincts for Quakers Hill WRRF site *(source: https://maps.blacktown.nsw.gov.au/ accessed on 22 July 2025)*

5.3 Historic flood data

Limited historic flood data was available for the project areas. The largest contemporary historic events of the 1980's and early 1990's do not represent current catchment conditions, with significant development having occurred since then.

5.4 Stream gauge data

A review of the available online stream gauge data maintained by Water NSW (https://realtimedata.waternsw.com.au/water.stm) and the Commonwealth Bureau of Meteorology (http://www.bom.gov.au/waterdata/) shows that no stream gauges are located within the catchment area of Breakfast Creek. However, the following stream gauges are located on Eastern Creek:

- Eastern Creek downstream of Great Western Highway (Station No. 567067)
- Eastern Creek at Quakers Hill (downstream of Richmond Road) (Station No. 212342)
- Eastern Creek at Riverstone (downstream of Garfield Road West) (Station No. 212296).

The existing flood studies listed in Section 5.1 have relied upon existing gauge data for calibration. This calibration is assumed to be applicable for use in this study.

5.5 Topographic data

The existing flood studies undertaken by Blacktown City Council for the catchment area of Eastern Creek and listed in Section 5.1 primarily use LiDAR data from 2010 and 2018 to represent the existing ground terrain surface. The overland flood models incorporate Blacktown City Council's drainage networks into the model. The mainstream Eastern Creek flood model (JSJV, 2024) excludes minor council drainage from the model.

6. Existing case flood modelling

A high-level summary of the existing case flood modelling results is provided below. Refer to Appendix A for a detailed summary of the existing case flood modelling.

6.1 Overview

In consultation with Conservation Programs, Heritage and Regulation Group of the Department of Climate Change, Energy, the Environment and Water, the following available flood models were selected for undertaking the flooding impact risk assessment for the project:

- Mainstream Eastern Creek flood model (JSJV, 2024)
- Overland flow path flood model for Eastern Creek (CSS, 2020)
- Overland flow path flood model for the Upper Parramatta River Catchment (CSS, 2020).

Base line existing condition flood modelling was established by reviewing the available mainstream and overland flow flood models in Section 5.1 to assess flooding impacts of the proposed project works. Impacts of the project works to mainstream and local catchment overland flooding have been assessed separately.

The following tasks were undertaken as part of the flood impact risk assessment:

1. Existing TUFLOW models were reviewed to determine model coverage and level of modelling detail around key project areas
2. Existing flood model hydrology was reviewed to determine ARR version compliance and available AEPs, durations and temporal patterns
3. Existing case TUFLOW models were updated where necessary to provide sufficient representation of the current existing condition at key project areas, including at the WRRF site and along the brine pipeline.
4. The updated existing case TUFLOW models were run to identify existing flood behaviour at the Quakers Hill WRRF and along the brine pipeline.

6.2 Hydrologic modelling

The hydrological modelling undertaken as part of the previous flood studies discussed in Section 5.1 were reviewed. No updates to the previous hydrological modelling were undertaken as part of this assessment. Refer to Appendix A for a detailed summary of the existing case hydrological modelling.

6.3 Hydraulic modelling overview

The hydraulic modelling undertaken as part of the previous flood studies discussed in section 5.1 were reviewed and are summarised below. Updates were made to the flood models to ensure that current Quakers Hill WRRF site conditions were represented with the best available information. Refer to Appendix A for a detailed summary of the existing case hydrological modelling.

Mainstream and overland flood models have been considered separately in this assessment, to account for the potential for multiple flooding regimes affecting the proposed works. For this assessment the mainstream flood model assesses mainstream flooding impacts which typically occur with longer catchment wide storm durations. The overland flood model assesses overland flood impacts which tend to occur from shorter durations local catchment storms. Refer to Appendix A for a detailed summary of the existing case hydrological modelling.

The selected mainstream and overland flood models have been adopted for use in this assessment as they are the most up to date modelling available at the time of this assessment.

6.3.1 Mainstream flood model

The mainstream flood model assesses the mainstream flooding of Eastern Creek and its tributaries, including Breakfast Creek. This flood model has been built to assess the mainstream flooding of these waterways most accurately and considers the longer durations and larger whole of catchment storm events. This flood model will be used to assess the potential for mainstream Breakfast Creek flood impact on the Quakers Hill WRRF site.

6.3.2 Overland flood models

The Eastern Creek overland flood model (CSS, 2020) includes the Eastern Creek and Breakfast Creek catchment areas. The flood model will be used to assess potential impacts to local overland flooding in typically shorter duration storm events.

The Upper Parramatta River Catchment (UPRC) overland flood model (CSS, 2020) includes the catchment areas of Blacktown Creek, Girraween Creek and Toongabbie Creek located within the Blacktown local government area on the northern side of the Great Western Highway. The UPRC flood model will be used to assess potential impacts to local overland flooding in typically shorter duration storm events.

7. Existing flood characteristics

The following sections provide a brief description of patterns of mainstream and overland flooding for the project under existing conditions. Appendix B contains a series of figures that show peak flood depths, peak water level contours, peak flow velocities and flood hazards with AEPs of 5%, 1%, 1% with climate change, and the PMF event.

7.1 Mainstream flooding

7.1.1 Quakers Hill WRRF

Only a small portion of Quakers Hill WRRF located adjoining the bank of Breakfast Creek is subject to flooding in a 5% AEP event. The proposed location of the AWTP and the secondary treatment location is not subject to flooding in the 5% AEP event.

The proposed location of the AWTP is not subject to flooding in the 1% AEP event. The proposed location of the secondary treatment is subject to flood depths of up to 0.2 metres along the southern corner of the proposed location. The depth of ponding at the southern corner of the secondary treatment is increased up to 0 0.35 metres in a 1% AEP with climate change event.

More than 50% of Quakers Hill WRRF is subject to flooding in the PMF event. The proposed location of the secondary treatment is subject to flood depth of up to 1.8 metres in the PMF event. However, the proposed location of the AWTP is not subject to flooding in the PMF event.

Peak flow velocities within the WRRF are typically up to 1 m/s up to and including a 1% AEP event. However, in the PMF event peak flow velocities are up to 3 m/s.

The combined flood hazard curve presented in Figure 7-1 have been utilised to set hazard thresholds that relate to the vulnerability of the community when interacting with floodwaters. Flood hazard at locations proposed for the AWTP Project works is typically H1 which is generally safe for people, vehicles and buildings up to and including a 1% AEP event. However, in the PMF event flood hazard is up to H5 which is unsafe for people and vehicles and buildings would require special engineering design and construction.

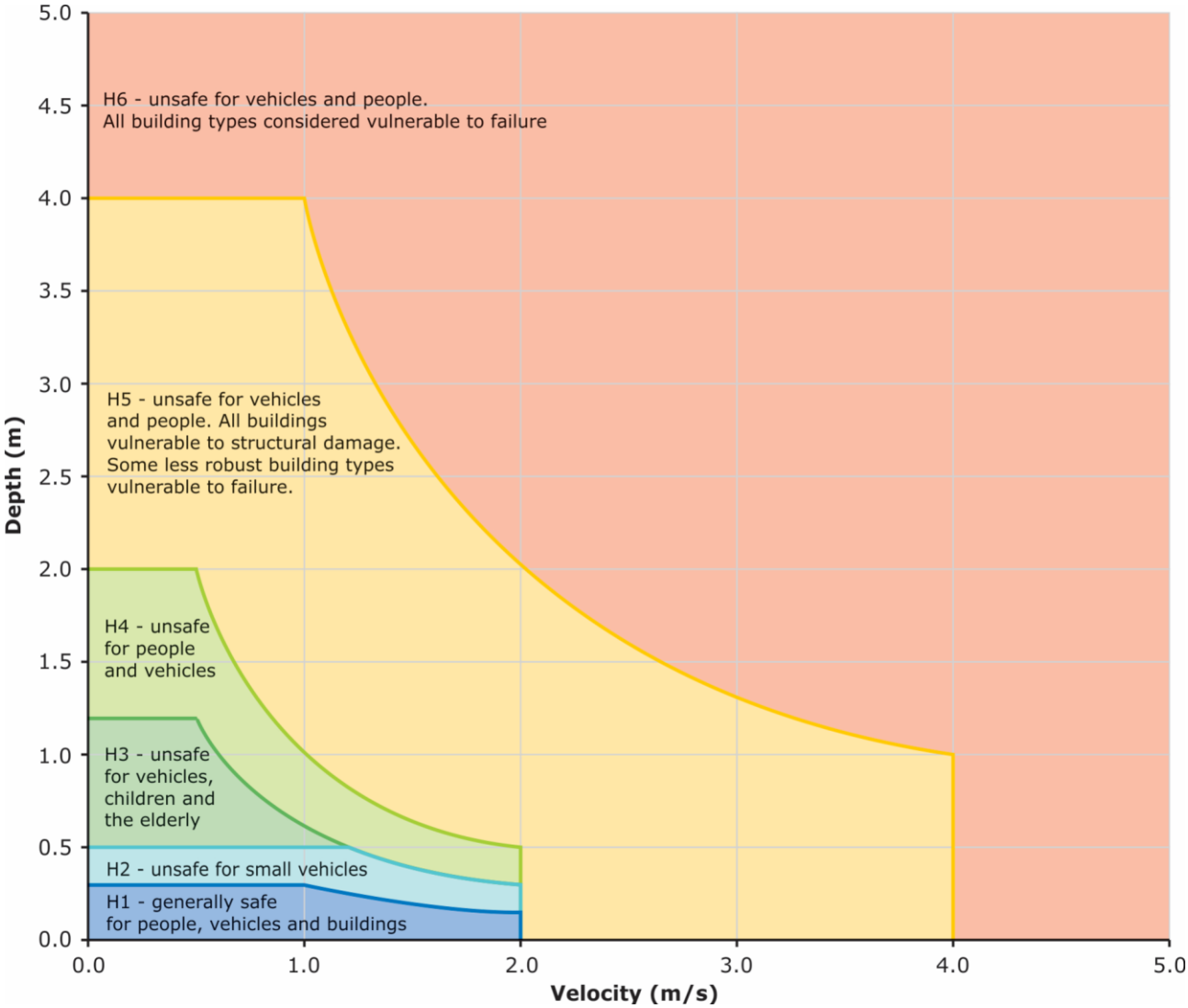


Figure 7-1 Combined Flood Hazard Curves (Smith et al., 2014)

7.1.2 Construction compounds

Construction compounds C1 to C9 are partially impacted by mainstream flooding in Breakfast Creek in a 5% AEP event. Construction compounds C18 to C20 are partially impacted by overland flooding in Blacktown Creek in the 5% AEP event.

7.2 Overland flooding

7.2.1 Quakers Hill WRRF

The proposed location of the AWTP is not subject to flooding in the 5% AEP event and the proposed location of the secondary treatment is subject to flood depths of up to 0.15 metres along the existing access road for the same flood event.

The proposed location of the AWTP is not subject to flooding in the 1% AEP event. However, the proposed location of the secondary treatment is subject to flood depths of up to 0.15 metres along the existing access road in the 1% AEP event.

In the PMF event, the proposed location of the AWTP is not subject to flooding and the proposed location of the secondary treatment is subject to flood depths of up to 2.05 metres.

Peak flow velocities at the proposed AWTP and the secondary treatment are less than 0.5 m/s in flood events up to and including a 1% AEP event. However, peak flow velocities in the PMF event are up to 1.75 m/s at the location proposed for the AWTP.

Flood hazard at the proposed AWTP and the secondary treatment is H1 up to and including a 1% AEP event. However, in the PMF event flood hazard is up to H5 which is unsafe for people and vehicles, and buildings would require special engineering design and construction.

7.2.2 Construction compounds

Construction compounds C1 to C9 are partially impacted by mainstream flooding in Breakfast Creek in a 5% AEP event. Construction compounds C18 to C20 are partially impacted by overland flooding in Blacktown Creek in the 5% AEP event. Further details on the nature of flooding at each construction compound is provided in Section 8.

7.2.3 Barometric loop

The height of the barometric loop is about 12 metres. The location proposed for the barometric loop is not subject to flooding up to and including the PMF event.

8. Potential construction impacts

This section provides an assessment of the flood risk associated with the construction of the ATU project as well as an overview of the potential impacts that the proposed construction activities could have on flood behaviour. The main construction activities (and sub-activities) that can cause flooding impacts are provided for each of the two main project elements. These are:

- Construction of the AWTP and associated infrastructure at the existing Quakers Hill WRRF
- Construction of a new brine pipeline to transfer brine from the Treatment Plant to the NSOOS

8.1 Potential flood risks at construction work areas

Without the implementation of appropriate management measures, the inundation of the construction work areas and ancillary facilities by floodwater has the potential to:

- cause damage to the proposed works and delays in construction programming
- pose a safety risk to construction workers
- detrimentally impact the downstream waterways through the transport of sediments and construction materials by floodwater
- obstruct the passage of floodwater and overland flow, which in turn could exacerbate flooding conditions in existing development located outside the construction footprint.

8.1.1 Advanced Water Treatment Plant and Secondary Treatment Plant

The Advanced Water Treatment Plant would comprise of the ultrafiltration feed building, pumps and tank, reverse osmosis building and tank, enhanced treatment building, system and pumps, brine storage tanks and pump station. The secondary treatment plant would comprise of the bioreactor process unit, membrane bioreactor process unit, pumps, blower room, odour control facility and sludge transfer station. There would also be a range of ancillary infrastructure such as chemical storage, and electrical and pipeline connections.

The main construction activities (and sub-activities) with the potential to cause flooding impacts include, but are not limited to:

- Site establishment/levelling
- Establishment of construction compounds, laydown areas and ancillary facilities
- Stockpiling

Due to the proximity to Breakfast Creek, the above-mentioned works have the potential to impact on the flood behaviour if not properly managed. Further detail on these potential impacts and mitigation measures is provided in Section 10.

Earthworks

Whilst establishment of construction compounds, laydown areas and ancillary facilities will occur in already cleared land, minor earthworks are likely to be required. Earthworks are likely to include:

- Levelling
- Small amount of vegetation clearing
- Construction of hardstand areas
- Stockpiling of sediment from works associated with the treatment plants.

The inundation of the earthworks by floodwater has the potential to cause scour of disturbed surfaces and the transport of sediment and construction materials into the receiving drainage lines and waterways. It would therefore be necessary to plan, implement and maintain measures that are aimed at managing the diversion of floodwater either through or around the construction areas. A broad outline of potential mitigation measures is provided in Section 10.

Stockpiling of topsoil

Excavated topsoil and imported fill would need to be stockpiled prior to being reused on the Project or transferred. Stockpiles of raw materials or spoil would be located as close as practical to the work area and appropriate environmental management measures would be implemented to minimise impacts on receiving waters from erosion and sedimentation.

Stockpiles located on the floodplain have the potential to obstruct floodwater and alter flooding patterns. Inundation of stockpile areas by floodwater can also lead to significant quantities of material being washed into the receiving drainage lines and waterways.

The locations within each construction work area and ancillary facility where materials would be stored would be subject to detailed design and construction planning.

Stockpile management during project construction would be detailed in the Construction Soil and Water Management Plan (CSWMP) and include locating stockpiles away from overland paths and providing stabilisation, watering and covering of stockpiles where necessary.

8.1.2 Brine pipeline

The key construction activity is installation of the brine pipeline. The installation of the brine pipeline would be mostly installed below ground using open trenching methods, with tunnelling and drilling methods in some locations to avoid constraints. There would also be some above-ground ancillary infrastructure associated with the buried pipeline such as scour valves and maintenance holes. A barometric loop about 12 m high would also be required at the high point in the pipeline alignment at Billy Goat Hill Reserve.

The brine pipeline would be linear infrastructure about 7.7 km long located underground between Quakers Hill WRRF to the International Peace Park where it connects to the NSOOS. The diameter of the proposed pipeline is 450 mm. The brine pipeline will be constructed using two construction methods, 5.1 km of the pipeline would be constructed via open trench and 2.6 km would be constructed using trenchless technology (expected to be HDD). Temporary construction compounds, laydown areas and access roads would also be required.

The main construction activities (and sub-activities) with the potential to cause flooding impacts include, but are not limited to:

- Temporary construction compounds and laydown areas
- Trenching
- Stockpiling
- Tunnelling

The abovementioned works have the potential to impact on flood behaviour in Breakfast Creek and Blacktown Creek if not properly managed. Potential impacts from these works are discussed in Section 8.2.

Construction compounds and material laydown areas

There would be up to 20 construction compounds proposed for the construction of the Brine pipeline. Construction compounds will be established on predominately grassed areas within the construction footprint and be used for variety of purposes including:

- Temporary buildings such as offices and meeting rooms, amenities and first aid facilities
- Stockpiling and sorting of waste material prior to disposal or reuse
- Storage of site equipment, including bunded storage for any chemicals such as fuel
- Tunnelling including the launch and receival plus for sections of pipeline construction, but tunnel and activities associated with drillings such as the drill rig, spoil management and pipe placement.

The majority of the construction compounds are located near waterways, primarily those along Breakfast Creek and also along Blacktown Creek. These compounds represent the greatest risk to flooding.

Trenching

Open trenches have the potential to redistribute flood flow and result in flooding of new areas which are not usually flooded. Section 10 provides a summary of potential measures to manage these impacts.

Stockpiling

The construction of the brine pipeline would generate spoil, some of which would need to be temporarily stored in stockpile areas for reuse on site or disposed of. It would also be necessary to temporarily store imported construction materials.

Stockpiles located on the floodplain have the potential to obstruct floodwater and alter flooding patterns. Inundation of stockpile areas by floodwater can also lead to significant quantities of material being washed into the receiving drainage lines and waterways.

The locations within each construction work area and ancillary facility where materials would be stored would be subject to detailed design and construction planning.

Tunnelling

Tunnelling has the potential to re-distribute flood flow and result in flooding of new areas which are not usually flooded. Section 10 provides a summary of potential measures to manage these impacts.

8.2 Potential construction flood impacts

The potential construction flood impacts are described in Table 8-1 below in relation to the impact area for the ATU project shown in Figure 1-2.

Table 8-1 Potential construction impacts

Construction work area	Construction ancillary facilities / other areas	Threshold of flooding[1]	Proposed construction activities[2]				Description of existing flood behaviour	Potential impacts of construction activities on flood behaviour
			Site facilities[3]	Material storage and stockpiling[4]	Earthworks[5]	Barometric loop[6]		
Quakers Hill WRRF	AWTP and Secondary Treatment facilities	5% AEP	✓	✓	✓		Site has potential to experience flooding from mainstream Breakfast Creek flows and local catchment overland flows. 5% AEP mainstream flows lead to minor flooding at the western edge of the site. 5% AEP overland flows lead to flooding along flow paths through site. Majority of site is H1 flood hazard	Potential flood impact to site facilities or plant stored at compound
Trenching	General construction method throughout alignment	Varies		✓	✓		The proposed alignment includes lengths of trenching that are located within or adjacent to stormwater drains and floodways. These flow paths would experience minor flooding in frequent storm events.	Flood impact to trench construction is likely during frequent storm events. This may redirect flows within the catchment.
HDD (Microtunneling)		Varies		✓	✓		Lengths of HDD are proposed along the pipeline alignment. Primarily proposed under major roads.	Risk of flood impact at the micro-tunnel launch and exit sites.
Barometric Loop	Located at Billy Goat Hill Reserve	N/A				✓	Barometric loop proposed at Billy Goat Hill Reserve. Located along a high point with very little upstream catchment.	Very low risk of flood impact during construction due to being located at a high point.

Construction work area	Construction ancillary facilities / other areas	Threshold of flooding[1]	Proposed construction activities[2]				Description of existing flood behaviour	Potential impacts of construction activities on flood behaviour
			Site facilities[3]	Material storage and stockpiling[4]	Earthworks[5]	Barometric loop[6]		
Construction Compounds	C1	5%	✓		✓		Partially flooded with up to H3 flood hazard. H1 flood hazard elsewhere	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C2	5%	✓	✓	✓		Partially flooded with up to H3 flood hazard. H1 flood hazard elsewhere	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C3	5%	✓	✓	✓		Partially flooded with up to H3 flood hazard. H1 flood hazard elsewhere	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C4	5%		✓	✓		Partially flooded with up to H5 flood hazard along edge of compound. Majority of compound is H1	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C5	5%	✓	✓	✓		Partially flooded with up to H5 flood hazard along edge of compound. Majority of compound is H1	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C6	5%	✓	✓	✓		Partially flooded with up to H5 flood hazard along edge of compound. Majority of the compound is not flood affected in up to the 1% AEP event. The majority of the compound has H1 flood hazard	Potential for obstruction of flows in Breakfast Creek leading to flood impact

Construction work area	Construction ancillary facilities / other areas	Threshold of flooding[1]	Proposed construction activities[2]				Description of existing flood behaviour	Potential impacts of construction activities on flood behaviour
			Site facilities[3]	Material storage and stockpiling[4]	Earthworks[5]	Barometric loop[6]		
Construction Compounds	C7	5%	✓	✓	✓		Partially flooded in 5% AEP event. Majority of compound is H1 flood hazard and not flood affected in up to 1% AEP with climate change event.	Minimal flood impact likely
Construction Compounds	C8	5%	✓	✓	✓		Partially flooded with up to H4 flood hazard along edge of compound with stormwater drain.	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C9	5%	✓	✓	✓		Partially flooded with along edge of compound with stormwater drain. H1 flood hazard throughout compound	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C10	5%	✓		✓		Flooded with depths of up to 150 mm in 5% AEP event. Up to H2 flood hazard.	Compound is likely to be impacted in minor rainfall event
Construction Compounds	C11	5%	✓		✓		Partially flooded with depths of up to 150 mm in 5% AEP event. Up to H1 flood hazard	Compound is likely to be impacted in minor rainfall event
Construction Compounds	C12	5%	✓	✓	✓		Partially flooded with up to H5 flood hazard in southern half of compound. Northern half of compound experiences minimal flooding with only H1 flood hazard	Potential for obstruction of flows in Breakfast Creek leading to flood impact

Construction work area	Construction ancillary facilities / other areas	Threshold of flooding[1]	Proposed construction activities[2]				Description of existing flood behaviour	Potential impacts of construction activities on flood behaviour
			Site facilities[3]	Material storage and stockpiling[4]	Earthworks[5]	Barometric loop[6]		
Construction Compounds	C13	5%	✓	✓	✓		Partially flooded with up to H3 flood hazard in northern half of compound. Carpark remains predominantly flood free in up to 1% AEP climate change event.	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C14	5%		✓	✓		Partially flooded with along edge of compound. Small areas of H2 flood hazard	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C15	5%		✓	✓		Partially flooded with along edge of compound. Majority of compound is H1 flood hazard, with the northern corner experiencing up to H4 flood hazard	Potential for obstruction of flows in Breakfast Creek leading to flood impact
Construction Compounds	C16	5%	✓	✓	✓		Flooding occurs primarily on the road and within the drain through the compound. Up to H5 flood hazard in these areas. Remainder of the compound experiences only H1 flood hazard	Obstruction of flows in drain may lead to flood impact.
Construction Compounds	C17	5%	✓	✓	✓	✓	Site is only partially flooded along its eastern boundary. Eastern boundary experiences H5 flood hazard. Remainder of site is only H1 flood hazard	Minimal flood impact likely. Barometric loop is located at highest point in compound and away from any overland flood depths

Construction work area	Construction ancillary facilities / other areas	Threshold of flooding[1]	Proposed construction activities[2]				Description of existing flood behaviour	Potential impacts of construction activities on flood behaviour
			Site facilities[3]	Material storage and stockpiling[4]	Earthworks[5]	Barometric loop[6]		
Construction Compounds	C18	5%	✓	✓	✓		Partially flooded primarily around road access. Up to H3 flood hazard	Potential flood impact to site facilities or plant stored at compound
Construction Compounds	C19	5%	✓	✓	✓		Overland flow path through the centre of the carpark. Up to H5 flood hazard through the main overland flow path through the carpark. Remainder of the carpark is H1 flood hazard	Potential flood impact to site facilities or plant stored at compound
Construction Compounds	C20	5%	✓	✓	✓		Minor flooding through centre of site in 5% AEP event. In 1% AEP with climate change event most of site is inundated, with typically H2 and H3 flood hazard ratings. Eastern half of compound remains H1 flood hazard.	Potential flood impact to site facilities or plant stored at compound

1 The assessed threshold of flooding is based on the existing case. Refer to Appendix B for flood extent mapping for the existing case

2 Refer to Section 7 for a description of flood risks associated with each construction activity.

3 Site facilities include site offices, staff amenities, stores and laydown, workshops and parking.

4 Spoil management includes stockpiling and treatment of excavated material.

5 Earthworks includes construction of road and drainage works.

6 Barometric loop includes supporting structure of loop

9. Assessment of design case flood impact

9.1 Description of design case

All permanent above-ground works to be located within the WRRF site for the ATU Project including the ultrafiltration feed building, pumps and tank, reverse osmosis building and tank, enhanced treatment building, system and pumps, brine storage tanks and pump station, and the bioreactor process unit, membrane bioreactor process unit, pumps, blower room, odour control facility and sludge transfer station associated with the secondary treatment plant have been represented both in the mainstream and overland flow TUFLOW models for the Eastern Creek catchment. Both models were run for the design case for design storms with AEPs of 5%, 1%, 1% with climate change, as well as the PMF event.

Apart from a barometric loop, all major permanent works for the brine pipeline would be buried and the land proposed for the barometric loop is free from flooding (i.e., not flooded in the PMF event (refer Section 7.2.3)). Hence the barometric loop would have no impacts to existing flood behaviour and consequently flooding impact due to the barometric loop was not assessed.

Further details on flood modelling undertaken for the design case are provided in Appendix C.

9.2 Impact assessment

The proposed permanent works for the ATU project have the potential to impact on flooding patterns within the Quakers Hill WRRF site and downstream of the site due to an increase in the rate and volume of runoff from the proposed works.

This section provides an assessment of the flood risk to the project and the impact it would have on flood behaviour during operation. The findings of an assessment into the potential impact of future climate change on both mainstream and overland flood behaviour under operational conditions are also presented.

Appendix D contains flood impact maps for the operational conditions of the project. The following figures should be referred to when reading the discussion on flooding impacts presented in this section:

- Figure D-1a to Figure D-1d show the impact that the proposed permanent works would have on mainstream flood behaviour in terms of changes in peak flood levels for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.
- Figure D-2a to Figure D-2d show the impact that the proposed permanent works would have on overland flood behaviour in terms of changes in peak flood levels for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.
- Figure D-3a to Figure D-3d show the impact that the proposed permanent works would have on mainstream flood behaviour in terms of changes in maximum velocities for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.
- Figure D-4a to Figure D-4d show the impact that the proposed permanent works would have on overland flood behaviour in terms of changes in maximum velocities for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.
- Figure D-5a to Figure D-5d show the impact that the proposed permanent works would have on mainstream flood behaviour in terms of changes in flood hazard for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.
- Figure D-6a to Figure D-6d show the impact that the proposed permanent works would have on overland flood behaviour in terms of changes in flood hazard for design storms with AEPs 5%, 1%, 1% with climate change, as well as the PMF event, respectively.

9.2.1 Impact of flooding on the project

The level of flood immunity to the proposed works located within the Quakers Hil WRRF would be maintained under post-developed conditions. As noted in Table 3-1, critical infrastructure and electrical works were designed to provide flood immunity above 1% AEP flood level with 0.5 metres freeboard. The flood modelling that has been carried out as part of the present investigation has demonstrated that this level of flood immunity is achieved under the post-developed conditions.

9.2.2 Impact of the project on flood behaviour

Changes in peak flood levels and depths of inundation

The following increases in peak flood levels and depths of inundation outside the Quakers Hill WRRF due to the project are noted below.

Mainstream flooding impacts are:

- Less than 0.01 metres increase in flood levels for design storms with AEPs 5%, 1% and 1% with climate change.
- Up to 0.06 metres increase in PMF levels in Breakfast Creek at two locations along the south-western boundary of the WRRF site.
- Overall, increases in mainstream flood levels due to the project are compliant to the adopted performance criteria (refer Table 3-2) up to and including a 1% AEP design storm.

Overland flooding impacts are:

- In general, less than 0.01 metres increase in flood levels for a 5% AEP design storm. Localised increase in flood levels in Breakfast Creek up to 0.07 metres just upstream of Quakers Hill Parkway. The impacted area is a natural reserve which is subject to more than 2.5 metres depth of inundation in a 5% AEP design storm in the existing case.
- Up to 0.01 metres increase in flood levels in a 1% AEP design storm.
- About 0.01 metres increase in flood levels at 26 properties located on Jasmine Avenue, Dhalia Street and Caper Place in a 1% AEP design storm event with climate change, due to minor flood level increases in Breakfast Creek resulting from increased runoff rate and volume from the Quakers Hill WRRF site. The impacted properties are subject to up to 0.8 metres depth of ponding for the same storm event in the existing case.
- Between 0.01 and 0.03 metres increase in flood levels at 18 properties located on Riley Place and Elwood Crescent (located north of Riley Place and not labelled on maps presented in Appendix D) in the PMF event. Flood levels are increased up to 0.04 and 0.03 metres respectively on the M7 cycleway and the Westlink M7 Motorway. Impacted section of M7 cycleway and the Westlink M7 Motorway are subject to more than 1.5 metres depth of inundation and hence impassable in the existing case.
- Overall, increases in overland flood levels due to the project are compliant to the adopted performance criteria (refer Table 3-2) up to and including a 1% AEP design storm. Minor increases in flood levels for the PMF event due to the project are expected to have minor impacts upon existing community emergency management arrangements.

Changes in flow velocities

Figure D-3a to Figure D-4d, show the project would have only minor impacts on maximum mainstream and overland flow velocities for the modelled flood events between a 5% AEP event and the PMF event. Increases in maximum flow velocities in Breakfast Creek and on its floodplain would be typically less than 10% and where it is greater than this maximum velocity under post-developed conditions would be less than one

metre per second. As a result, the project is expected to have only a minor impact on the scour potential in the receiving drainage lines.

The project has the potential to increase scour potential due to localised increased in flow velocities at the outlet of the drainage structures within the Quakers Hill WRRF site. During detailed design, appropriate scour protection and energy dissipation measures would be incorporated into the design of the drainage outlets where it is required to manage localised increases in flow velocity.

Changes in the extent and duration of flooding

Given the relatively minor increases in peak flood levels and the depth of inundation that are attributable to the project, there would also be only minor changes in the extent of inundation for all events up to the PMF.

From inspection of water level hydrographs in the vicinity of Quakers Hill Parkway both for the existing case and the post-developed case, it is concluded that the project would have only minor impacts (less than one hour increase) on the duration of flooding for the modelled flood events between a 5% AEP and the PMF event both for the mainstream and overland flooding.

Changes in flood hazard

Flood hazard is measured in terms of the potential danger to personal safety and damage to property based on the depth and velocity of floodwater. Given the minor nature of the changes in the depth of inundation and velocity of flow that are attributable to the project, it is also expected to have a minor impact on the hazardous nature of flooding.

Minor changes in both mainstream and overland flood hazard due to the project from the existing case are presented in Figure D-5a to Figure D-6d in Appendix D which show that areas subject to changes in low flood hazard (i.e. H1 and H2) to high hazard (i.e. H3, H4, H5 and H6) due to the project are generally small and isolated. The small and isolated areas of increased flood hazard from low to high would have no adverse impacts on personal safety and damage to property.

9.2.3 Consistency with Council's floodplain risk management plans

There is no existing Floodplain Risk Management Plan for Eastern Creek. It is understood that Blacktown City Council is in the process of preparing a Floodplain Risk Management Plan for the Blacktown local government area. This study has utilised Blacktown City Council's mainstream and overland flood models to define mainstream and overland flood behaviour for the existing case and the post-developed case. As a result, a consistent approach has been adopted in the assessment of post-developed impacts on flood levels, flow velocities, flood hazard and duration of inundation.

9.2.4 Impact of future climate change on flood behaviour

The flooding impacts were also assessed for a climate change scenario to identify the resilience of the project to climate change conditions, which would be in the form of higher intensity storm events. Blacktown City Council has adopted a 20% increase in 1% AEP rainfall intensities to assess impacts of climate change on mainstream flood behaviour. Council has also adopted a 19.7% increase in rainfall intensities under Representative Concentration Pathway (RCP) scenario 8.5 conditions (i.e. current greenhouse gas emissions increase in the future).

A review of difference mapping shows that rainfall increases due to climate change will increase 1 % AEP flood levels under the existing climate up to 0.20 m within the Quakers Hill WRRF site and along the proposed brine pipeline. This means that the adopted freeboard for the project works would be reduced from 0.5 m to 0.3 m with a1% AEP climate change event with RCP 8.5.

Flood maps showing flood behaviour for a 1% AEP event with climate change for the existing case are presented in Appendix A. Impacts of the project to adjacent areas in a 1% AEP event with climate change are discussed in Section 9.2.2 and impact maps are presented in Appendix D of this report.

9.2.5 Compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land

It is understood that Blacktown City Council is in the process of delineating flood ways, flood storage areas and flood fringe areas. This mapping will be available once the Floodplain Risk Management Plan currently under preparation is adopted by Council.

The majority of the proposed works for the project within Quakers Hill WRRF are located on lands which are not subject to flooding in a 5% AEP flood event. Hence, the loss of floodplain storage and redistribution of flood flows due to the project are expected to be minimal.

9.2.6 Impacts on the social and economic costs to the community

The project would have no discernible impacts to adjoining properties due to mainstream and overland flooding up to a 1% AEP flood event. However, in a 1% AEP design storm with climate change, flood levels at 18 properties are increased just above 0.01 metres. All impacted properties are subject to significant depths of ponding in the existing case.

In the PMF event, flood levels at 18 properties would increase between 0.01 m and 0.03 m due to mainstream flooding and the impacted properties are subject to between 0.30 m and 2.3 m depth of ponding in the existing case.

Based on the above, the incremental social and economic costs due to the project is expected to be minor.

9.2.7 Impacts upon existing community emergency management arrangements

Flooding within Quakers Hill WRRF and along the proposed brine pipeline route results from short duration storms up to 2 hours long. The project would have minor impacts on flood levels, minor increase in duration of inundation of less than 1 hour, and localised and isolated increase in flood hazard from low to high. In addition, roads adjoining most of the impacted properties are cut-off in the existing case. Hence, the project is expected to have minor impacts upon existing community emergency management arrangements.

10. Mitigation measures

This section provides a summary of the key performance outcomes, as well as the mitigation measures associated with potential surface water and flooding impacts from the proposed works.

The key performance outcome for the proposed works is to manage adverse impacts outside of the Quakers Hill WRRF site caused by changes in flood behaviour.

10.1 Mitigation and management measures

The mitigation and management measures described in Table 10-1 have been identified to address the potential flood impacts of the proposed works.

Table 10-1 Flooding mitigation measures

ID	Mitigation measure	Applicable area
Construction		
FL1	A flood management plan will be prepared as part of the CEMP for the proposed works that will describe the processes for flood preparedness, materials management, weather monitoring, flood incident management and site management. Flood incident management measures should be prepared in consultation with NSW SES and Blacktown City Council.	All construction areas
FL2	Activities that may impact existing drainage systems during construction will be carried out so that existing hydraulic capacity is maintained where practicable.	All
FL3	Open trenches excavated on flood prone land have the potential to redistribute flood flows. Excavation of open trenches should be planned to avoid potential flooding impacts to people and property.	All
FL4	Spoil stockpiles should be located in areas which are not subject to frequent inundation by floodwater, ideally outside the 10% AEP flood extent.	All
FL5	Construction facilities should be located outside of high flood hazards areas based on a 1% AEP flood.	All
Operation		
FL6	The impact of the proposed works on flood behaviour should be confirmed during detailed design if there are any major updates made to the 50% concept design assessed in this study. This should consider future climate change and a partial blockage of the stormwater drainage system.	All
FL7	If there are any major updates made to the 50% concept design, the proposed works are to be designed and further refined to minimise adverse impact on: ▪ Surrounding development for storms up to 1% AEP in intensity ▪ Critical infrastructure, vulnerable development or increases in risk to life due to a significant increase in flood hazard for floods up to the PMF.	WRRF site
FL8	Localised increased in flow velocities at drainage outlets of the proposed works should be mitigated with the provision of scour protection.	All

11. References

Catchment Simulation Solutions (2014) Eastern Creek Hydraulic Assessment, Report prepared for Blacktown City Council, Final Report, Revision 3, November 2014

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Department of Planning and Environment (2023b), Flood Impact and Risk Assessment - Flood Risk Management Guideline LU01

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