Upper South Creek Advanced Water Recycling Centre

Submissions Report

March 2022

Table of contents

Figures

Tables

Figures

Tables

1 Executive summary

The project

Sydney Water is proposing to build and operate a new wastewater treatment plant and associated pipelines to provide wastewater services for the Western Sydney Aerotropolis Growth Area (WSAGA or Aerotropolis) and South West Growth Area (SWGA). The project includes:

- a new Advanced Water Recycling Centre (AWRC) to collect wastewater from businesses and homes and treat it, producing high-quality treated water, renewable energy and biosolids for beneficial reuse
- a new green space area around the AWRC, adjacent to South Creek and Kemps Creek, to support the ongoing development of a green spine through Western Sydney
- new infrastructure from the AWRC to South Creek, to release excess treated water during significant wet weather events, estimated to occur about 3 – 14 days each year
- a new treated water pipeline from the AWRC to Nepean River at Wallacia Weir, to release high-quality treated water to the river during normal weather conditions
- a new environmental flows pipeline from Wallacia to Warragamba River, to release high-quality treated water to the river just below the Warragamba Dam
- a new brine pipeline from the AWRC connecting into Sydney Water's existing wastewater system to transport brine to the Malabar Wastewater Treatment Plant
- a range of ancillary infrastructure.

The project is planned to be built in stages, with Stage 1 consisting of:

- building and operating the AWRC to treat a daily wastewater flow, known as the average dry weather flow (ADWF), of up to 50 megalitres per day (ML/day)
- building all pipelines to cater for up to 100 ML/day flow coming through the AWRC (but only operating them to transport and release volumes produced by Stage 1).

Public exhibition and submissions

The Department of Planning and Environment (DPE) issued the final Secretary's Environmental Assessment Requirements (SEARs) for the project in January 2021. Sydney Water prepared an Environmental Impact Statement (EIS) responding to these requirements, which was on public exhibition for 28 days from 21 October to 17 November 2021. Since public exhibition of the EIS, the Minister for Planning has also declared the project as critical State significant infrastructure.

DPE received 30 submissions on the EIS. This included two from Commonwealth agencies, 17 from State agencies (of which one had no comments), five from local Councils, two from organisations and four from individual members of the public. Ten of the submitters were characterised as local, 18 were characterised as regional, one was from outside NSW and one submitter's location was not provided. Three submissions objected to the project and three supported it. The remaining submissions provided comments and queries about the project and some supported or objected to specific elements of the project.

A total of 430 individual issues were raised across the submissions. Most issues were raised by Commonwealth and State agencies (61%), followed by local councils (35%), individuals (3%) and organisations (1%).

In accordance with the guideline *Appendix C to the state significant infrastructure guidelines – preparing a submissions report* (DPIE, 2021d), Sydney Water grouped issues raised in submissions into one of five broad categories:

- Project.
- Procedural matters.
- Economic, environmental and social impacts of the project.
- Justification and evaluation of the project as a whole.
- Issues that are beyond the scope of the project or not relevant to the project.

Sydney Water also developed a range of sub-categories to further characterise the issues. Most issues (73%) related to economic, environmental and social impacts of the project. Of the issues raised in that category, most related to hydrodynamics and water quality (19%), followed by flooding and terrestrial biodiversity (both 11%) and aquatic ecology and surface water (both 7%). The remaining issues related to a broad array of economic, environmental and social factors.

This Submissions Report includes Sydney Water's responses to the issues raised in each submission. Preparing these responses included several tasks such as:

- clarifying or expanding on content in the EIS on a range of matters
- additional assessment relating to waterway modelling, flooding, surface water, groundwater, aquatic ecology and cumulative impacts
- providing further detailed technical information on waterway modelling to the Environment Protection Authority (EPA) and DPE Biodiversity and Conservation (BCD) and on contaminated land to EPA
- consulting with various stakeholders to follow up matters raised in submissions
- considering changes to statutory and strategic context
- amending existing management measures and adding new management measures to address issues raised. The main changes relate to consultation, waterway impacts and monitoring, terrestrial biodiversity, surface water, groundwater, soils and contamination, Aboriginal and non-Aboriginal heritage, visual impacts, noise and vibration, traffic and transport, bushfire hazard, social impacts, waste management, airport operations and utilities.

Sydney Water considers that none of the issues raised in submissions affect the need for the project, project opportunities, strategic context or statutory context described in the EIS.

Summary of themes most commonly raised in submissions

Table 1-1 summarises the themes most commonly raised in submissions and how Sydney Water has responded. Chapters 5-8 describe all the issues raised in submissions and Sydney Water's response to each.

Table 1-1 Key themes raised in submissions and Sydney Water's response

Theme	Response
Water quality modelling approach used	The water quality modelling in the EIS is a comprehensive and best practice approach to assessing waterway impacts. Sydney Water is working with NSW government agencies to progressively improve priority areas of the models, through further research and development. However, Sydney Water's substantial recent investments in the models make them robust tools to assess the project's impacts on waterways. Sydney Water has clarified a range of technical issues raised in submissions about particular elements of the models, the statistical approaches used and the scenarios assessed. Sydney Water has also provided key agencies with more detailed technical information about model calibration and statistical outputs, and included copies of peer reviews in this report that demonstrate suitability of models for assessing project impacts.
Location and design of treated water release structures and quality of treated water releases	As outlined in the EIS, Sydney Water has completed a comprehensive options assessment process for the project, and has located the release structures to balance a range of constraints. Sydney Water has designed the project to achieve best-practice advanced wastewater treatment. This means the treated water releases typically provide benefits to the waterways and negligible impacts on aquatic ecology and recreation. As part of this report, Sydney Water has completed additional modelling to establish what would be required to achieve further dilution and mixing of the lower quality wet weather releases and has committed to further investigating this during detailed design. Sydney Water has also amended and added several management measures relating to waterway impacts to address issues raised in submissions.
Alignment with NSW government water related policies including waterway objectives, nutrient frameworks, and stormwater management approaches	Sydney Water has provided clarification in the report to demonstrate the project aligns with the Hawkesbury Nepean nutrient framework and NSW government waterway objectives for South Creek. The report also includes additional assessment using the NSW Government's stormwater modelling toolkit that demonstrates stormwater objectives in the draft Phase 2 Development Control Plan for the Aerotropolis can be achieved at the AWRC site.
Construction impacts on waterways	Pipeline crossings of waterways will avoid and minimise impacts by tunnelling where practical, however some crossings will be constructed by open trenching across the waterway. Since the EIS was completed, Sydney Water has amended the project to avoid trenching across Kemps Creek, which further reduces impacts. Sydney Water committed to a range of management measures in the EIS to manage and monitor construction impacts on waterways and has enhanced these in this report in response to issues raised.

Theme	Response
Monitoring of project waterway impacts	As part of the EIS, Sydney Water proposed a comprehensive baseline and post-commissioning waterways monitoring program to verify predicted project impacts. Sydney Water has made some minor changes to this program to address issues raised in submissions.
Flood impacts at the AWRC site and modelling approach taken	Operational areas of the AWRC will be built above the 1% AEP flood planning level defined by Penrith City Council. As a result, modelling in the EIS demonstrated negligible impacts of the project on flooding. Sydney Water has included additional modelling in this report that demonstrates good alignment between the EIS modelling and other State and local government flood models for the area and confirms the project's negligible impacts on flooding.
Reducing impacts on terrestrial biodiversity	Sydney Water has minimised the project's impacts on biodiversity through project optioneering and design and committed to a range of measures in the EIS to seek further opportunities to reduce impacts as detailed design progresses. This report amends some of these management measures to address issues raised in submissions. Since the EIS was completed, Sydney Water has also amended pipeline alignments as part of its Amendment Report (Sydney Water, 2022) which has reduced the area of vegetation removal required by 1.09 ha, or about 8%.
Construction noise and vibration impacts	Construction will be carried out progressively along pipeline alignments so for most receivers, noise impacts will be experienced for short periods of up to several weeks. There are some locations such as the AWRC site where construction in one location will take longer and receivers will therefore experience noise and vibration impacts over longer periods. Sydney Water notes the importance of strong and proactive engagement with the impacted communities and the EIS commits to a range of measures to ensure this occurs. Sydney Water is also committed to working closely with organisations and agencies delivering other major infrastructure projects in the area such as the M12 Motorway team, to minimise cumulative impacts during construction.

Project amendments

Sydney Water has also prepared a separate Amendment Report (Sydney Water, 2022) seeking approval for changes to several aspects of the project described in the EIS. Sydney Water initiated these changes as a result of consultation with stakeholders during EIS preparation. Some of these matters were also raised in submissions as outlined below:

- Realignment of brine pipeline and construction compound near Bartley Street in Cabramatta, which was raised by Fairfield City Council. The project amendment is proposed to avoid impacts to Cabravale Memorial Park.
- Realignment of brine pipeline alignment and change in construction methodology around Kemps Creek, which was raised by EPA, DPE – BCD and Penrith City Council. The project amendment is proposed to reduce removal of native vegetation by using an existing

cleared pipeline corridor. In addition, the construction method to cross Kemps Creek will involve tunnelling through an existing pipeline casing rather than open trenching.

- Minor realignment of brine pipeline through Western Sydney Parklands which was raised by Greater Sydney Parklands. The project amendment is proposed to avoid a paved road and fencing in the Western Sydney Parklands.

Public exhibition runs from 23 March to 5 April 2022 and Sydney Water will address any issues raised in submissions in a separate Submissions Report.

Stakeholder engagement

Sydney Water engaged with the community during public exhibition of the EIS, including through virtual information sessions on 29 October and 4 November. These were advertised on Facebook and LinkedIn which collectively reached 33,000 people. The events themselves were attended by 55 people. Sydney Water also provided briefings during the EIS exhibition period to local Councils and councillors, and local MPs.

Sydney Water has continued consulting with the community since public exhibition of the EIS, as part of preparing the Amendment Report (including face to face meetings and letters) and as part of preparing this Submissions Report (including a series of meetings with State agencies). Sydney Water will continue to engage with the community and stakeholders as the project progresses as outlined in the EIS.

Conclusion

The project provides essential infrastructure and an opportunity to improve liveability, sustainability and the environment across the Western Parkland City. It also aligns with Ecologically Sustainable Development (ESD) principles. Through a rigorous options assessment process, the project has been identified as the best option to achieve project objectives.

Sydney Water has provided a comprehensive response to 430 issues raised across 30 submissions, has strengthened the management measures to address issues raised, and has reduced the project’s impacts as described in the EIS as part of the Amendment Report. Sydney Water considers that although some impacts remain as a result of the project, they can be effectively managed through the measures outlined in Table 15-3 of the EIS and updated in Appendix B of this report. Sydney Water is therefore not proposing any further changes to the project in response to submissions received.

2 Introduction

This chapter provides an overview of the project, key activities undertaken to date, and the purpose of this report.

2.1 Project overview

Western Sydney is growing and wastewater services are needed by 2025 to enable population growth and economic development of the Western Sydney Aerotropolis Growth Area (WSAGA or Aerotropolis), South West Growth Area (SWGA) and the new Western Sydney International Airport. Sydney Water's wastewater servicing area for this catchment is known as the Upper South Creek Servicing Area. It includes already established suburbs such as Oran Park and Leppington, and the new precincts of Bradfield and the Northern Gateway.

Sydney Water is proposing to build and operate a new facility and associated pipelines to provide wastewater services for the WSAGA and SWGA. The project includes:

- a new Advanced Water Recycling Centre (AWRC) to collect wastewater from businesses and homes and treat it, producing high-quality treated water, renewable energy and biosolids for beneficial reuse
- a new green space area around the AWRC, adjacent to South Creek and Kemps Creek, to support the ongoing development of a green spine through Western Sydney
- new infrastructure from the AWRC to South Creek, to release excess treated water during significant wet weather events, estimated to occur about 3 – 14 days each year
- a new treated water pipeline from the AWRC to Nepean River at Wallacia Weir, to release high-quality treated water to the river during normal weather conditions
- a new environmental flows pipeline from Wallacia to Warragamba River, to release high-quality treated water to the river just below the Warragamba Dam
- a new brine pipeline from the AWRC connecting into Sydney Water's existing wastewater system to transport brine to the Malabar Wastewater Treatment Plant
- a range of ancillary infrastructure.

Figure 2-1 shows this project infrastructure and the Upper South Creek Servicing Area.

The project is planned to be built in stages, with Stage 1 consisting of:

- building and operating the AWRC to treat a daily wastewater flow, known as the average dry weather flow (ADWF), of up to 50 megalitres per day (ML/day)
- building all pipelines to cater for up to 100 ML/day flow coming through the AWRC (but only operating them to transport and release volumes produced by Stage 1).

Sydney Water is seeking a staged approval for the overall concept of the AWRC operating at up to 100 ML/day. Future stages will involve expansion of the AWRC capacity but will not require new pipelines. This avoids disruption and impacts from laying more pipelines in the future.

Current growth projections suggest the ultimate capacity of the AWRC could be up to 100 ML/day. The timing and size of future stages will be established over time to align with growth in demand in the servicing area.

Sydney Water expects to start building Stage 1 in mid-2022 and to start operating it in mid-2025.

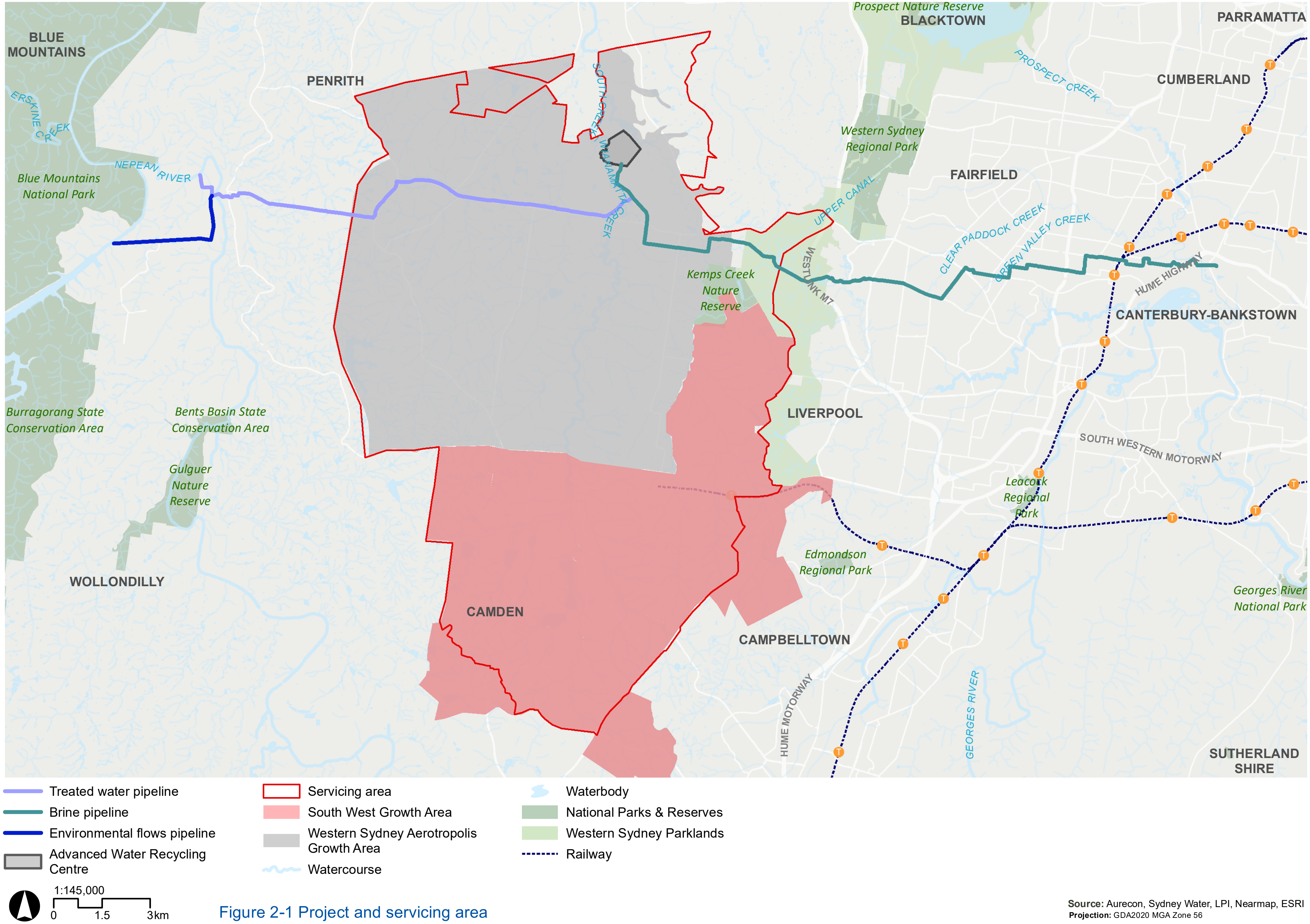


Figure 2-1 Project and servicing area

2.2 Statutory context

The project is State significant infrastructure under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and requires approval from the Minister for Planning. Since Environmental Impact Statement (EIS) exhibition, the project has also been declared critical State significant infrastructure.

In addition, the project is a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), will be assessed under the bilateral agreement with NSW and require approval from the Commonwealth Minister for the Environment.

The then Department of Planning, Industry and Environment (DPIE), now Department of Planning and Environment (DPE) issued Sydney Water with Secretary's Environmental Assessment Requirements (SEARs) in August 2020 and re-issued them in January 2021 to include assessment requirements for Matters of National Environmental Significance (MNES) and approval requirements under the EPBC Act.

Sydney Water prepared an EIS to assess the potential impacts of the project and recommend management measures to appropriately manage those impacts. The EIS was prepared in accordance with the SEARs and the relevant provisions of the now repealed Schedule 2 of the Environmental Planning and Assessment Regulation 2000, which has been replaced by Part 8, Division 5 of the Environmental Planning and Assessment Regulation 2021.

2.3 Public exhibition of the EIS

The EIS was on public exhibition for 28 days from 21 October to 17 November 2021. During this period any individual or organisation was able to make a submission about the project via DPE's website.

The exhibition was notified by DPE in the following newspapers in early October 2021:

- Daily Telegraph.
- Sydney Morning Herald.
- Western Weekender.

Sydney Water also provided notifications and communications about public exhibition of the EIS including:

- Hosting two online community information sessions (29 October and 4 November 2021) attended by 55 people.
- Promoting via Sydney Water social media:
  - Facebook event
  - Facebook geotargeted paid advertisements which reached 30,000 people
  - LinkedIn post which reached 3,000 people.

- Developing a simplified project brochure (in English, Simplified Chinese, Vietnamese and Arabic) and distributing to community via:
  - DPE website (with EIS documents)
  - Sydney Water Talk (Sydney Water's online project engagement platform)
  - SBS online
  - Wechat (Chinese social media platform)
  - Ethnic Communities' Council of NSW website and social media.
- Sending direct emails to database of community members who have previously been engaged about the project.
- Sending emails offering briefings to government agencies consulted during preparation of the EIS.
- Posting multiple notifications via Sydney Water Talk.
- Providing local Members of Parliament with brochure and social post templates to promote via their online channels.
- Mentioning EIS in general newsletter to Fairfield local government area.
- Briefing sessions delivered to Wollondilly, Penrith, Liverpool, Fairfield and Canterbury-Bankstown and Blue Mountains Councils.
- Briefing provided to an attendee from a previous online community session to discuss concerns and questions they had with respect to flooding.

Sydney Water also notified landowners about the project through public notices in The Sydney Morning Herald and Daily Telegraph on 6 October 2021, to meet the requirements of the now repealed clause 193(4)(b)(i) of the Environmental Planning and Assessment Regulation 2000 (now clause 181(6)(b)(ii) of the Environmental Planning and Assessment Regulation 2021).

2.4 Purpose of this document

DPE received 30 submissions and letters of agency advice during exhibition of the EIS and provided copies of these to Sydney Water. In accordance with section 5.17(6) of the EP&A Act, the Secretary requires Sydney Water to provide responses to the issues raised in the submissions.

Sydney Water has prepared this report in accordance with the DPE guideline 'State significant infrastructure guidelines – preparing a submissions report' (DPIE, 2021d). The following sections of this report are structured as follows:

- Chapter 3 analyses submissions, including a breakdown of the groups and individuals who made submissions and a summary of the issues raised.
- Chapter 4 summarises actions taken since exhibition, including any project changes, community and stakeholder engagement and further assessment.

- Chapter 5 responds to issues raised by Commonwealth and State agencies.
- Chapter 6 responds to submissions raised by local councils.
- Chapter 7 responds to issues raised by organisations.
- Chapter 8 responds to issues raised by individuals.
- Chapter 9 provides an updated project justification.
- Appendix A includes a register of all submissions received, grouped by agencies, local councils, organisations and individuals.
- Appendix B provides a list of updated management measures. These measures have been updated in response to issues raised in the submissions. It also includes changes identified in the Amendment Report (Sydney Water, 2022). New management measures are highlighted in orange and modified measures are in red text.
- Appendix C includes an addendum to the Flooding Assessment.
- Appendix D provides additional information on dissolved to total nutrient ratios.
- Appendix E provides additional aquatic ecology mapping.
- Appendix F includes an addendum to the Surface Water Assessment.
- Appendix G includes a technical note outlining a Platypus Impact Assessment.
- Appendix H includes an updated Groundwater Report.
- Appendix I provides two letters outlining the results of an independent peer review of the water quality models.

3 Analysis of submissions

This chapter analyses the 30 submissions received during public exhibition of the EIS and how the 430 issues raised in these submissions have been categorised.

3.1 Overview of submissions

The Department of Planning and Environment (DPE) received 30 submissions during exhibition of the EIS. None of these were petitions or form letters.

Each submission received by DPE is available on its Major Projects website[1]. Table 3-1 summarises the source of submissions received and whether they supported, objected or provided comments on the project. For clarity in Table 3-1, Sydney Water has separated the Commonwealth and State agencies. However, in later sections, Commonwealth and State agencies have been combined in one category.

Multiple submissions noted support for the project, or elements of the project. However, support has only been noted in Table 3-1 where the Major Projects website specifies that the submission supports the project.

Table 3-1 Summary of submissions received

Source	Object	Support	Comment	Total
Commonwealth agencies			2	**2**
State agencies			17	**17[1]**
Local councils		1	4	**5**
Organisations		1	1	**2**
Individuals	3	1		**4**
Total	**3**	**3**	**24**	**30**

Notes to table:

One submission, from the NSW Resource Regulator, noted that the the documents had been reviewed but that it had no comment. Accordingly, Chapter 5 only includes two submissions from Commonwealth agencies and 16 from State agencies.

[1] https://mpweb.planningportal.nsw.gov.au/major-projects/project/38261/submissions/13111/3251

3.2 Submitters

Most submissions (63%) were made by NSW State agencies and Commonwealth agencies. Local councils represented 17% of submissions, with individuals representing 13% and organisations 7%.

The agencies that provided submissions were:

- Civil Aviation Safety Authority
- Department of Premier and Cabinet – Heritage NSW (Aboriginal and Cultural Heritage)
- Department of Primary Industries (DPI) – Agriculture
- DPI - Fisheries
- Department of Planning and Environment (DPE) - Biodiversity and Conservation
- DPE - Crown Lands
- DPE – Water
- Greater Sydney Parklands
- Heritage Council of NSW
- NSW Environment Protection Authority (EPA)
- NSW Health
- NSW Resource Regulator
- NSW Rural Fire Service
- Regional NSW
- Transport for NSW
- WaterNSW
- Western Parkland City Authority
- Western Sydney Airport
- Western Sydney Planning Partnership.

The local councils that provided submissions were:

- Canterbury Bankstown City Council
- Fairfield City Council
- Liverpool City Council
- Penrith City Council
- Wollondilly Shire Council.

The organisations that provided submissions were:

- Endeavour Energy
- Western Sydney Leadership Dialogue.

The individuals that provided submissions were:

- Steven Broussos
- Matthew Fowler
- Laurence Jones
- Nicholas Nasser.

3.3 Analysis of issues

Appendix A provides a register of the submissions received and where in this report each submission has been addressed.

In accordance with the guideline *Appendix C to the state significant infrastructure guidelines – preparing a submissions report* (DPIE, 2021d), Sydney Water grouped issues raised in submissions into one of five broad categories:

- Project (eg the site / corridor, the physical layout and design, uses and activities, timing).
- Procedural matters (eg level or quality of engagement, compliance with the Secretary's Environmental Assessment Requirements (SEARs), identification of relevant statutory requirements).
- Economic, environmental and social impacts of the project (eg amenity, air, biodiversity, heritage).
- Justification and evaluation of the project as a whole (eg consistency of project with Government plans, policies or guidelines, support for the project)
- Issues that are beyond the scope of the project (eg broader policy issues) or not relevant to the project.

Within these broad categories, Sydney Water then applied sub-categories as outlined in Table 3-2.

Table 3-2 Issue sub-categories

Project	Procedural matters	Economic, environmental, and social impacts of the project	Justification and evaluation of the project as a whole
Construction activities	Compliance with legislation, regulations and guidelines	Aboriginal heritage	Project outcomes

Project	Procedural matters	Economic, environmental, and social impacts of the project	Justification and evaluation of the project as a whole
Design requirements	Land acquisition and easements	Airport operations	Release strategy
Operation activities	Stakeholder and community engagement	Air quality	Supports project
Project Description	Utility provider procedures/requirements	Aquatic ecology	
Project options		Ecohydrology and geomorphology	
Project timing		Flooding	
Strategic context		Groundwater	
Statutory context		Human health and hazards	
		Hydrodynamic and water quality	
		Landscape character and visual amenity	
		Management measures	
		Noise and vibration	
		Non-Aboriginal heritage	
		Socio-economics	
		Soils and contamination	
		Surface water	
		Sustainability	
		Terrestrial biodiversity	
		Traffic and transport	
		Utilities	
		Waste management	

Project	Procedural matters	Economic, environmental, and social impacts of the project	Justification and evaluation of the project as a whole
		Waterways	
		World and National heritage	

The category for issues beyond the scope of the project was not given any sub-categories as it stands most clearly as its own category.

Sydney Water reviewed each submission and identified the issues raised. Chapters 5 to 8 provide a response to each issue raised. Chapter 5 responds to issues raised by Commonwealth and State agencies, Chapter 6 responds to submissions raised by local councils. Chapter 7 responds to issues raised by organisations and Chapter 8 responds to issues raised by individuals.

3.4 Summary of issues raised

A total of 430 issues were raised across the 30 submissions. Most related to economic, environmental and social impacts, as illustrated in Figure 3-1.

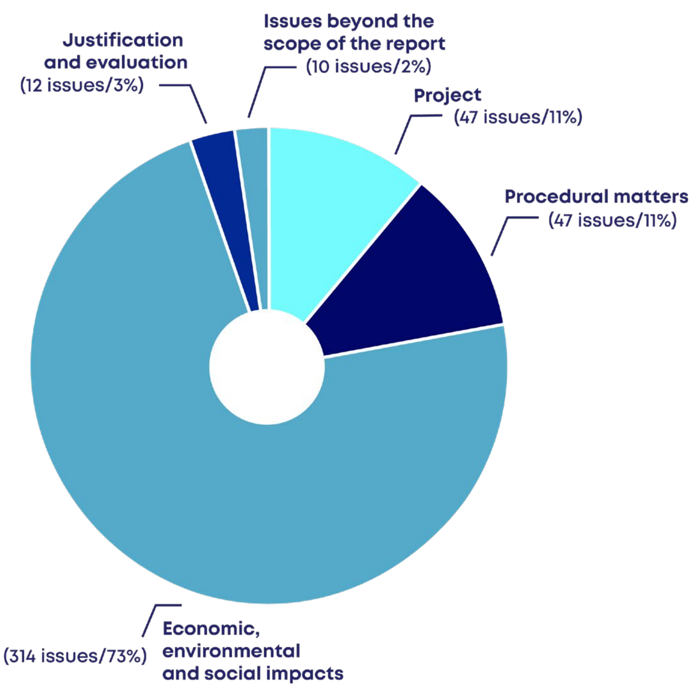


Figure 3-1 Overview of categories of issues raised

Table 3-3 illustrates the number of issues raised in each issue category by different groups.

Table 3-3 Categories of issues raised by submitter

	Agencies	Councils	Organisations	Individuals	Totals
Project	20	21	-	6	47
Procedural matters	29	14	2	2	47
Economic, environmental and social impacts	204	107	-	3	314
Justification and evaluation of the project as a whole	7	3	1	1	12
Issues beyond the scope of this project	3	4	-	3	10
Total issues raised	**263**	**149**	**3**	**15**	**430**

The sections below discuss the types of issues raised in each issue category. Some issues raised were the same or very similar across more than one submission. However, Sydney Water has categorised each of these as separate issues and responded to each separately in this report, to help submitters in reviewing Sydney Water's responses to their issues raised. This section summarises the types of issues raised and Chapters 5 to 8 provide more detail about each individual issue. Sydney Water has structured the report to respond to each submission separately, given the small number of submissions.

3.5 Location of submitters

Sydney Water categorised each submission based on the location of the submitter in relation to the project. Three categories were used:

- Local (within 5km of project).
- Regional (within 5-100km of project).
- Broader (further than 100km from project).

Most submissions (18) were categorised as regional since they were from NSW State agencies and organisations with a regional focus. Ten of the submissions were categorised as local, comprising the local councils, Western Sydney Airport, Western Sydney Planning Partnership and Greater Sydney Parklands, and two individuals. Of the remaining two submissions, both were individuals. The location of one was not provided and the other was categorised as broader location, given the submitter is located in Queensland.

3.5.1 Economic, environmental and social impacts

73% of issues raised related to economic, environmental and social issues. Most related to hydrodynamics and water quality (14% of all issues and 19% of the issues in this category). This was followed by flooding, terrestrial biodiversity (both 8% of all issues and 11% of the issues in this category) and then surface water (5% of all issues and 7% in this category). This was followed by aquatic ecology and noise and vibration (both 5% of the total issues and 6% of the issues in this category). This is illustrated in Figure 3-2.

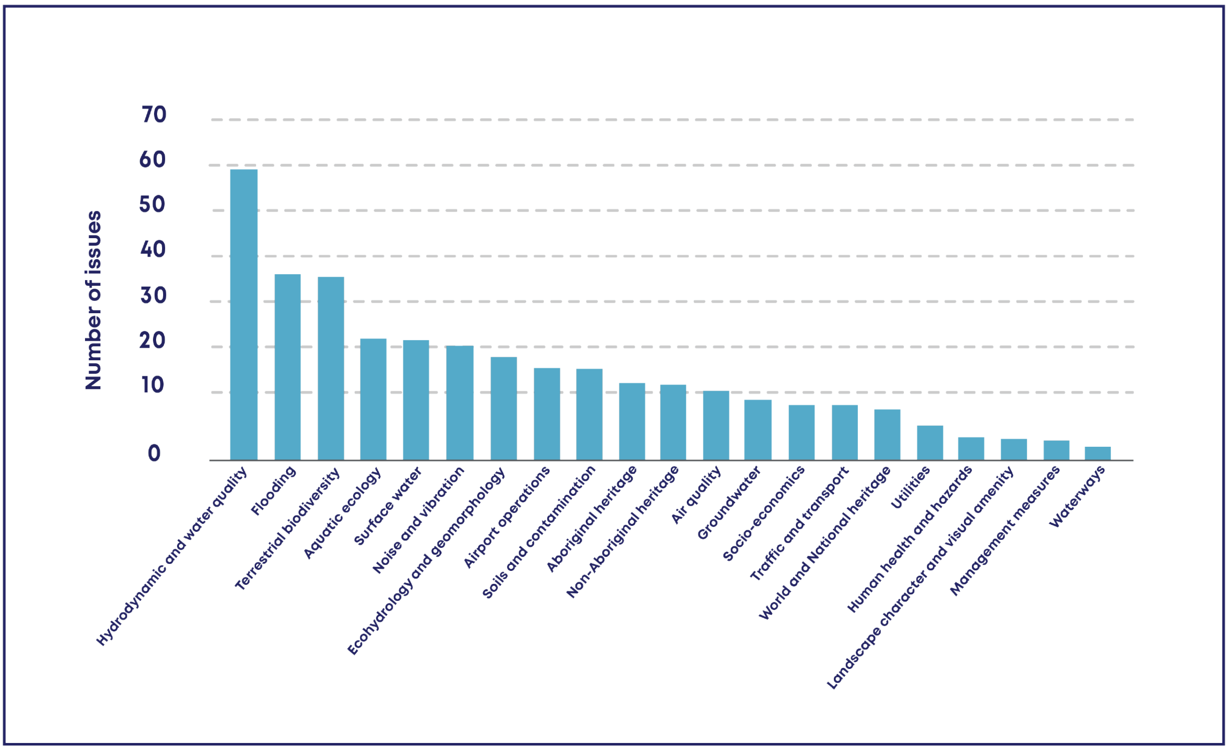


Figure 3-2 Overview of issues raised

Given some submissions raised more than one issue in a particular category, it is useful to analyse the number of submissions in which these issues were raised, to assess the importance of each issue across all submissions. Taking this approach, terrestrial biodiversity was of broadest importance, raised in 30% of submissions. This was followed by aquatic ecology, noise and vibration, surface water and Aboriginal heritage which were all raised in 20% of submissions. This is illustrated in Figure 3-3.

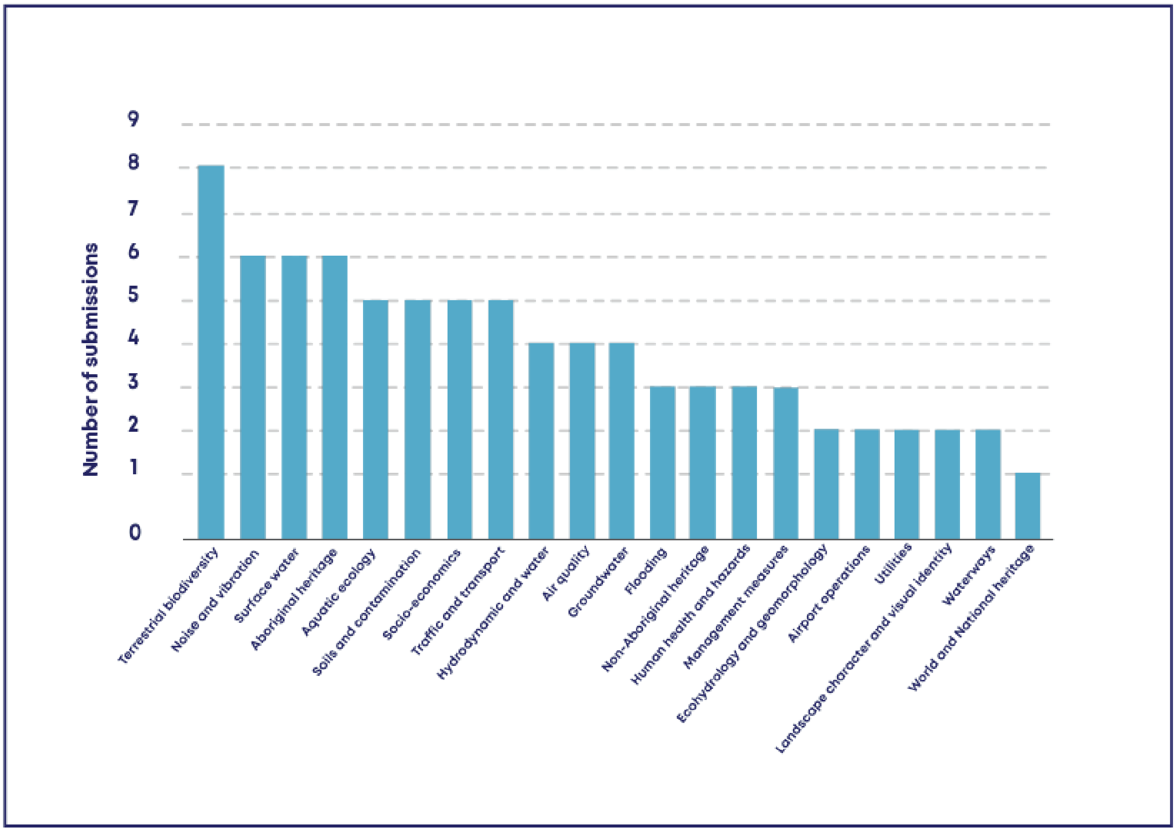


Figure 3-3 Number of submissions in which issues raised

3.5.2 Procedural matters

11% of the total issues raised related to procedural matters. Of these, 40% of the issues within this category related to stakeholder and community consultation, and 17% related to compliance. Figure 3-4 illustrates the number of individual issues in each sub-category. When analysing the broad importance of issues across all submissions, these percentages do not change.

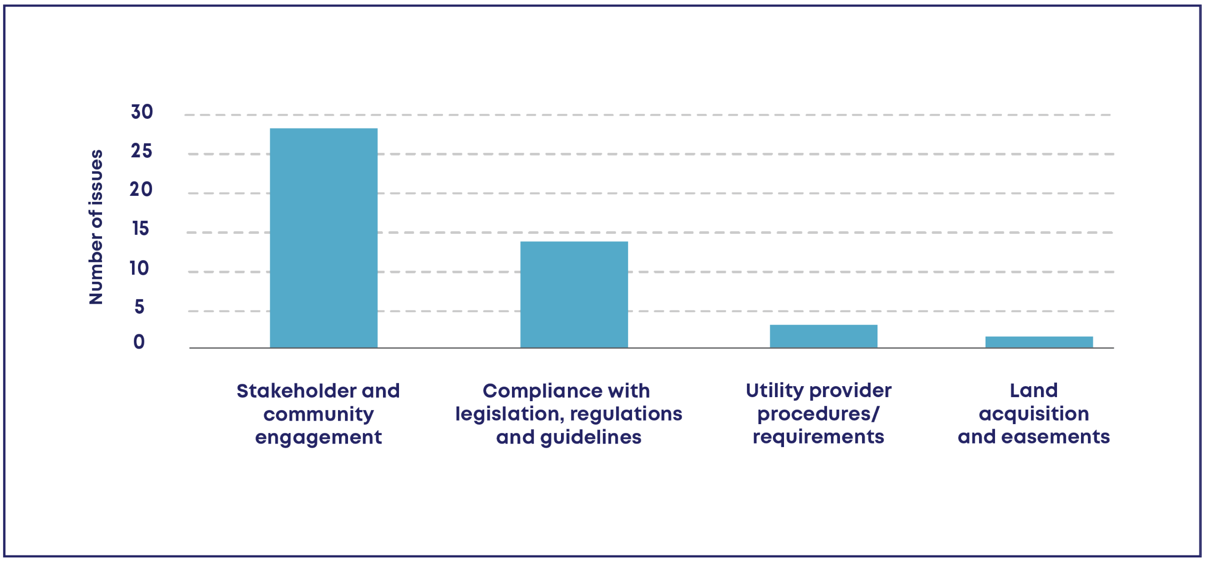


Figure 3-4 Overview of procedural matters issues raised

3.5.3 The project

11% of the individual issues related to the project, particularly in relation to design requirements and the project description. Figure 3-5 illustrates the number of issues raised in each sub-category.

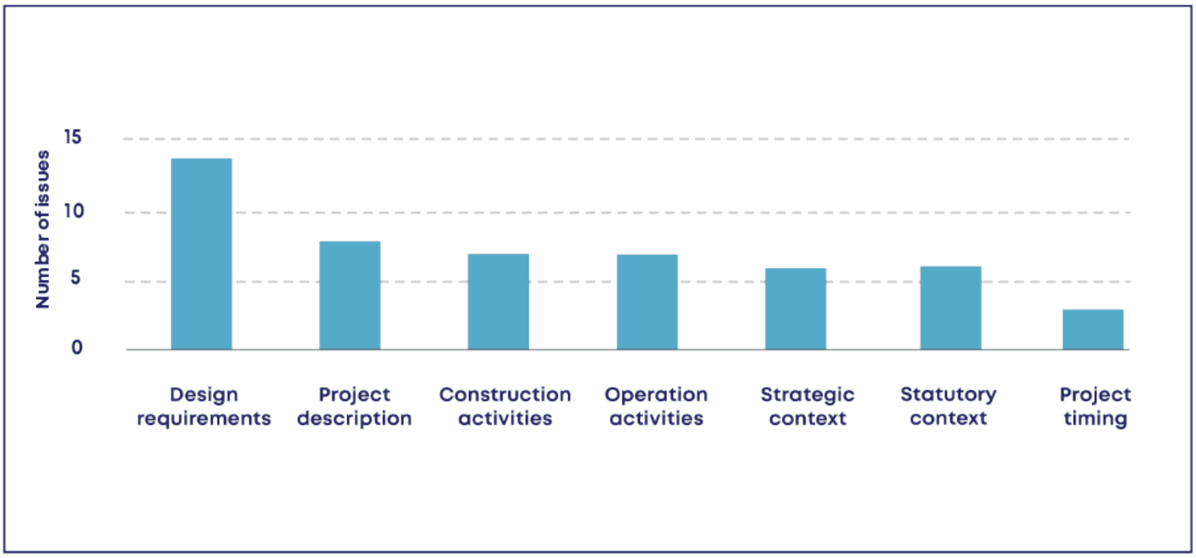


Figure 3-5 Overview of project issues raised

When analysing the broad importance of issues across all submissions, 30% of submissions raised matters related to design requirements, and 13% of submissions raised issues about statutory context, construction and operation activities. This is illustrated in Figure 3-6.

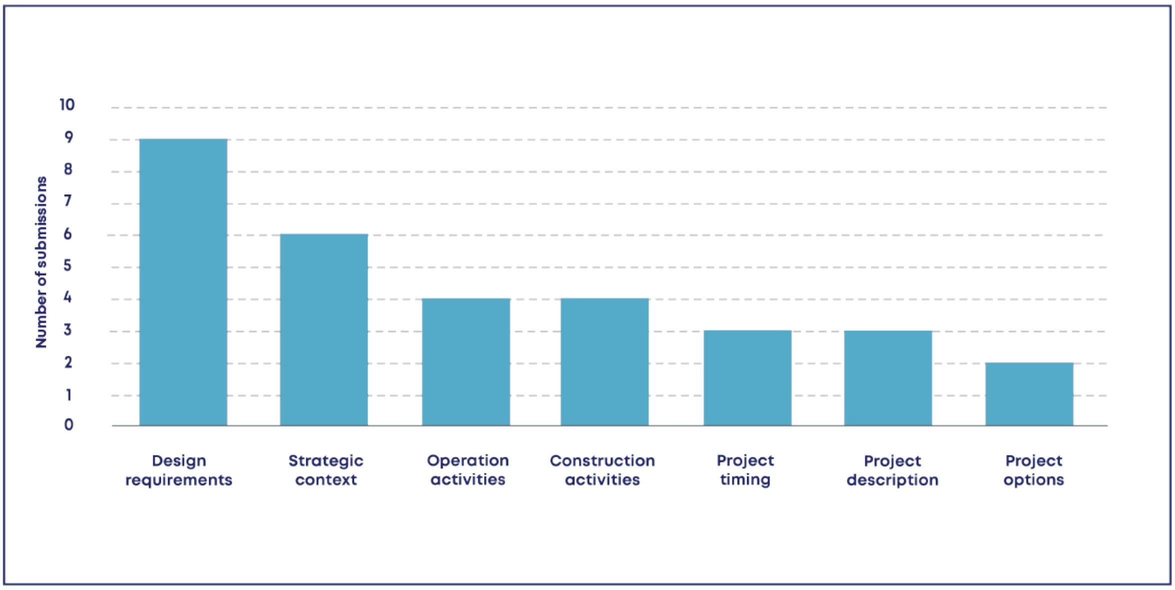


Figure 3-6 Number of submissions in which issues raised

3.5.4 Justification and evaluation

One issue was raised about project outcomes and release strategy. The other 10 issues in this category expressed support for the project or some element of the project. The 10 issues expressing support for the project were in 10 different submissions so 30% of the submissions expressed support for the project or elements of it.

3.5.5 Issues beyond the scope of the project

Ten issues were raised that are beyond the scope of this project. These issues related to the broader wastewater network, the opportunity for future sustainability options and requests for comment from DPE. These issues have been addressed where applicable in the following chapters to clarify why they are out of scope of the current project.

4 Action taken since exhibition

This chapter describes key actions Sydney Water has taken since public exhibition of the EIS, including project amendments, stakeholder consultation and further assessment.

4.1 Changes to the project

Sydney Water has proposed several amendments to the project since the Environmental Impact Statement (EIS) was submitted to the Department of Planning and Environment (DPE). These changes are in response to consultation with government agencies, local councils and landowners and developments during the detailed design phase. The changes include pipeline realignments at six locations and a change to the boundary of the Advanced Water Recycling Centre (AWRC) site:

- Northern Road realignment – amended to accommodate upgrades to The Northern Road and Elizabeth Drive.
- M12 Motorway crossing – amended to avoid a stormwater detention basin proposed for the M12 motorway.
- South Creek realignment – shifted away from South Creek to provide space for future Sydney Water pipelines in the same corridor.
- Kemps Creek realignment - amended to utilise an existing pipeline corridor (PROMAC). Construction of the waterway crossing will occur by tunnelling rather than open trench.
- Western Sydney Parklands realignment – amended to avoid a paved road and fencing within the Western Sydney Parklands.
- Bartley St realignment – construction compound and realignment of pipeline to avoid impacts to Cabravale Memorial Park.
- A property boundary amendment at the southern end of the AWRC site to align with land purchased by Sydney Water.

These changes have been assessed separately in an Amendment Report for the project (Sydney Water, 2022). The impacts of these changes are minor and do not change the significance of impacts assessed in the EIS. Public exhibition of this Amendment Report is between 23 March and 5 April 2022.

4.2 Additional community and stakeholder engagement since EIS exhibition

Section 2.3 describes the stakeholder and community engagement during EIS exhibition.

4.2.1 Engagement in relation to submissions

Sydney Water has consulted with several stakeholders to clarify content in submissions and/or discuss Sydney Water's approaches to responding to issues raised. This includes consultation with the following:

- DPE Biodiversity and Conservation (BCD) and NSW Environment Protection Authority (EPA) to discuss waterway health issues.
- Brick/clay exploration licence holders around the treated water pipeline to understand any potential interactions of the project with their licences.
- DPE BCD to seek further information about additional land proposed for reservation under the *National Parks and Wildlife Act 1974* adjacent to Kemps Creek Nature Reserve.
- DPE Water to clarify details about academic papers referenced.

4.2.2 Engagement about project amendments

Sydney Water's engagement on the project amendments is outlined in Chapter 6 of the Amendment Report (Sydney Water, 2022). In summary:

- Most of the amendments arose from stakeholder consultation.
- Sydney Water has consulted with directly affected landowners and those immediately adjacent to the project changes, either through meetings, phone calls or letters.

4.2.3 Ongoing regular engagement

Sydney Water regularly meets with several organisations about project updates and design interfaces. This includes:

- fortnightly meetings with Transport for NSW (TfNSW) M12 Motorway team
- quarterly meetings with Greater Sydney Parklands
- monthly meetings with Western Sydney Planning Partnership
- monthly meetings with University of Sydney.

4.3 Further assessment

Sydney Water has included additional assessment on the following matters to address issues raised in submissions:

- Additional assessment on flood impacts at the AWRC site in Appendix C.

- Additional information about dissolved to total nutrient ratios in Appendix D.
- Additional assessment of aquatic ecology values, with maps included in Appendix E.
- Additional assessment of surface water impacts in Appendix F.
- Additional information about impacts to Platypus in Appendix G.
- An updated groundwater assessment in Appendix H.
- Copies of independent peer reviews of the water quality model in Appendix I.

Sydney Water has also provided the following more detailed technical information to several NSW government agencies in response to issues raised in submissions:

- Detailed hydrodynamic and water quality modelling technical information to NSW EPA and DPE – BCD. This included a calibration report of the Hawkesbury Nepean and South Creek Water Quality Response Models (Sydney Water 2021a), an expert review of the calibration report (Appendix I) and a full suite of model scenario results including statistical plots.
- Detailed Site Investigation for contaminated land to NSW EPA.

5 Response to State and Commonwealth agency submissions

This chapter provides Sydney Water's response to issues raised in submissions from Commonwealth and State government agencies.

Two submissions were received from Commonwealth agencies (the Civil Aviation Safety Authority and Western Sydney Airport, both primarily focused on airport and aviation issues). Sixteen submissions were received from State agencies.

Each submission has been addressed separately and broken down into discrete issues. Appendix A summarises the submissions received, categories of issues raised and the section in the submissions report where they are addressed. In some instances, the subsections below respond to more than one issue, where the issues are related or very similar.

New or amended management measures resulting from a submission have been noted in the response and added to the management measures in Appendix B. Appendix B is based on Tables 15-3 and 15-4 in the Environmental Impact Statement (EIS), with new measures shaded orange and changes to existing measures in red text.

5.1 Civil Aviation Safety Authority

5.1.1 Airport operations - alignment with National Airports Safeguarding Framework

Issue description

The Civil Aviation Safety Authority (CASA) notes that the Aviation Safeguarding Report by Aurecon identifies potential risks by considering each National Airports Safeguarding Framework (NASF) guideline (NASF, 2018). The risk of distractions to pilots from lighting in the vicinity of Western Sydney Airport (Guideline E) and the risk of intrusions into the protected airspace of Western Sydney Airport (Guideline F) have been adequately addressed in the Aurecon Report. CASA agrees that NASF Guidelines B, D, H and I are not applicable for this matter. Guidelines A and G are matters for Airservices Australia's consideration.

Response

Sydney Water notes that NASF Guidelines A and G are matters for Airservices Australia's consideration. Sydney Water and its consultants Aurecon consulted with Airservices Australia during development of the reference design and the Aviation Safeguarding Report in Appendix AA of the EIS. Guideline A has been addressed in section 13.2.4 of the EIS, with further clarification provided in section 5.18.2 of this report. Appendix D of the Aviation Safeguarding Report includes correspondence between Aurecon and Airservices Australia which confirms that Guideline G is not applicable to the project.

5.1.2 Airport operations - risk of wildlife strikes

Issue description

CASA notes that in relation to NASF Guideline C, Managing the Risk of Wildlife Strikes in the Vicinity of Airports, the Airport Operations section of the Environmental Impact Statement Executive Summary advises that Sydney Water will develop a Wildlife Management Plan for the AWRC site to minimise the risks caused by wildlife, in particular birds. CASA notes the Sydney Water Wildlife Hazard Assessment by Avisure provides wildlife hazard management recommendations at Section 6.2, Table 6.

Response

Management measure AO02 in Table 15-3 of the EIS commits to preparing and implementing a Wildlife Management Plan for the Advanced Water Recycling Centre (AWRC) site. Management measure AO01 also commits to investigating opportunities for additional measures during detailed design to manage potential wildlife populations at the AWRC site during operation. The management recommendations in Table 6 of section 6.2 in Avisure's Wildlife Hazard Assessment, in Appendix AA of the EIS, have been summarised into management measures AO01 and AO02.

5.1.3 Airport operations - overall view of the project

Issue description

CASA does not object to the proposed Upper South Creek Advanced Water Recycling Centre, subject to the management of lighting risks and airspace risks as described in the Aviation Safeguarding Report by Aurecon and the implementation of the recommendations in the Sydney Water Wildlife Hazard Assessment by Avisure.

Response

Sydney Water notes the importance of appropriate management of lighting, airspace and wildlife risks. Sydney Water has captured these in management measures AO01-AO03 in Table 15-3 of the EIS and new management measure AO04 in Appendix B of this report. This new management measure includes assessing the consistency of any proposed changes to the AWRC design with the Avisure Wildlife Hazard Assessment.

5.2 Department of Premier and Cabinet – Heritage NSW

5.2.1 Aboriginal heritage

Issue description

Department of Premier and Cabinet – Heritage NSW supports the following measures in the project's Aboriginal Cultural Heritage Assessment and recommends Sydney Water implement them:

- Mitigation measures for Aboriginal sites in the impact area (Table 6 on pages 82-85).
- Management Policy for Aboriginal heritage (section 11 on pages 88-92).

Response

Sydney Water notes Department of Premier and Cabinet – Heritage NSW support for the recommended management measures. Sydney Water has added management measure AH06 in Appendix B to clarify that these measures will be implemented for the project.

5.3 Department of Planning and Environment – Crown Lands

5.3.1 Land acquisition and easements

Issue description

Crown Lands notes that no Crown waterways are contained within the project footprint (assumed to refer to the Advanced Water Recycling Centre (AWRC) footprint), however two Crown waterways, South Creek and Kemps Creek, adjoin the project footprint. Crown Lands advises that Sydney Water may need to acquire land within Crown waterways or other Crown land, in order to implement the project. Land may need to be acquired under the *Land Acquisition (Just Terms Compensation) Act 1991.*

Crown Lands advises that where pipelines cross Crown land, roads and/or waterways an easement will be required for protection of the infrastructure. Sydney Water as a government agency with acquisition powers are able to compulsorily acquire land and easements under the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*.

As the acquisition process may be a lengthy process Crown Lands advises that Sydney Water are able to apply for interim licensing arrangements.

Crown Lands also advises that the Department may also need to consider the transfer of the affected Crown roads to the local council or Roads and Maritime Service.

Crown Lands notes that licences or easements must be in place before infrastructure can traverse Crown land or roads and that authority must be in place before Crown land or roads can be used, traversed, accessed or infrastructure can be built.

Response

Sydney Water will continue to work with government and private landowners that may be affected by the project. Acquisition of easements will be assessed on a case-by-case basis subject to the asset's size, location, and impact.

At this stage, Sydney Water does not expect that it will be necessary for it to enter into any licence arrangements specifically with Crown Lands, nor for it to compulsorily acquire any Crown Land for the project.

Sydney Water has statutory powers to enter land and carry out works under Part 6, Division 4 of the *Sydney Water Act 1994* (NSW). Sydney Water expects that it will utilise those powers in accordance with the applicable statutory regime to the extent that the project requires access to private or government owned land. This is consistent with the longstanding usual practice in relation to Sydney Water's access to land for the purposes of works.

5.4 Department of Planning and Environment – Biodiversity and Conservation

5.4.1 Flooding - comments on existing case flood model

Department of Planning and Environment Biodiversity and Conservation (DPE BCD) raises a range of issues about flood modelling relating to the Advanced Water Recycling Centre (AWRC) site. Given these are primarily technical modelling questions, Sydney Water has included some broader context below in addition to its response on each technical issue in the following sections. This summarises relevant flood studies and assessments (in Table 5-1), Sydney Water's approach to flood impact assessment, and the conclusions of additional assessment undertaken by Sydney Water to address issues raised by DPE BCD, described in Appendix C of this report.

Table 5-1 Summary of relevant flood studies and assessments

Flood study/assessment	Purpose
Upper South Creek Flood Study (Department of Natural Resources,1990)	This study has been superseded by Penrith City Council's 2015 adopted flood study (WorleyParsons 2015a). It uses ARR1987 hydrology and RMA2 software.
Updated Upper South Creek Flood Study (WorleyParsons, 2015a)	Developed on behalf of Penrith City Council. This is Penrith City Council's 2015 adopted flood study which means it is used to define flood planning levels for developments in the local government area (LGA). The 1% Annual Exceedence Probability (AEP) flood extent from this model has been used to inform the AWRC reference design described in Chapter 4 of the EIS. It uses ARR1987 hydrology and RMA2 software.

Flood study/assessment	Purpose
Western Sydney Aerotropolis South Creek Flood Study (AAJV, 2019)	Developed on behalf of Sydney Water. It has been adapted as the basis of the Upper South Creek Flood Impact Assessment (Appendix L of the EIS). It uses ARR2019 hydrology and TUFLOW software.
Wianamatta (South) Creek Flood Study – Existing Conditions (Advisian, 2020)	Developed on behalf of Infrastructure NSW (INSW). This study is an update of Penrith City Council's adopted flood study to include the most recent 2019 LiDAR data. 1% AEP hydrographs and flood extents from this study have been used to validate the AWRC EIS flood model in Appendix C of this Submissions Report. It uses ARR1987 hydrology and RMA2 software.
Upper South Creek AWRC Flood Impact Assessment (Aurecon, Arup, 2021) This is Appendix L of the EIS.	Developed on behalf of Sydney Water to assess flood impacts of the AWRC. This study uses a trimmed refined version of the *Western Sydney Aerotropolis South Creek Flood Study* (AAJV, 2019). It enables a better focus on potential flood impacts at the AWRC site rather than the whole South Creek catchment. It uses ARR2019 hydrology and a Flood Frequency Analysis (FFA) flow from *the Wianamatta (South) Creek Flood Study - Existing Conditions report* (Advisian, 2020) and TUFLOW software.
Upper South Creek AWRC EIS flood model validation using 1% AEP hydrographs from INSW (Aurecon, Arup, 2022) This is Appendix C in this report.	Undertaken on behalf of Sydney Water. This is additional assessment that was undertaken to validate the AWRC TUFLOW model used in the *Upper South Creek AWRC Flood Impact Assessment* (Appendix L of the EIS) and provide further evidence that the AWRC TUFLOW model is fit for the purpose of flood impact assessment. It uses the AWRC TUFLOW model (Appendix L of the EIS) and adopts 1% AEP hydrographs (obtained from INSW in December 2021 *(extracted from datafiles South Ck Sector - 1% AEP Flood Extent [Peak of Peaks]_Rev G (Advisian, Oct 2020))*) from the *Wianamatta (South) Creek Flood Study - Existing Conditions report* (Advisian, 2020). The additional assessment compares: • 1% AEP flood levels between Penrith City Council's 2015 adopted flood study (WorleyParsons, 2015a) and the AWRC TUFLOW model (Appendix L of the EIS) using 1% AEP hydrograph inputs from the 2020 Advisian study. • 1% AEP flood extents from the AWRC TUFLOW model (Appendix L of the EIS) to 1% AEP flood extents from the 2020

Flood study/assessment	Purpose
	Advisian Study, using 1% AEP hydrograph inputs from the 2020 Advisian study.

Sydney Water has used 1% AEP flood extents and 1% AEP flood levels from Penrith City Council's adopted flood study to inform AWRC design. The AWRC operational area is located outside the 1% AEP flood extent defined by Penrith City Council.

For the purposes of addressing the project's Secretary's Environmental Assessment Requirements (SEARs) and assessing potential flood impact from the AWRC operational area, the EIS used a trimmed refined version of the TUFLOW model from the Western Sydney Aerotropolis South Creek Flood Study (AAJV, 2019). This is because the TUFLOW model for South Creek (AAJV, 2019) had previously been developed by Sydney Water for the purposes of flood impact assessment and was available for Sydney Water to use. This is considered appropriate because the TUFLOW model has not been used to set flood planning levels or define absolute flood levels but used only to assess the relative change in flood levels as a result of development of the AWRC.

Sydney Water notes that TUFLOW is industry accepted flood modelling software and the modelling described in Appendix L is calibrated (described in Table 5-2 and Appendix C of this report) and consists of the latest available topographical and hydrological datasets. Penrith City Council's older RMA2 flood model is considered outdated due to its age and use of much older datasets. Given a suitable more up to date TUFLOW model was available which could be adapted to better assess flood impacts associated with the AWRC site, Sydney Water decided to adopt this model for the impact assessment. Sydney Water also notes the 2020 Advisian work was still underway when flood assessment for the project commenced.

Sydney Water obtained the Wianamatta (South) Creek Flood Study – Existing Conditions report (Advisian 2020) from DPE BCD (Environment, Energy and Science (EES) section) in May 2021 and 1% AEP hydrographs and the 1% AEP flood extent in this study from INSW in December 2021. The 1% AEP hydrograph is the only data that has been provided by INSW and was provided after completion of the EIS. In accordance with advice from DPE EES during EIS preparation, the EIS included a flow scenario that closely matches Council's 1% AEP design flood event conditions.

However, Sydney Water recognises DPE BCD's position that the 2020 Advisian study be used as the basis for defining existing scenario behaviour within the Western Sydney Aerotropolis. To address this, Sydney Water has undertaken additional assessment (Appendix C and discussed further in Table 5-2 of this report) using the 1% AEP hydrographs from INSW. This provides further evidence that the modelling described in Appendix L of the EIS is fit for the purpose of assessing flood impacts as required by the SEARs and provides a reasonable basis for defining existing scenario flood behaviour.

The assessment described in Appendix C (and Table 5-3) shows that by using 1% AEP hydrographs provided by INSW (Advisian, 2020) the impact of the AWRC on the flood environment is negligible because there is no encroachment on the 1% AEP floodplain and therefore no changes to flood conveyance, flood storage or flood hazard. This result confirms the conclusions of the flood impact assessment in Appendix L of the EIS, that the project's impacts on flooding are negligible. The assessment also demonstrates a good level of agreement between results from the Advisian 2020 model and the modelling in the EIS, with the differences in flood level a result of Sydney Water's model using more recent topographic data sets.

Issue description

DPE BCD raises several issues relating to the validation and calibration of the existing case model used in the EIS. Table 5-2 responds to each of these.

Response

Table 5-2 Response to DPE BCD comments on existing case flood model validation and calibration

Issue raised	Response
DPE BCD notes discussion on validation of hydrologic and hydraulic models in section 4.3 and section 4.4.7 is misleading and incorrect and notes the modelling approach is neither sound nor appropriate to inform modelling results of the flood assessment.	Sydney Water considers the validation and calibration approach is consistent with NSW industry best practice and sections 4.3 and 4.4.7 are neither misleading nor incorrect. This table responds to specific DPE BCD issues raised on this matter.
DPE BCD notes validation was undertaken using different models to those used in Penrith Council flood study and project's XP-RAFTS model uses ARR2016 not ARR1987 and applied uncalibrated input parameters. Appropriate calibration is essential. DPE BCD refers to losses parameters and suggests the study uses the least preferable approach for calibration and validation which resulted in the model significantly underestimating the flow (i.e. it is about half the flow value in Council's adopted flood study). Submission notes this is inappropriate and inconsistent with NSW's industry best practice. DPE BCD notes that if any alternate models used they must be calibrated and validated to historical data to ensure discharge and hydrographs, levels and timing within the hydraulic model for key events and locations in pre-developed case, match those in INSW flood model and/or Council's adopted flood models before commencing design flood events for existing scenarios.	**AWRC Appendix L hydrologic model (XP RAFTS) calibration** Section 4.3 in Appendix L of the EIS discusses that the AWRC XP RAFTS modelling has been calibrated to the 1988 and 1986 historical events and this was done by Catchment Simulation Solutions on behalf of Sydney Water (AAJV, 2019). Reasonable calibration was achieved to 1986 peak flow and hydrograph shape at Elizabeth Road gauge and the Great Western Highway. Loss parameters provided a good fit with those events. Sydney Water considers this calibration is appropriate for the ARR1987 event. The AWRC XP RAFTS model described in Appendix L of the EIS uses ARR2019 hydrology for the existing case model because it is considered appropriate to use both ARR1987 and ARR2019 parameters. A discussion is provided in section 4.4.7 of Appendix L of the EIS about how ARR2019 1% AEP peak flow yields a lower discharge than the Penrith City Council's 1% AEP adopted peak flow. It also notes the ARR2019 peak flow rates are within the 90% Confidence Limits produced by WMA Water in that location and show agreement with the flood frequency estimates. It is noted that this ARR2019 1% AEP peak flow rate is considered in modelling described in Appendix L of the EIS but is not used to set flood planning levels on the AWRC site. As noted in the EIS, Penrith City Council's endorsed flood planning levels will be used to set habitable floor levels within the AWRC site. In accordance with advice provided during consultation, a flood scenario is also presented in the EIS where flows at the AWRC match Penrith City Council's adopted 1% AEP flow. This scenario is considered to closely match Penrith City Council's 1% AEP design flood event conditions.

Issue raised	Response
	Using 1% AEP hydrographs obtained from INSW within the AWRC TUFLOW model Since the EIS adopts an alternate hydraulic model (TUFLOW), this model has been validated by comparing results to historical data and hydraulic model results for the 1% AEP event and at key locations in the pre-developed model case. To further demonstrate this and address concerns raised by DPE BCD, an additional assessment is provided in Appendix C that adopts 1% AEP hydrographs provided by INSW and used in the 2020 Advisian study (referred to as the South Creek Sector Review in documentation provided by INSW) within the AWRC TUFLOW model. The hydrographs are understood to be the same as those developed by Penrith City Council and State Government in applying the NSW Floodplain Development Manual (DIPNR, 2005), and have been appropriately calibrated and endorsed through the processes prescribed in the Floodplain Development Manual. Adopting these hydrographs as an additional assessment is considered to now fully address the hydrologic calibration requirements for the existing case model from DPE BCD. Only the 1% AEP hydrographs are used at this time because this is the only data made available to Sydney Water from INSW. The Probable Maximum Flood (PMF) peak flows adopted in the EIS match the PMF peak flows adopted by Penrith City Council and the PMF flows are suitably consistent. **Further AWRC TUFLOW hydraulic model validation** To address DPE BCD's concerns about consistency, further validation of the AWRC TUFLOW model has been undertaken using the 1% AEP hydrographs provided by INSW and described above. This validation is considered to address DPE BCD's concerns that the validation described in section 4.3 in Appendix L used different hydrologic models. **Validation of AWRC TUFLOW 1% AEP flood levels to historical flood data** Additional assessment described in Appendix C shows that when the 1% AEP hydrographs provided by INSW were applied to the AWRC TUFLOW model, 1% AEP flood levels show a reasonable fit to historical 1986 and 1988 flood markers which are reported to be equivalent to 1% AEP events in the Ropes and South Creek catchments respectively.

Issue raised	Response
	It is acknowledged that calibration cannot be achieved without the matching topographic survey of the floodplain from 1988. Notwithstanding this, the comparison between the historical flood markers is reasonable and this validates that the TUFLOW model performs well at modelling existing flood conditions and provides a reasonable basis for flood impact assessment. **Validation of AWRC TUFLOW 1%AEP flood extent by comparing with Penrith City Council's 1% AEP flood data** The additional assessment in Appendix C compares the 1% AEP AWRC TUFLOW flood extent (using INSW hydrographs) with Penrith City Council's adopted 1% AEP flood levels (Figure 1) and provides further evidence that USC AWRC TUFLOW hydraulic model is reasonable at modelling existing flood conditions and fit for undertaking a flood impact assessment. Generally, comparison between the Penrith City Council's 2015 adopted flood model and AWRC TUFLOW model results using the 2020 Advisian flood hydrographs are up to 500 mm higher adjacent to the Kemps Creek dam and up to 10 mm higher in Wianamatta-South Creek on the western side of the AWRC site. Differences in flood level are explained by differences in topographic data adopted by the Penrith City Council's model and AWRC TUFLOW model. It is understood that the Penrith City Council model uses topographic data from as early as 2006, while the AWRC model uses topographic data from 2019. Significant changes are apparent between those data sets and as such, the models will not produce identical flood levels. Locations where topographic differences are most significant are shown in Figure 1 in Appendix C of the report and Figure 4-12 in Appendix L of the EIS. This is consistent with the topographical data differences noted and it is also noted that similar differences between the Penrith City Council's 2015 adopted flood model and the Department of Natural Resources 1990 flood model have previously been reported (WorleyParsons, 2015a). **Validation of AWRC TUFLOW 1%AEP flood extent by comparing with INSW 1% AEP flood extent map** The INSW 1% AEP hydrographs were applied to the AWRC TUFLOW hydraulic model and the 1%AEP flood extent results have been compared to 1% AEP flood extent mapping provided by

Issue raised	Response
	INSW (referred to as South Ck Sector - 1% AEP Flood Extent [Peak of Peaks]_Rev G (Oct 2020)) which has used recent topographic data of the floodplain (Figure 1). Sydney Water notes no flood level data has been provided by INSW at this time and the flood levels in the EIS can therefore not be compared, however the flood extent comparison provides an indication of where flood levels intersect natural topography. Where flood extents match or are similar, it can be assumed that flood levels are also within a similar range. A comparison between the 1% AEP model extents are provided below in Figure 1 in Appendix C which shows a good level of agreement between the INSW hydraulic model (blue outline) and AWRC EIS model results (block colour ramp). The AWRC TUFLOW hydraulic model 1% AEP flood extent closely matches the 1% AEP INSW flood extent map undertaken in 2020. On this basis, the AWRC EIS flood model therefore reasonably predicts the existing hydraulic characteristics of the floodplain for the 1% AEP event and therefore provides a sound modelling basis for testing flood impacts associated with the post development scenario. Post development flood impact assessment (flood level difference with INSW provided hydrographs is shown in Figure 2 of Appendix C.
DPE BCD notes that inputs to TUFLOW model were taken from AWRC XP RAFTS model not Council model.	The AWRC TUFLOW model uses inputs from the calibrated ARR2019 AWRC XP RAFTS model because it is industry best practice. To address concerns on flow inputs raised by DPE BCD, Sydney Water has undertaken additional assessment using 1% AEP hydrographs from the 2020 Advisian model as described above and in Appendix C.

Issue raised	Response
DPE BCD references in titles of figures in section 6.2 that they are based on WorleyParsons (2015) are misleading and incorrect.	Sydney Water notes that Figure 6-30 refers to WorleyParsons (2015a) 1% AEP flood extent (Penrith City Council's adopted 1% AEP flood extent). Figure 6-30 is based on the WorleyParsons 1% AEP flood extent however the floodway flood storage and flood fringe categories have been developed using the approach described in section 4 of Appendix L of the EIS. The intent of Figure 6-30 is to identify the flood planning area used for the project (as required by the project's SEARs) and to confirm that Penrith City Council's 2015 adopted 1% AEP flood extent has been used to inform the project's reference design. Figure 6-30 has been revised to address concerns that the plan is misleading and is included in Appendix C.

5.4.2 Flooding - assessing the existing flood condition

Issue description

DPE BCD makes several comments on amending the flood impact assessment to address the existing flood condition. Table 5-3 includes Sydney Water's responses to each of these.

Response

Table 5-3 Response to DPE BCD comments on assessing existing flood condition

Issue raised	Response
DPE BCD notes INSW has previously provided the *Wianamatta (South) Creek Catchment Flood Study - Existing Conditions report* (Advisian November 2020) report to Sydney Water. Information from Council's flood studies would also be available.	Sydney Water has a copy of the 2020 Advisian report but notes that several data requests to INSW were made over 2021 including after meeting with DPE EES in May 2021. INSW provided 1% AEP flood hydrographs and corresponding flood extents for Kemps, South and Badgery's Creek in December 2021. Sydney Water has used the 1% AEP flood extent from Penrith City Council's 2015 adopted flood study to inform the project's reference design. This means that the AWRC operational area and detention basins are above the 1% AEP flood planning level so there is no encroachment into Penrith City Council's adopted 1% AEP flood extent.
DPE BCD requests Sydney Water identify existing flood behaviour (pre-development condition) for the full range of floods up to and including PMF and outline and map existing flood behaviour based on *Wianamatta (South) Creek Catchment Flood Study - Existing Conditions report* (Advisian, November 2020) report.	Figures 6-4 to 6-29 in Appendix L of the EIS include existing case (pre-developed) condition flood mapping (level, velocity and flood hazard) for a range of flows (115-1650 m^3/s) including the 10%, 1%, 0.2%, 0.5% and the PMF. The flood mapping also includes a flow of 538 m^3/s (which is equivalent to the 1% AEP flow derived from flood frequency analysis (FFA) reported in the 2020 Advisian study. Sydney Water has completed additional modelling (Appendix C) using 1% AEP flood hydrographs from the 2020 Advisian study. As noted above, Sydney Water has not been able to obtain any other data (including flood levels) from the Advisian study. These 1% AEP flood hydrographs are the same as those adopted by Penrith City Council and by using these hydrographs the AWRC TUFLOW model now provides a reasonable basis for defining the existing scenario 1% AEP flood behaviour. Validation of the AWRC TUFLOW 1% AEP flood extent against Penrith City Council's 1% AEP flood levels and the 2020 Advisian study 1% AEP flood extent (Table 5-2 and Figure 2 in Appendix C) has shown the AWRC TUFLOW model can produce reasonable results comparable to Penrith City Council's 2015 adopted model. Where validation has shown flood levels differ or are increased from Penrith City Council's adopted flood model, the assessment in Appendix C notes this is because topography data used in the AWRC TUFLOW model shows similar differences in these locations.

Issue raised	Response
DPE BCD notes the study area should include vicinity of the AWRC, adequate distance upstream of Elizabeth Drive and downstream to Great Western Highway	Given the AWRC flood study and the additional modelling with INSW hydrographs in Appendix C has confirmed negligible impact, Sydney Water considers that extending the AWRC TUFLOW model will provide no additional value to the flood impact assessment. This is because the assessment demonstrates negligible impact in immediate vicinity of the AWRC site which means there will be negligible impacts on existing flood behaviour further upstream and downstream of the AWRC site.

5.4.3 Flooding - assessing the developed flood condition and impact assessment

Issue description

DPE BCD makes a range of recommendations for assessing developed condition and impact assessment. Table 5-4 provides Sydney Water’s response to each of these.

Response

Table 5-4 Response to DPE BCD comments on assessing flood impacts of the developed case

Issue raised	Response
DPE BCD recommends amendments to the existing case model to develop compatible hydrologic and hydraulic flood models to reflect the post-developed case including landform modification and proposed infrastructure, including AWRC components, pumped systems pipes (trenched and tunnelling) from AWRC and proposed green space area including any earthworks and change in vegetation in floodway areas	Table 5-2 and Table 5-3 address suitability of models used in the EIS and additional work completed to address DPE BCD comments about calibration and validation. On this basis, Sydney Water considers the models used in the EIS are suitable to assess the post-development case. The developed case assessment in Appendix L of the EIS and Appendix C of this report is based on the project's reference design. The project's reference design uses Penrith City Council's 2015 adopted flood model to locate the proposed AWRC infrastructure outside the 1% AEP flood extent derived in that model which means that there is no filling within the 1% AEP flood extent. Developed case modelling described in Appendix L of the EIS allows for landform modification and includes modelling the swale that discharges to South Creek and the vegetated green space area. For the vegetated green space area, modelling described in Appendix L assumes that no earthworks fill the floodplain and uses roughness coefficients which adopt a similar roughness to the existing floodplain for floodplain roughness planning. Sydney Water considers that no further amendments of the existing case AWRC TUFLOW model are required to assess the impacts associated with the AWRC.
DPE BCD recommends that Sydney Water identify and map flood behaviour for developed condition for full range of flood up to the PMF	Sydney Water considers this was done in the EIS. Figures 6-31 to 6-54 in Appendix L of the EIS include developed condition flood mapping for a range of flows (115-1600 m^3/s) including the 10%, 1%, 0.2%, 0.5% AEP events and the PMF. The mapping also includes a flow of 538 m^3/s (which is equivalent to the 1% AEP flow derived from FFA in the 2020 Advisian study). Figure 6-53 in Appendix L of the EIS shows the 1% AEP FFA developed case flood extent. In addition, Figure 4 in Appendix C of this report now shows developed condition flood mapping for the 1% AEP event as adopted by Penrith City Council's 2015 flood study. Sydney Water has also updated Figure 6-53 to show the AWRC operational area and included it in Appendix C of this report.

Issue raised	Response
DPE BCD recommends Sydney Water identify and report on impacts of proposed infrastructure for full range of flood up to PMF on flood behaviour and on community for construction and operation. DPE BCD recommends Sydney Water assess impacts of flooding on proposed infrastructure. DPE BCD notes that impacts on flooding due to alignment of pumped systems pipes that are crossing waterways outside South Creek catchment should also be adequately assessed.	The developed case (operational) impact assessment in section 7 of Appendix L of the EIS identifies that for all flows up to the PMF (as described above) the impacts of the AWRC are negligible because there is no encroachment on the floodplain, no change in flood conveyance, and no changes to flood storage or flood hazard within the floodplain. Because the impacts are limited to the AWRC site there are no impacts to the downstream community. For the PMF, the impacts are assessed as low because the modelling indicates some localised backflow impacts which floods the AWRC access road and may impact evacuation. Additional assessment completed in Appendix C of this report shows that for the 1% AEP event as adopted by Penrith City Council's 2015 flood study, the impact is also negligible because there is no encroachment on the floodplain and therefore no changes to flood conveyance, and no changes to flood storage or flood hazard within the 1% AEP floodplain. Sydney Water considers that this result confirms the conclusions of the impact assessment described in Appendix L of the EIS. Section 7.1 and Appendix L of the EIS note that during operation, pipelines will be underground so impacts to the flood environment are not expected. Section 7 in Appendix L of the EIS has identified potential impacts associated with working on or near flood prone land (including compounds and pipeline waterway crossings) during construction. These impacts include obstruction of overland flow paths, loss of floodplain storage and hazardous working conditions. Section 7.1 in Appendix L of the EIS notes that because the duration of construction activities will be temporary, the likelihood of a 1% AEP event occurring during construction is very low.
DPE BCD recommends Sydney Water outline management measures to offset these impacts for construction and operation	The reference design locates the AWRC (including detention basins) infrastructure above Penrith City Council's adopted 1% AEP flood level so there are no additional measures required to manage this impact. The detention basins at the AWRC site have been designed to function with Penrith City Council's adopted 1% AEP flood level as a tailwater level. The detention basin assessment is described in section 9.2 and Appendix K (Surface Water Impact Assessment) of the EIS. The green space area on the AWRC site may have a stormwater management function to facilitate achieving DPE's healthy waterway objectives for South Creek. This assessment is described in section 9.2 and Appendix K (Surface Water Impact Assessment) of the EIS. To ensure impacts

Issue raised	Response
	from the green space area associated with works in the floodplain are avoided, management measure UD01 in Table 15-3 of the EIS commits to ensuring the Urban Design and Landscaping Plan for the AWRC site addresses flooding constraints as detailed design progresses. Sydney Water has committed to several management measures in Table 15-3 of the EIS to address temporary construction impacts including: • management measure G06 commits to preparing construction site layout plans for areas that may be impacted by flooding. This includes identifying flood risk and where possible, locating temporary stockpiles and buildings outside the 1% AEP flood extent and away from drainage pathways. • management measure FL01 commits to a flood preparedness procedure for any works near flood prone land.
DPE BCD recommends Sydney Water assess the impact of climate change due to increase in rainfall intensities and should consider life cycle of infrastructure and not limited to 2070	Climate change has been assessed in accordance with the 'Practical Consideration of Climate Change – Flood Risk Management Guideline (DECC, 2007) which shows indicative changes in extreme rainfall for 2030 and 2070. Given the impact assessment in Appendix L of the EIS shows negligible changes to flooding conditions from the AWRC under PMF, Table 9-36 in section 9.3 of the EIS indicates that the impacts will remain negligible for all less-severe events, including any possible climate change scenario. This is because the PMF is the largest possible flood that will impact the AWRC infrastructure at this location, larger than even the most severe flood resulting from climate change.

5.4.4 Flooding - general comments

Issue description

DPE BCD makes several general comments about flooding. Table 5-5 includes Sydney Water's response to each.

Response

Table 5-5 Response to DPE BCD general comments on flooding

Issue raised	Response
DPE BCD notes this statement about flood models is incorrect 'As part of the Western Sydney Aerotropolis South Creek Flood Study (AAJV, 2019), a XP-RAFTS hydrology model and a 1D/2D TUFLOW model (refer to Section 4.3 and Section 4.4) were prepared for the South Creek catchment and validated against previous studies. These models were used as the basis for development of the models in the AWRC study.' It also notes DPE EES position on how flood studies/management is being overseen in the Aerotropolis, with Western Sydney Planning Partnership having engaged Advisian to undertake the Western Sydney Aerotropolis Flood Impact and Risk Assessment.	The statement about the models used by Sydney Water to assess flood impacts in the EIS is correct. Sydney Water considers that clarifications on flood models in Table 5-2 and Table 5-3 above and additional assessment in Appendix C demonstrate that the flood impact assessment described in Appendix L of the EIS aligns with the Wianamatta (South) Creek Catchment Flood Study - Existing Conditions report (Advisian, November 2020) and that it is fit for the purpose of flood impact assessment. Sydney Water reiterates the AWRC reference design is informed by Penrith City Council's 1% AEP adopted flood extent and the AWRC and detention basins do not encroach on the 1% AEP flood extent.
DPE BCD notes NSW Flood Prone Land Policy does not exclude the location of stormwater infrastructure in the 1% AEP flood extent if development demonstrates there are no detrimental impacts on flood behaviour or community. Infrastructure such as basins should be excluded from the floodway and flood storage areas as the areas are essential for the conveyance and storage of the flow during flood and would result in detrimental impact on flood behaviour and on the community.	As noted above, the flood detention basins in the reference design are outside Penrith City Council's 1% AEP flood storage and floodway extents as defined by Penrith City Council's 2015 adopted flood study so there is no loss of floodplain storage or conveyance under the 1% AEP flood extent. The green space area is located within Penrith City Council's adopted 1% AEP flood extent however, it will be designed to ensure impacts associated with works in the floodplain are avoided.

5.4.5 Project options - dry weather flows to South Creek

Issue description

DPE BCD notes its support for Sydney Water's strategy of not releasing dry weather flows to South Creek to achieve DPE EES flow objectives. It also notes that flow objectives have been finalised since the EIS was written, although this does not affect the proposal to exclude dry weather flows from the AWRC to South Creek.

Response

Sydney Water notes DPE BCD's support for not releasing dry weather flows to South Creek and that flow objectives have been finalised. Sydney Water considers no further response is required to this issue.

5.4.6 Design requirements - Western Parkland City stormwater harvesting

Issue description

DPE BCD notes that the EIS was developed ahead of approval of a regional stormwater strategy for the Western Parkland City. It notes that it expects the EIS to be significantly revised to accommodate a reticulated harvesting system to ensure the integrated water cycle management strategy is implemented, given Sydney Water has publicly discussed this approach via a purple pipe. The submission notes a key factor that must be incorporated is scenario analysis/modelling to demonstrate the AWRC and associated pipelines have volume/capacity to accommodate the harvested stormwater and manage wet weather releases to South Creek. It is assumed wet weather releases are occurring during flood events and expected that the revised EIS will be strategically aligned with flood impact assessment.

Response

Stormwater harvesting across the Western Parkland City is out of scope for this project. Sydney Water is separately developing approaches for integrated water cycle management in the Aerotropolis, including stormwater harvesting. These approaches are still progressing to a stage where they are ready to seek planning approval. They will be subject to appropriate modelling and analysis, and consideration of how they interact with the AWRC. The planning approval pathway will be identified once planning has progressed.

5.4.7 Hydrodynamics and water quality, ecohydrology and geomorphology - modelling impacts on receiving waterways

Issue description

DPE BCD notes that it is unable to assess whether the EIS adequately quantifies the extent of impact of AWRC operation on receiving waters because:

- it is heavily dependent on a coupled series of models but summary statistics on performance and uncertainty are not provided. Without understanding magnitude and source of model error, it is difficult to determine whether these errors mask the variance from environmental benchmarks or objectives
- the assessment is mostly qualitative but can be extended and made more robust via simple quantitative statistics
- it is unclear whether cumulative impacts over time were assessed, or whether the model runs were limited to one year simulations.

The submission also raises several more specific comments on Appendix F of the EIS related to hydrodynamics and water quality.

Response

Sydney Water has completed complex and industry best practice modelling, described in Chapter 8 and Appendix F of the EIS, to assess how the releases of treated water from the AWRC may impact the hydrodynamics and water quality in the receiving waters of South Creek and the Hawkesbury Nepean River. Stage 1 and future stages of the AWRC were evaluated along with cumulative impacts of other expected changes in the surrounding catchments.

Hydrodynamic and water quality modelling software was used to simulate the existing and future waterway conditions and predict potential impacts from the AWRC releases.

Two Water Quality Response Models (WQRMs) were upgraded specifically for use in the assessment to allow simulation of the relevant hydrodynamic and water quality processes in the Hawkesbury Nepean River and South Creek. Further detail is provided in section 8.2.3 of the EIS, including an overview of models used and the interfaces between them in Figure 8-2.

Calibration of the WQRMs has been detailed in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water, 2021a).

Three different types of model scenarios were developed to incorporate a range of catchment conditions and releases that could be expected during the operational life of the AWRC, including:

- baseline scenarios to represent current (circa 2020) conditions
- background scenarios to simulate catchment and waterway conditions expected in 2036 and 2056 without the introduction of AWRC releases
- impact scenarios to allow targeted evaluation of any potential impacts from the treated water releases from the AWRC.

All scenarios were run for a representative dry and wet year to understand the range of potential impacts under different climatic conditions.

For brevity and commentary purposes, only a selection of results were presented in the main body of the Hydrodynamic and Water Quality Impact Assessment report, with a complete set of results provided in Appendix D for representative scenarios. Sydney Water provided DPE a complete set of results in December 2021, presented as timeseries, box and whisker and longitudinal profile plots, for all the scenarios. Sydney Water also provided a copy of the Model Calibration Report (Sydney Water, 2021a).

The modelling, analysis and assessment process was a comprehensive piece of work that considered potential water quality and hydrodynamic impacts across a wide range of potential scenarios. Independent experts have confirmed it is robust and fit for purpose. Table 5-6 provides detailed and specific responses to DPE BCD's comments.

Table 5-6 Response to DPE BCD comments – modelling impacts on receiving waters (South Creek)

Issue raised	Response
Provides comments on App F Hydrodynamics and Water quality - Part 1. Reviews of models not provided as part of EIS, nor has information/data on uncertainty estimates for modelling. Recommended that summary of model reviews, numerical performance statistics and uncertainty estimates be included with the EIS. Until this information available, DPE EES unable to decide on extent of impact of AWRC releases on water quality in South Creek.	The EPA raised a similar issue and Sydney Water's response in sections 5.10.6 and 5.10.7 provides further detail about the model review process and information about model performance and uncertainty. In December 2021, Sydney Water provided DPE EES with additional detailed information about the modelling to address this issue, including: • Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water 2021a) • independent review of the calibration of the Hawkesbury Nepean and South Creek hydrodynamic and water quality modelling (by Mr Brett Miller, Principal Engineer for Hydraulics and Modelling at the UNSW Water Research Laboratory) (Appendix I) • complete set of model results including all scenarios, presentation formats and statistical plots. Sydney Water believes this additional information will assist DPE EES in assessing the extent of impacts of AWRC releases on water quality in South Creek.
Water Quality Response Models (WQRMs) were developed and calibrated using only a 1-year time series, and an additional two month warm up period for the model run. The rationale for a limited time series needs to be better explained, given that typical periods for good model development are between 5-10 years.	The Hawkesbury Nepean Source model, which helps drive the WQRMs, simulates the catchment processes of hydrology. This model was calibrated and validated over 13 years between 2005 and 2018. Given low model run times, reduced complexity in regard to their setup and inputs, models like this Source model are typically calibrated over decades, principally for hydrology but to a lesser extent, water quality. The WQRMs are much more intensive in terms of their setup, inputs, processes simulated, targeted timelines and associated run times. This means the calibration and validation of the WQRMs also require detailed inputs on timelines and a selection of relatively recent years to simulate current catchment and population conditions. Accordingly, they were calibrated and validated using four 14-month simulations (12 months of analysis duration with two months of warm up). As outlined in section 4.1 of the calibration report of the Hawkesbury Nepean and South Creek Water Quality Response Models (Sydney Water 2021a), and section 4.1.2 of Appendix F of the EIS, water quality calibration for the WQRMs was undertaken over the period July 2017-June 2018. This year was selected as it presented the most extensive and

Issue raised	Response
	comprehensive dataset within both Hawkesbury River and South Creek. The period could therefore be used to constrain the parameter selection during the calibration process. Validation years for the WQRMs included July 2013-June 2014 and July 2014-June 2015. These periods were selected as representative dry and wet years, respectively. Due to more extensive monitoring data, an additional validation year, July 2012-June 2013, was also run for the Hawkesbury-Nepean WQRM. Modifications to the above periods were required for calibration and validation of the WQRM pathogen modules. Due to limitations in relevant monitoring datasets, July 2012-June 2013 and Jan 2018-Dec 2018 were selected for calibration and validation purposes for pathogens in the South Creek WQRM. Sydney Water's experts consider the above calibration and validation periods do not represent a limited time series and significantly exceed industry practice which typically includes a one year calibration period and a one year validation period. Sydney Water's experts are not aware of any WQRM model development that includes 5-10 years of calibration, and do not consider this to be standard practice for this type of modelling. The inputs required for the WQRMs are extensive and it is not as simple as running the model for longer. Validation and calibration across a 10-15 year timescale would require 'evolving' boundary conditions to force the model to represent these changes, such as for land use. This adds another level of complexity and relies on the data to represent the changes being accurate and available. It is also noted that the WQRMs are very complex simulation tools, with corresponding high computational requirements and geographic scope of modelling, which Sydney Water also considers exceeds industry best practice. With respect to the scenario simulations, the models were run over two one-year periods that were representative of higher and lower rainfall years. Each of these simulations included a two month 'warm up/conditioning' period to allow the models to adjust to new loading conditions. Sydney Water experts and independent reviewers also consider this an approach that equals or surpasses typical industry practice.

Issue raised	Response
Unclear whether cumulative impacts of AWRC releases over time have been assessed. Modelled outcomes are presented for only 1 year time spans. Important to clarify whether the 2036 and 2056 scenario outputs reflect the potential impact of the cumulative releases from 2020 (baseline) or whether the scenario outputs just reflect the change in population growth and development. If the latter, then recommended that models are run to produce the time series to allow cumulative impacts over time to be assessed.	The scenarios are one year time spans that reflect 2036 and 2056 conditions. It is not yet possible within the modelling community to run 20-30 year coupled catchment - estuary models to assess cumulative impacts. This is due to restrictions in computational ability, and issues relating to error accumulation over longer simulations. Sydney Water is currently developing the capacity to run longer term planning simulations as part of future model development initiatives undertaken as part of the Hawkesbury Nepean Science Working Group roadmap. This applies to both the Hawkesbury Nepean and South Creek WQRMs. It is typical for these complex water quality model simulations to run indicative future scenarios as snapshots. Running an ensemble of snapshot simulations gives insight into a range of plausible future conditions. In the context of the AWRC releases, it is noted that the AWRC nutrient load input is low (~1% of total Hawkesbury Nepean catchment) and tends to have a generally beneficial effect on water quality. By not running a cumulative simulation for 20+ years, the snapshot scenarios are inherently conservative estimates, as they do not account for the generally lower nutrient concentrations that would potentially develop in the system over time. The cumulative effects on the river are considered by comparing the AWRC release scenarios (impact scenarios) with other changes due to land-use and projected wastewater treatment plant (WWTP) changes (included in the background and impact scenarios). The model runs suggest that the cumulative changes in the river will be dominated by changes in catchment development, climate change driven changes in flow and temperature and WWTP discharge changes, rather than the AWRC releases.
Analysis of extent of impact is qualitative, making it difficult to determine whether the impacts are indeed 'slight', 'marginal' or 'minor' as reported. The typical approach is to use a worst expected value assessment or exceedance of medians in relation to quartiles, and an analysis of frequency of exceedance.	The NSW Environment Protection Authority (EPA) raised a similar issue and Sydney Water's response in section 5.10.7 provides further detail about the range of assessment methods used, including quantitative analysis such as statistical box-whisker plots. As noted above, in December 2021, Sydney Water provided DPE EES with a complete set of model results including all scenarios and presentation formats.

Issue raised	Response
The analysis of extent of impact does not appear to be comparing 'apples with apples'. Water quality objectives (guideline values) are for long term ambient conditions and ideally not compared to individual release events as show in the various plots. Recommended that in addition to existing plots, the annual median over an extended time series (to represent ambient condition) be calculated and be compared to the objectives. For example, box and whisker plots that Sydney Water used to analyse the monitoring data could also be created for the modelled data.	The analysis approach is explained in more detail in section 5.10.7 of this report and in section 4.6.4 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS. In summary, scenario impacts were assessed using several methods: • understanding the broad changes caused by the scenario in the mean river condition (longitudinal profiles) • understanding how wet and dry periods and events in different years would differ (time-series plots) • understanding how the statistical nature of the variable is anticipated to change, including the likelihood of guideline exceedance with and without AWRC releases and any outliers (box-whisker plots). As noted above, in December 2021, Sydney Water provided DPE EES with a complete set of model results including all scenarios and presentation formats. This included all formats of model results.
The analysis of the extent of impact needs to be extended to identify the change in the biogeochemical regime because of the releases. Changes to the 'water quality regime' could affect primary productivity and subsequent upper trophic levels.	The structure of the WQRMs includes modules to simulate a suite of biogeochemical processes including nutrient cycling and algal growth/primary productivity. Further details relating to the model structure are presented in section 4 of the Hydrodynamic and Water Quality Impact Assessment and in the finalised Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water 2021a), provided to DPE EES in December 2021. The results from the model scenarios highlight the localised and generally beneficial effect the releases have on waterway condition in terms of reducing nutrient levels. The modelling also indicates that the extent and type of changes to nutrient concentrations are almost negligible compared to other stressors facing the system. The modelling provides no evidence that a fundamental shift in the biogeochemical regime is anticipated due to the AWRC releases. As the water is cooler in summer, it has higher oxygen content and generally lower nutrients overall. The releases would therefore potentially push the regime away from a

Issue raised	Response
	eutrophic phytoplankton dominated system towards a mesotrophic system. However, as the projected nutrient reductions are quite modest this may not be significant. Regardless, the changes associated with the land-use development and other stressors on the system are projected to be the main driver of regime change, shifting the balance of nitrogen to phosphorus relative to the current condition as more urban runoff is added. Further refinements to the model as planned through the Hawkesbury Nepean Science Working Group will allow Sydney Water to address the question of altered flow and urban nutrient loading with more confidence in future projects. Assessments of potential impacts on higher trophic levels are also addressed in the Aquatic Ecology Impact Assessment (Appendix H of the EIS). In summary there is a risk that short term localised impacts to the water quality regime may occur which may affect primary production, which is evidenced primarily through short lived spikes in chlorophyll *a* (as predicted in the Warragamba River). In this location, only advanced treated water would be released and the spikes may be a product of lower turbidity as well as nutrient availability. Depending on the magnitude and duration of these spikes, there is potential that dissolved oxygen depletion of the water column may occur which can cause knock on effects to higher trophic level organisms, particularly fish species that are not particularly mobile. There is also potential for an increase in primary production response, particularly by benthic species of diatoms and algae. This could drive a shift in the community assemblage which in turn may increase or decrease favoured food resources of benthic macroinvertebrate species which may result in a shift in community composition. As a result, this may then affect food resources of higher order species that rely on invertebrate prey as a primary resource for food. Although there is not enough understanding of the Warragamba River to make specific predictions about how the trophic cascade will react, it is anticipated that any change driven by the water quality regime will be localised and short lived.

Issue raised	Response
	As outlined in section 8.2.2 and 8.11 of the EIS, Sydney Water is undertaking a baseline environmental monitoring program to understand water quality conditions in waterways potentially impacted by the AWRC releases. The program will be continued in the post-commissioning phase to allow impacts to be analysed.
It is important to recognise that the various nutrient forms making up the total concentrations for nitrogen and phosphorus in the DPE EES water quality objectives. The ratio of totals to the bioavailable (inorganic) forms (eg total nitrogen (TN) : dissolved inorganic nitrogen (DIN)) in the AWRC releases should be used to inform the overall impact assessment.	Appendix D of this report provides a supplementary analysis of dissolved to total nutrient ratios. The results compare the baseline, background and impact scenarios for a representative set. In general almost all sites show negligible differences when comparing with or without the AWRC release. The only notable difference is a marginal increase in DIN:TN at the location downstream of Wallacia Weir and Warragamba River and some difference noted in Penrith Weir. When interpreting this however, it is important to note that the mean concentrations of nutrients are predicted to decrease at these locations.
Sydney Water has identified the impacts (on water quality) of primary treated sewage releases from the AWRC to South Creek during severe wet weather events are minor and temporary given the events are rare and will be diluted. However, without a longer-term time series analysis of these severe wet weather events, it is difficult to assess whether there are any cumulative impacts of this strategy. DPE EES notes that there are impacts related to elevated toxicants and bank effects at the site of release or primary treated sewage during the wet weather events.	With respect to South Creek, the impacts from the AWRC releases are predicted to be infrequent, and short lived. Releases that include primary treated water are expected to occur two to three times per year but may vary between zero and six events per year. Further, the EPA submission notes that it is correct that the instream impacts will be negligible in South Creek itself due to short water residence times during wet weather flows, and considers the real impacts will be felt once this water reaches the freshwater tidal pool (Windsor to Wisemans Ferry reach) where residence times increase significantly. The response in section 5.10.20 addresses this point. The capacity to run longer term simulations using the WQRMs is discussed above (refer to the third row of this table). Due to the frequency, volumes and timing of the releases, in combination with the characteristics of South Creek, the risk of cumulative impacts on downstream reaches of South Creek is considered very low. Further longer term modelling of the creek is therefore not considered of value, or warranted. With respect to the risk of impacts from the AWRC releases to South Creek, other sections of this report also address this matter:

5.4.8 Ecohydrology and geomorphology – South Creek

Issue description

DPE BCD raises several comments on Appendix G of the EIS related to ecohydrology and geomorphology. Table 5-7 addresses each of these issues.

Response

Table 5-7 Response to DPE BCD comments on the Ecohydrology and Geomorphology Impact Assessment

Issue raised	Response
DPE BCD notes that DPE EES has finalised flow objectives for South Creek meaning Table 2 (page 22) should be replaced with the table provided in their submission. DPE BCD notes that the main changes are to frequency and duration of freshes, but do not affect the overall outcome of the Ecohydrology and Geomorphology Impact Assessment. This is because the impact assessment has a different definition of freshes from that used by DPE EES and therefore did not include this comparison in the assessment.	Sydney Water acknowledges the changes to the flow objectives. The new flow objectives are included in section 5.4.16 and also discussed in section 5.4.9. Sydney Water confirms that the changes to frequency and duration of freshes do not affect the overall outcome of the Ecohydrology and Geomorphology Impact Assessment.
DPE BCD notes that the impact assessment outcomes are dependent on the accuracy of the outcomes of models in Appendix F. As above, it is difficult to assess extent of change or impact without information on the model performance and uncertainties. In this specific impact assessment, the baseline scenario has been disregarded by Streamology due to the uncertainty in the baseflow predictions compared to gauged data. Only relative differences between the background and impact scenarios were considered, but if model performances are not reported it is difficult to determine whether the model errors mask the variances among the scenarios.	Sydney Water confirms that the Ecohydrology and Geomorphology Impact Assessment relies on model outcomes from Appendix F (Hydrodynamic and Water Quality Impact Assessment). Additional information on these models, including the calibration report, independent review and a complete set of scenario results were provided to DPE on 23 December 2021 for sharing with DPE BCD.

Issue raised	Response
DPE BCD notes that the terminology on the percentiles are not intuitive for those that are unfamiliar with flow exceedance curves (eg 10th percentiles are identified as high flows and 90th percentiles as low flows).	Flow exceedance curves show the percentage of time in a flow record that flow exceeds a particular value. The median daily flow is the 50^{th} percentile value (that is, half the time flows are lower than this flow, and half the time they are higher). Higher flows occur less frequently (eg 10^{th} percentile flows or less, which is a flow only exceeded 10 percent of the time). Low flows occur more frequently (eg 90^{th} percentile values or greater, which is a flow exceeded 90 percent of the time). This is a standard method of describing flow exceedance curves and associated percentiles.
One main point in the impact assessment is the relative impact of urban developments compared to the AWRC releases. It is unclear whether the modelling has considered DPE EES's stormwater controls for South Creek, which is expected to be achieved for all new developments.	The Parklands scenario has been modelled and used as a basis for considering DPE EES stormwater controls for South Creek. The Parkland scenario represents a vision of a greener and cooler landscape for Western Sydney than current urban forms being delivered under Business as Usual (BaU) conditions. The Parklands scenario is represented in the Source catchment model through changes to the imperviousness values for Parkland urban forms. This is an appropriate representation of the stormwater management measures based on the information available at the time of this study and the scale most relevant to the receiving water model used for the project. The Parkland urban form is represented in the Source catchment model as land use areas. The land use areas were based on a combination of datasets including the consolidated growth forecast geospatial data and land use typology data prepared by COX Architecture for INSW. The percentage of imperviousness for the Parkland urban form was based on draft data available from the Aerotropolis precinct planning.

5.4.9 Ecohydrology and geomorphology – comparison to flow objectives

Issue description

DPE BCD notes that the upland drainage area should be included in Table 30 for transparency of calculations when comparing to the DPE EES flow related objectives. The modelled (scenario) daily flow volumes in Table 30 are significantly lower than the DPE EES flow objectives, and it is hard to determine from the text whether the modelled daily flow volumes are for the AWRC releases only or whether they include the stormwater discharges too or even whether the calculations are correct. This section of the document needs to be better explained.

Response

Sydney Water and consultants from Streamology have reviewed Table 30 of the Ecohydrology and Geomorphology Impact Assessment (Appendix G) of the EIS in response to DPE BCD's comment. An incorrect drainage area was used in the original calculations. An updated and expanded version of Table 30 is provided in Table 5-8. This includes the updated criteria provided by DPE BCD in its submission. The median and mean daily flow volume have been converted using a drainage area of 96 km^2. This represents the South Creek catchment area upstream of the Badgerys Creek confluence. The mean annual flow volume that was included in Table 30 has not been included, given that it is not a criterion provided by DPE BCD. Text shown in red indicates where a criteria is predicted to be exceeded.

The key changes as a result of the updates include:

- Baseline median daily flow volume exceeds the pre-development criteria.
- Background and impact scenarios exceed the mean daily flow criteria. There is little difference between the background and impact scenarios which highlights that the main contribution is the predicted changes in land use and associated increase in stormwater flows. The AWRC releases make a negligible contribution to overall flow volumes.
- Cease to flow metrics continue to not be met. This was previously discussed in Appendix G of the EIS.

Table 5-8 Comparison of flow objectives performance criteria to baseline (SC00), background (SC01-4) and impact (SC05-8) scenario results for key metrics about 500 m downstream of the AWRC release to South Creek

Metric	Updated DPE EES criteria		Converted criteria		Modelled results at AWRC release[4]		
	Pre-development	Post-development	Pre-development	Post-development	Baseline[2] (SC00)	Background[3] (SC01-SC04)	Impact[3] (SC05-SC08)
Median daily flow volume	71.8 ± 22.0 L/ha/day	1095.0 ± 157.3 L/ha/day	0.7 ± 0.2 ML/day[1]	10.5 ± 1.5 ML/day[1]	2.3 ML/day	6 – 7 ML/day	7 – 9 ML/day
Mean daily flow volume	2351.1 ± 604.6 L/ha/day	5542.2 ± 320.9 L/ha/day	22.6 ± 5.8 ML/day[1]	53.2 ± 3.1 ML/day[1]	27.7 ML/day	66 – 99 ML/day	67 – 101 ML/day
Cease to flow (proportion of time/year)	0.34 ± 0.05	0.03 ± 0.01	n/a	n/a	0.09	0.03 – 0.09	0.03 – 0.09
Cease to flow – Duration (days per year)	39.2 ± 8	3.9 ± 1.2	n/a	n/a	0.1	0.1 – 0.2	0.1 – 1.9

Notes to table:

1. Based on 96 km^2 drainage area.
2. Baseline scenario has been compared to pre-development criteria. Sydney Water notes that earlier versions of the DPE BCD criteria referred to the pre-development criteria as applying to first and second order streams (which does not include South Creek). In the absence of published guidance on how to apply these criteria, Sydney Water has taken this approach.
3. Background and impact scenarios have been compared to the post-development criteria.
4. The modelled daily flow volumes are predicted flow volumes in South Creek and include stormwater and AWRC releases.

5.4.10 Ecohydrology and geomorphology – risk assessment

Issue description

DPE BCD notes that the extent of impacts is based on a risk assessment matrix, noting it is based on technical expertise. Given the nature of this assessment, DPE BCD recommends that the document be updated with details of how the modelled and field data were translated into the likelihood and consequence criteria in the matrix. Typically for expert opinion-based approaches, a range of stakeholders affected by the decision and/or with subject matter expertise should be consulted. Given there are modelled data, it is strongly recommended that Streamology scope options to make the risk assessment quantitative rather than qualitative. For example, the modelled outcomes could be categorised according to quartiles, and for each quartile to represent one of the unlikely to almost certain scores in the risk matrix.

DPE BCD also note that overall, it is difficult to determine whether the assessment of low impact is correct given the qualitative nature of the assessment.

Response

Subject matter experts

A range of experts with subject matter expertise were involved in assessing or reviewing the risk assessment, including:

- Dr Geoff Vietz is a fluvial geomorphologist and stream management specialist with more than 22 years of relevant experience.
  - Geoff is the Director and Principal Scientist of Streamology Pty Ltd. Geoff has been in technical and managerial roles on projects throughout Australia and internationally. His specialties include geomorphology, sedimentology, ecohydraulics and environmental and operational flows as they apply to both rural and urban environments, river rehabilitation, monitoring and evaluation, and strategic water resources management. He has extensive experience in waterway design through several major engineering and waterway consulting companies.
  - Geoff is also a Senior Research Fellow at The University of Melbourne with the Waterway Ecosystem Research Group. His research is focused on the geomorphology, ecohydraulics and management of waterways, and is internationally regarded for his work on urban stormwater and stream response. He has authored and co-authored over 30 scientific papers, three book chapters, more than 100 technical reports and has been chief editor of the Australian Stream Management (ASM) Conference proceedings since 2014, and was most recently on the 10ASM Scientific Reference Panel.
  - Geoff is a Fellow of the Peter Cullen Water and Environment Trust and past-president of the River Basin Management Society. Geoff has lectured on fluvial geomorphology, hydrology, river rehabilitation and environmental flows and is a member of the Australian and New Zealand Geomorphology Group and International Association of Geomorphologists. These, and other roles, are focused on knowledge transfer and

scientifically-based decision making: to achieve better management and policy development for catchment, waterway and water management.

- Dr Christine Lauchlan Arrowsmith is a highly experienced waterway engineer specialising in hydrology, hydraulics, and sediment transport. She has over 22 years experience in river, estuary and coastal investigations, from the analysis of river, estuary and coastal processes through to both physical and numerical modelling of such systems. Her project experience spans a range of water related projects, focusing on the analysis of; river systems (flood studies, hydraulic-geomorphic analysis, eco-hydraulics and scour), estuaries (environmental flow requirements, water quality, monitoring programs), and coasts (coastal processes, coastal erosion and inundation hazard assessments, coastal adaptation studies, outfalls and water quality, asset management).
- Dr Chris Gippel has been continuously involved in applied science related to hydrology, environmental hydraulics and fluvial geomorphology for 38 years. He has a First Class Honours Degree in Geography (1983) and a PhD in Hydrology and Geomorphology (1989). He is currently an independent consultant undertaking projects within his range of expertise for government and the private sector in Australia and other countries, and is also an Adjunct Senior Research Fellow with the Australian Rivers Institute, Griffith University. His research and applied work covers a range of fields, including:
  - river and lake health assessment
  - assessment of environmental flow requirements
  - prediction of river geomorphology
  - numerical modelling of dam operations and downstream impacts
  - stream design and rehabilitation
  - lake and wetland water balance
  - hydrological prediction and hydraulic modelling for ecological and geomorphological objectives
  - assessment of hydraulic, hydrological and geomorphological impacts of developments such as mining, industrial and urban development, dam construction and operation, and pipeline construction and operation
  - terrain and remote sensing analysis for landform, vegetation and watercourse definition.
  - Dr Gippel developed the hydrology software Flow Health (http://watercentre.org/portfolio/rhef/project-resources/flow-health-hydrology-assessment-tool), and was a co-author of the international text book Stream Hydrology: An Introduction for Ecologists (Wiley & Sons, Chichester). Dr Gippel regularly undertakes peer review for journals, and acts as an Expert Witness to the Courts.

Sydney Water considers that the involvement of these highly qualified and experienced subject matter experts has led to a risk assessment that is fit for purpose. Given this and the predicted minor nature of the impacts, involving a range of affected stakeholders in the risk assessment process would not have increased its robustness.

Approach to risk assessment

The risk assessment for Nepean River is quantitative as it considers the explicit changes in hydraulic metrics (velocity, water surface elevation, wetted perimeter and shear stress) along the waterway under different flow conditions, including the AWRC releases and the likely impacts of these on the waterway. Hydraulic modelling, proportional changes, and the physical relationships to geomorphology, are empirically derived and objective. These data demonstrate the almost imperceptibly small changes occurring in metrics such as surface water level or velocity, as a result of releases. The following sections provide some further detail about how the likelihood and consequence categories were defined and examples of how they were applied.

- Likelihood was defined according to a series of categories based on geomorphic sensitivity. Geomorphic sensitivity describes the propensity of landforms to respond or adjust to environmental disturbance (see Fryirs, 2017 and Fryirs and Brierley, 2016). Sensitivity was based on the RiverStyles approach (defined by the Fragility Index in the RiverStyles database) and data. It also drew on the commonly used environmental flows approach where changes in hydraulics are used to inform likely geomorphic changes. The only increase in rigour could be undertaken *post hoc*, where actual measurements of change are used to determine sensitivity to stressors (such as in Khan and Fryirs, 2020). This is obviously not possible for an *a priori* assessment such as for the likely impacts of the AWRC.
- The consequence of any changes associated with releases from the AWRC was assessed using the results of the hydraulic modelling. The consequence categories were described in section 4.8 of Appendix G of the EIS (Ecohydrology and Geomorphology Impact Assessment). The consequence considers the temporal and spatial magnitude of changes along each reach. The consequence has been aggregated across each reach, where a reach was defined based on its typical geomorphic form and conditions and taking into account the proposed treated water release locations.

In response to the suggestion of using quartiles to define risk assessment categories, there are no data with which to define quartiles. The sensitivity and potential geomorphic response are not measured by a single variable or variables whereby the absolute range of change has a direct outcome (as can be the case for water quality parameters). The geomorphic conditions are also very site specific which means it is not feasible to use standard categories. As a result, expert judgement has been used based on the literature noted above to assess the overall impact and risk.

The results of the likelihood and consequence assessment were combined in a standard risk matrix. The content below provides some examples of how the risk assessment approach was applied in Nepean River and South Creek.

Nepean River

Section 6.1.4 of Appendix G of the EIS presents the hydraulic modelling results for the Nepean River reach from Wallacia Weir to Warragamba River. This section is defined as a bedrock controlled gorge in the RiverStyles database (Table 19 of Appendix G) with a low sensitivity to change (Table 20 of Appendix G). Therefore, as defined in Table 11 of Appendix G, the likelihood of change is categorised as unlikely.

Consequence is an assessment of the likely impacts of any given change. Hydraulic changes in the reach between Wallacia Weir and Warragamba River (eg depth, velocity, shear stress) identified through hydraulic modelling are in a range where they would be imperceptible in the field and the consequence of these changes is therefore insignificant in terms of measurable geomorphic change. For instance, the modelled results for this reach show that for the 50 ML/day AWRC release scenario the water surface elevation change varies from +0.01 to +0.05 m, velocity changes are typically around 0.05 m/s with a higher increase of 0.25 m/s across a steep riffle section (<100m in length), and shear stress increase is typically < 1 N/m^2 except for the steep riffle section. These changes are insignificant as they would not result in any measurable geomorphic changes (ie they would not increase the sediment transport rate above the threshold for the bed or bank materials within this reach). Table 5-9 (taken from Appendix D in Appendix G of the EIS) provides an example of the shear stress thresholds required for sediment mobilisation. The modelled changes do not increase the shear stress above these threshold values for the relevant bed sediment in the reach.

Table 5-9 Sediment classification and indicative critical shear stress for erosion (based on Lagasse et al, 2012)

Sediment Classification	Particle Size Range	Critical Shear Stress (N/m^2)
Cobbles / Boulders	> 64 mm	> 20
Gravel	2 mm to 64 mm	1 to 20
Sand	0.065 mm to 2 mm	0.05 to 1
Silts	0.004 mm to 0.065 mm	Not defined
Clays	< 0.004 mm	Not defined

South Creek

The risk assessment for South Creek was based on a similar approach (ie likelihood of impacts as defined by the fragility index in the RiverStyles layer for the creek). However, consequence was based on the relative change in hydrologic metrics rather than specific hydraulic metrics. This approach was adopted because the AWRC releases only occur during wet weather conditions and are therefore combined with upstream and local stormwater inflows. The relative change in a series of hydrologic metrics was assessed for a wide range of baseline, background and impact scenarios. The consequence was then defined by the proportional change in metrics for the impact scenarios compared to the background conditions. The changes for each metric were then aggregated for the reach and the consequence rating assigned.

For example, the flow metrics for South Creek two kilometres downstream of the AWRC (see Table 29 in Appendix G of the EIS) show that there is limited change in conditions between baseline and impact scenarios. There is no generally agreed threshold for categorising the consequence and therefore the team used its expert interpretation of the data to assign a consequence category of moderate. This assumption was reviewed by the peer reviewers as part of the report in Appendix I of the EIS.

5.4.11 Ecohydrology and geomorphology - peer review report

Issue description

DPE BCD notes that peer reviewers and Sydney Water did not arrange a direct briefing with DPE EES to clarify concerns with DPE EES's water quality and flow-related objectives. Final objectives are now available and technical studies have been reviewed by independent experts and will be published in 2021. The main changes to the flow objectives are in the headings. DPE EES maintains that flow volumes for the current state should apply to the more sensitive creek types such as 1-2 order streams. This will achieve the post-development objectives as determined by DPE EES's modelling to derive associated stormwater management targets. The submission provides some further information about how flow objectives were derived. It also notes that water quality objectives are like the objectives already adopted by local government in the South Creek catchment.

Response

Sydney Water confirms that a meeting was not held with DPE EES to clarify concerns raised by independent experts on the waterway objectives. It also notes that DPE EES technical studies on these objectives were not available during preparation of the EIS and were not available at time of writing this Submissions Report. Although the independent peer review report in Appendix I noted concerns with some aspects of the objectives, Sydney Water incorporated DPE EES's water quality objectives for South Creek into the project's waterway objectives (section 8.4 of the EIS) and impacts were also reviewed against the flow objectives (Appendix G and K of the EIS).

5.4.12 Aquatic ecology – South Creek

Issue description

DPE BCD raises several comments on Appendix H of the EIS related to aquatic ecology. Table 5-10 addresses each of these issues.

Response

Table 5-10 Response to DPE BCD comments on the Aquatic Ecology Impact Assessment

Issue raised	Response
DPE BCD notes that the assessment is heavily reliant on the outputs of the models in Appendix F, G and K and has independently identified the difficulty in assessing the ecological impacts of the hydraulic changes in Nepean and Warragamba Rivers due to limitations of the models.	Sydney Water confirms that this is correct. Assumptions and limitations of the Aquatic Ecology Impact Assessment have been noted in Appendix E of Appendix H and section 8.2.3 of the EIS. Modelling inherently involves assumptions and limitations and Sydney Water sought expert peer review of the work (in Appendix I of the EIS) to verify the assessment approach taken was appropriate.
DPE BCD note that the impact assessment is informed by a significant amount of field data to establish the presence/absence of threatened species and good baseline assessment of current condition. Assessment of ecological changes from the two impact scenarios is limited to a qualitative discussion, mostly inferred from the changes to the ecosystem stressors (water quality and flows and habitat changes) which was based on the modelling. DPE BCD note that this approach is appropriate especially since stressor and ecological response relationships are well established in literature. DPE BCD is unable to determine whether overall conclusion that impacts are negligible or minor is correct due to the limited reporting on model performance.	Sydney Water notes DPE BCD supports the aquatic ecology assessment approach. Sydney Water has provided additional information on model performance as outlined in section 5.4.7.
The assessment has used DPE EES's new water quality objectives for comparing current water quality in the South Creek catchment. The comparisons need to be extended to the dissolved fractions of nutrients (not just total) where the data are available.	Section 8.5 of the EIS compared existing water quality at a number of sites in the South Creek catchment to ANZECC/ARMCANZ (2000) and DPE EES water quality objectives, including for oxidised nitrogen and ammonia. Median values of oxidised nitrogen exceeded the DPE EES guideline values at one site in South Creek upstream of the AWRC and one site in Kemps Creek. All median values of ammonia were below the DPE EES guideline value. In terms of predicted impacts, the Hydrodynamic and Water Quality Impact Assessment (Appendix F) modelled changes to total and dissolved fractions of nutrients. This included total nitrogen, oxidised nitrogen, ammonium, total phosphorus and filterable reactive phosphorus. Results for South Creek were compared to DPE EES's new water quality objectives.

Issue raised	Response
	Sections 6.1.4 and 6.1.5 of the Aquatic Ecology Impact Assessment considered the results from the modelling, including predicted changes to the indicators listed in the previous paragraph.
In regard to identifying threatened and other high ecological value ecosystems and species, it is recommended that this assessment be extended to include comment (and if relevant assessments) on sch 4 of the Water Sharing Plan for Greater Metropolitan Region Groundwater Sources 2011.	Schedule 4 of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 was reviewed as part of the Groundwater Impact Assessment (refer to section 9.4.3 of the EIS) and revisited in light on DPE EES comments. This identifies high priority groundwater dependent ecosystems, high priority endangered ecological communities and high priority karst environment groundwater dependent ecosystems. Table D in Schedule 4 lists high priority groundwater dependent ecosystems (GDEs). The ones closest to the project include Salt Pan Creek near Riverwood, Botany Wetlands, Long Swamp (20km west of Moss Vale), Longneck Lagoon (about 8km north-west of Windsor) and O'Hares Creek near Appin. None of these are in the vicinity of the project and impacts are therefore unlikely to occur. Table E in Schedule 4 lists high priority threatened ecological communities. Section 11.4 of the Biodiversity Development Assessment Report in Appendix J of the EIS (Biosis, 2021) assessed the project's potential impacts on GDEs including those listed under Table E. Three EECs which represent the surface expression of GDEs listed under the Water Sharing Plan were identified as being potentially impacted by the project: • Shale Gravel Transition Forest • River-flat Eucalypt Forest • Cumberland Forest Potential impacts were identified as disruption to surface water and groundwater connectivity and induced drawdowns as a result of dewatering excavations during construction. The assessment concluded that these impacts would be minor and temporary during construction only. With the recommended management measures in place no significant or ongoing impact to any GDEs are anticipated. Table F in Schedule 4 lists high priority karst environment groundwater dependent ecosystems, none of which are located in Sydney. Accordingly, impacts are unlikely to occur.

Issue raised	Response
The impact assessment needs to include a section on the timing of changes to the ambient flow regime and potential impacts on breeding, feeding and migration cycles of aquatic species.	Changes to the ambient flow regime will occur in Nepean River. Changes in Warragamba River will be consistent with the existing Warragamba Dam releases and in South Creek, releases will occur infrequently and only during wet weather. The Aquatic Ecology Impact Assessment assessed the potential impacts on breeding, feeding and migration cycles of aquatic species. Species that may be susceptible to changes in flow are those that migrate throughout the system, including Australian Bass (*Macquaria novemaculeata*) and.Macquarie Perch (*Macquaria australasica*). AWRC releases to the Nepean River will result in an increase to ambient flows. The regular pattern of releases from the AWRC will not interrupt seasonal flow variations such as winter freshes that trigger downstream Bass migration. Given the releases will not significantly increase velocity in Nepean River (particularly in the Penrith and Wallacia weir pools) this is also unlikely to affect Bass migration. The additional flow will likely raise water levels and increase depths in some areas of Nepean River which has potential to result in sub-optimal depths for some macroinvertebrate prey species. However, any increase in depth is predicted to be very localised and will be potentially offset by creation of additional shallow water habitats predicted by the modelled increase in wetted perimeter of some in-channel riffles and bars. With regards to breeding cycles, Australian Bass do not breed in freshwater, but migrate to estuarine waters to spawn. The project will not create permanent barriers to fish passage on Nepean River and South Creek. Management measure WW17 in Table 15-3 of the EIS commits to avoid open trenching waterways during Bass migration periods where practical. Management measures WW05 and WW14 also commit to undertaking waterway construction and restoration in accordance with by the Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013). A population of Macquarie Perch inhabits Erskine Creek and Glenbrook Creek. The treated water releases to Nepean River are not predicted to cause significant disruption to these waterways, albeit some more frequent inundation of the vegetated bar at the mouth of Glenbrook Creek is predicted to occur. It is therefore

Issue raised	Response
	unlikely the prey, migration or breeding cycles of this species will be impacted by the treated water releases.

5.4.13 Aquatic ecology - High Ecological Value Water Dependent Ecosystems mapping

Issue description

DPE EES has also released mapping of high ecological value waterways and water dependent ecosystems in Greater Sydney, and this mapping/GIS layer can be used as a diagnostic tool to help assess whether other values need to be considered in the assessment (see High Ecological Value Waterways and Water Dependent Ecosystems - Greater Sydney Region).

Response

Sydney Water reviewed DPE EES's High Ecological Value Water Dependent Ecosystems (HEV) mapping for each study area assessed by the Aquatic Ecology Impact Assessment, to determine if any further values need to be considered.

HEV data sets reviewed for this assessment include:

- High Ecological Values and Water Dependent Ecosystems – Camden LGA
- High Ecological Values and Water Dependent Ecosystems – Penrith LGA
- High Ecological Values and Water Dependent Ecosystems – Liverpool LGA
- High Ecological Values and Water Dependent Ecosystems – South Creek Catchment.

HEV mapping shows areas where waterways and water dependent ecosystems are defined as high ecological value, based on the definitions, guidelines and policies under the *Environment Protection and Biodiversity Conservation Act 1999*, *Biodiversity Conservation Act 2016*, *Fisheries Management Act 1994* and *Water Management Act 2000*.

HEV mapping also delineates areas of high ecological value which are subject to statutory protection (HEV 'protect') and areas where strategic prioritisation should be considered to restore and link existing patches of high value (HEV 'restore') With the exception of South Creek catchment, the individual values were not ground-truthed as part of this DPE EES HEV mapping. However, as part of the EIS, field validation of the existing environment was completed for the project's impact area.

HEV mapping is in one hectare hexagonal grids containing attributes including area, length and/or frequency of occurrence of high value water dependent ecosystems. The dataset integrates up to 28 data layers/indicators being used by the Government to define high value ecosystems. Appendix E shows HEV mapping in the study areas used in the EIS's Aquatic and Riparian Ecosystem Assessment. This mapping has been developed following the completion of the EIS.

Table 5-11 shows ground-truthed HEV values mapped in study areas 1-3 of the Aquatic and Riparian Ecosystem Assessment in Appendix H of the EIS. Table 5-12 shows non-ground-truthed HEV values mapped in study areas 2-6 of the Aquatic and Riparian Ecosystem Assessment in Appendix H of the EIS. Both tables also note where in the EIS these values were assessed, or where equivalent values were assessed using different methods. Sydney Water considers there are no additional values from the HEV mapping that need to be assessed.

Table 5-11 Ground-truthed HEV within project study areas

Value description from HEV mapping (ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
National Parks and Wildlife Service (NPWS) and Crown Land Estate dedicated to conservation	1	AWRC site	The AWRC site is not located on NPWS or Crown Land estate.
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: includes flora sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The Biodiversity Development Assessment Report (BDAR) in Appendix J of the EIS assesses impacts on this plant community type (PCT 835) and threatened flora.
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion: includes flora sightings (threatened, critically endangered, vulnerable)	2	Brine pipeline	The BDAR in Appendix J of the EIS assesses impacts on Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion (PCT 883) and threatened flora.
Groundwater Dependent Ecosystems reliant on sub-surface expression of groundwater	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on groundwater dependent ecosystems.
Groundwater Dependent Ecosystems reliant on surface expression of groundwater	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on groundwater dependent ecosystems.

Value description from HEV mapping (ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
Riparian vegetation: includes Local Environment Plan (LEP) riparian lands and watercourses and environmentally sensitive areas	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on riparian vegetation. Where other impacts are relevant in these areas (for example flooding, geomorphology, these are also addressed in a range of other studies in the EIS).
Wetlands, including farm dams: includes Environmental Planning Instrument—zoned wetlands	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on wetlands and farm dams.
Emergent vegetation bird foragers potential habitat: includes bird sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.
Large bird waders potential habitat: includes bird sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.
Open water bird foragers potential habitat: includes bird sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.
Riparian vegetation bird foragers potential habitat: includes bird sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.
Small bird waders potential habitat: includes bird sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.

Value description from HEV mapping (ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
Flying Fox potential habitat: includes bat sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on Grey-headed Flying Fox and bats, including information about sightings.
Microbats potential habitat: includes bat sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on microbats, including information about sightings.
Southern Myotis (Fishing Bat) potential habitat : includes bat sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on Southern Myotis, including information about sightings.
Ground and burrowing frogs potential habitat: includes frog sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on frogs, including information about sightings.
Tree frog potential habitat: includes frog sightings (threatened, critically endangered, vulnerable)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on frogs, including information about sightings.
Key Fish Habitat	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The Aquatic Ecology Assessment in Appendix H of the EIS assesses impacts on Key Fish Habitat.
Fish nativeness of moderate or higher	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The Aquatic Ecology Assessment in Appendix H of the EIS has completed a desktop impact assessment to native fish, including the Australian Bass and Macquarie Perch. This assessment also used fish data collected by Sydney Water.
Chain-of-ponds per River Styles	1	AWRC site	The Ecohydrology and Geomorphology Impact Assessment in Appendix G of the EIS assesses geormorphology impacts, including consideration of River Styles.

Value description from HEV mapping (ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
Recovery potential high/conservation per River Styles	1, 3	AWRC site, treated water pipeline	The Ecohydrology and Geomorphology Impact Assessment in Appendix G of the EIS assesses geomorphology impacts of the project, including considerations of River Styles.
Shannon-Weiner Index macroinvertebrate (biodiversity)	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	The Aquatic Ecology Assessment in Appendix H of the EIS assesses macroinvertebrate diversity and potential impacts on macroinvertebrates.
Fourth order or greater streams	1, 2, 3	AWRC site, brine pipeline, treated water pipeline	Several studies assess impacts on waterways impacted by the project, including fourth order or greater streams. This includes the Aquatic Ecology Impact Assessment (Appendix H of the EIS), Water Quality and Hydrodynamic Assessment (Appendix F of the EIS) and Ecohydrology and Geomorphology Impact Assessment (Appendix G of EIS).

Table 5-12 Non-ground-truthed HEV within project study areas

Value description from HEV mapping (non-ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
Freshwater fish community status	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	The Aquatic Ecology Impact Assessment in Appendix H of the EIS assesses freshwater fish community impacts.
Waterways located within protected areas	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	Several studies assess impacts on waterways impacted by the project, including those within protected areas. This includes the Aquatic Ecology Impact Assessment (Appendix H of the EIS), Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) and Ecohydrology and

Value description from HEV mapping (non-ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
			Geomorphology Impact Assessment (Appendix G of EIS).
Strahler streams located within protected areas	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	Several studies assess impacts on waterways impacted by the project, including Strahler streams within protected areas. This includes the Aquatic Ecology Impact Assessment (Appendix H of the EIS), Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) and Ecohydrology and Geomorphology Impact Assessment (Appendix G of EIS).
Stream geomorphic condition	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	The Ecohydrology and Geomorphology Impact Assessment in Appendix G of the EIS assesses geomorphology impacts of the project, including stream geomorphic condition.
Stream recovery potential	2, 3, 5, 6	Brine pipeline, treated water pipeline, Wallacia weir pool, Penrith weir pool	The Ecohydrology and Geomorphology Impact Assessment in Appendix G of the EIS assesses geomorphology impacts of the project, including stream recovery potential.
Strahler stream order	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	Several studies assess impacts on waterways impacted by the project, including Strahler streams within protected areas. This includes the Aquatic Ecology Impact Assessment (Appendix H of the EIS), Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) and Ecohydrology and Geomorphology Impact Assessment (Appendix G of EIS).

Value description from HEV mapping (non-ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
River Condition Index	3, 4, 5, 6	Treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	The River Condition Index is an Ausrivers classification metric. The Rapid Riparian Appraisal (RRA) field assessment in the Aquatic Ecology Impact Assessment (Appendix H of the EIS) was applied to assess riparian vegetation and creek channel condition.
Groundwater Dependent Ecosystems (surface)	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on groundwater dependent ecosystems.
Groundwater Dependent Ecosystems (subsurface)	2, 3, 4, 5, 6	Brine pipeline, treated water pipeline, release locations, Wallacia weir pool, Penrith weir pool	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on groundwater dependent ecosystems.
Water dependent threatened or migratory bird sightings	2, 5, 6	Brine pipeline, Wallacia weir pool, Penrith weir pool	The BDAR in Appendix J of the EIS assesses impacts on bird habitat, including information about bird sightings.
Water dependent threatened fauna sightings	2, 3, 5, 6	Brine pipeline, treated water pipeline, Wallacia weir pool, Penrith weir pool	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on threatened fauna, including information about sightings.
Threatened Fish species distribution—Macquarie Perch	3, 4, 6	Treated water pipeline, release locations, Penrith weir pool	The Aquatic Ecology Assessment in Appendix H of the EIS assesses impacts on Macquarie Perch.
Riparian lands, watercourses and vulnerable lands	2, 6	Brine pipeline, Penrith weir pool	The BDAR in Appendix J of the EIS and Aquatic Ecology Impact Assessment in Appendix H of the EIS assess impacts on riparian lands and watercourses. Where other impacts are relevant in these areas (for example flooding, geomorphology, these are also addressed in a range of other studies in the EIS).

Value description from HEV mapping (non-ground-truthed areas)	Study area	Relevant infrastructure	Where addressed in EIS
Coastal wetland area	2, 3	Brine pipeline, treated water pipeline	The BDAR in Appendix J of the EIS assesses impacts on coastal wetlands.

5.4.14 Hydrodynamics and water quality - EIS Executive Summary

Issue description

DPE BCD provides several comments on the EIS Executive Summary:

- Table ES1 needs to include data on drainage areas to permit comparisons with objectives. Maximum releases to South Creek are expected to be up to 59 ML/day during wet weather. If divided by drainage of area of AWRC site the volume is 0.8 ML/ha/day.
- Some conclusions in the Executive Summary appear to have watered down findings of specific impact assessments (eg construction impacts on waterway crossings which says standard management measures and Appendix H identified extensive management measures).

Response

Table ES1 of the Executive Summary provides an overview of the AWRC operational flow releases to the Nepean and Warragamba Rivers and South Creek under different weather conditions. During severe wet weather up to 59 ML/day of advanced treated water would be released to South Creek. Maximum operational releases to South Creek would be higher than 59 ML/day once flows reach above three times average dry weather flow (ADWF). At this point, wet weather treated water will also be released to South Creek. Sydney Water notes that these are releases of wastewater collected from the wastewater network and are not from the drainage area of the AWRC site. It is therefore not appropriate to divide the operational release volumes by the area of the AWRC site.

Section 8.7.2 of the EIS includes a comparison of modelled baseline, background and impact scenarios to the DPE flow objectives. These scenarios represent a range of conditions in the catchment based on hydrological modelling. Hydrological metrics, including those detailed in DPE EES's flow objectives, were extracted from locations throughout the South Creek catchment, including a site immediately downstream of the AWRC site. By comparing the results between background and impact scenarios any changes to these metrics associated with the AWRC releases can be determined. As the analysis is based on flows in South Creek it is appropriate to use the catchment area of South Creek upstream of the analysis site when translating the hydrologic metrics to the units used in the flow objectives. The operational releases from the AWRC site are not considered independently and therefore were not compared to the flow objectives directly. It is the AWRC site area plus the associated upstream catchment of South Creek that contributes to the streamflow received in the channel that is of interest.

By its nature, the executive summary of the EIS provides a brief overview of the impacts identified in the main body the EIS. The focus is on a high level summary of key findings, rather than specific details about impact assessments and management measures. A full description of the potential impacts, and management measures, is provided in Volume 3 of the EIS and supported by the specialist studies included in the appendices. Sydney Water maintains that impacts described in the executive summary and Volume 3 provide an accurate representation of the specialist studies. For example, management measures included in Appendix H (as referenced by DPE BCD) have been adopted, with the exception of monitoring of benthic diatoms and calculation of associated biotic indices. This was not adopted as impacts to aquatic ecology can be assessed via monitoring of macrophytes, macroinvertebrates and fish, a standard and well established Sydney Water practice.

5.4.15 Hydrodyamics and water quality - review by others

Issue description

DPE BCD notes an assumption that the EIS has also been provided to other relevant parts of NSW Government and that comments are limited to AWRC impacts in the Wianamatta-South Creek catchment.

Response

Sydney Water contacted the government agencies consulted during EIS preparation to let them know the EIS was on exhibition. Sydney Water understands that DPE also contacted a range of government agencies seeking their comments on the EIS.

5.4.16 Hydrodynamics and water quality - general comments on impact assessment

Issue description

DPE BCD provides several comments on Volume 3 Part 1 of the EIS:

- This volume would benefit from a clearer narrative for various sections.
- Numerical values and headers in Table 8-5 need to be replaced with updated waterway objectives.

Response

Sydney Water notes DPE BCD’s comment that Volume 3 Part 1 of the EIS would benefit from a clearer narrative in various sections. However, without more specific details about the sections to which DPE BCD is referring, Sydney Water cannot provide any additional clarity here.

Table 8-5 from the EIS has been replicated and updated in Table 5-13. Changes are shown in orange text. These changes have been considered in section 5.4.9 and 5.4.17.

Table 5-13 Updated Wianamatta – South Creek waterway health (flow) objectives

Flow variable	Description[1]	Unit	Performance Criteria	
			Pre-development	Post-development
Median Daily Flow Volume	Volumetric flow rate (runoff) per unit area (catchment response to rainfall).	L/ha/day	71.8 ± 22.0	1096.0 ± 157.3
Mean Daily Flow Volume	Volumetric flow rate (runoff) per unit area (catchment response to rainfall).	L/ha/day	2351.1 ± 604.6	5542.2 ± 320.9
High Spell ≥ 90^{th} Percentile Flow Volume	High spell flow days have been defined in the objectives as the top ten percent of days with the highest flows.	L/ha/day	2048.4 ± 739.2	10,091.7 ± 769.7
High Spell – Frequency High Spell – Average duration	Number of high spell events (flow conditions defined above) that occur in a year. Number of days during which a high spell event occurs in a year.	Number/yr Days/yr	6.8 ± 0.6 6.3 ± 0.6	19.1 ± 1.0 2.2 ± 0.2
Freshes ≥ 75^{th} and ≤ 90^{th} Percentile Flow Volume	Freshes are defined as the days when the flow exceeds the 75th percentile flow rate (or the top 25% of flows) but excludes the high spell flow conditions (>90^{th} percentile values). These flows are more than the median flows but less than high flows.	L/ha/day	327.1 to 2048.4	2642.9 to 10091.7
Freshes – Frequency Freshes – Average Duration	Number of freshes events (flow conditions as defined above) that occur each year. Average number of days in a year during which freshes event occur.	Number/yr Days/yr	2.8 ± 0.5 3.2 ± 0.8	8.9 ± 0.4 1.3 ± 0.1

Flow variable	Description[1]	Unit	Performance Criteria	
Cease to Flow	The proportion of time per year that zero flows occur in the waterway.	Proportion of time/yr	0.34 ± 0.05	0.03 ± 0.01
Cease to Flow – Duration	Number of days per year that zero flows occur in a year.	Days/yr	39.2 ± 8	3.9 ± 1.2
Baseflow Index			0.13 ± 0.02	0.30 ± 0.02

Notes on table:

1. Description not provided in objectives but included to explain Sydney Water's interpretation.

5.4.17 Surface water and aquatic ecology – construction management measures

Issue description

DPE BCD raises several issues on construction management measures. Table 5-14 responds to each of these.

Response

Table 5-14 Response to DPE BCD comments on construction management measures

Issue raised	Response
DPE BCD notes that it assumes that the construction and water management plans will focus on impacts to loss of habitats, shallow aquifers, interactions with soil salinity, sodicity and contaminants.	Sydney Water commits to a range of management measures in Table 15-3 of the EIS to effectively manage impacts to surface water, soils and contaminated land, biodiversity and groundwater during construction. These measures will be included in a Soil and Water Management Plan and a Biodiversity Management Plan as part of the project's Construction Environmental Management Plan (CEMP).
DPE BCD recommends that Sydney Water revisit standard sediment and erosion control measures in EIS in context of on-ground practice. For example, the EIS refers to the Blue Book which is 20 years old and there are current efforts in place to strengthen provisions. The submission refers to the Mamre Road Precinct Development Control Plan (DCP) and the draft Western Sydney Aerotropolis Development Control Plan – Phase 2 (Phase 2 DCP) which requires compliance with construction phase targets, high efficiency basins and certified practitioners. DPE BCD recommends that the impact assessment be extended to demonstrate how these targets are achieved during the construction phase.	Given the AWRC site is located in the Aerotropolis, Sydney Water considers that the Phase 2 DCP is most relevant to the project. At the time of writing, the Phase 2 DCP remains in draft. However, the assessment below considers the construction stormwater targets in that document. Sydney Water also notes that the Mamre Road Precinct DCP was finalised during public exhibition of the EIS. Sydney Water considers the relevant measures in the draft Phase 2 DCP are PO1 in section 4.3.2 (stormwater management and water sensitive urban design) and PO1-PO5 in section 9.6.2 (erosion and sediment control). **PO1 in section 4.3.2** The project's reference design includes detention basins on the north and south west boundary of the AWRC (shown in Figure 7-3 in Appendix K of the EIS). The assessment in Appendix K demonstrated that areas proposed for future detention could also have sufficient capacity for basins to manage sediment laden runoff during construction. Sydney Water has undertaken additional assessment that considers the construction phase stormwater quality targets from the draft Phase 2 DCP. The results from the assessment are shown

Issue raised	Response
	in Table 3 in Appendix F of this report and indicate that the proposed detention basins can be configured meet the target basin volume of 196 m^3/ha required for high efficiency sedimentation basin types during construction. The assessment shows the basins can achieve the target of 50 mg/L of total suspended solids for at least 80% of the average annual runoff volume from construction areas and demonstrates construction phase stormwater quality targets are met. This means the potential impact to water quality in South Creek associated with sediment laden surface water runoff from the AWRC during construction can be effectively managed and DPE EES's Wianamatta South Creek water quality and flow objectives can be achieved. The construction phase target for managing the release of oil, contaminants and waste will be met by management measure SW06 in Table 15-3 of the EIS which commits to the storage of chemicals and oils in appropriately bunded areas and management measure G06 which commits to ensuring waste storage and equipment areas are away from drainage pathways. The construction phase target for managing the stabilisation of all site surfaces will be met by management measure SW03 in Table 15-3 of the EIS which requires the progressive construction of stormwater management facilities to ensure all stormwater management facilities and drainage systems are installed. Management measure G05 commits to the rehabilitation of pipeline worksites and management measure UD01 commits to the preparation and implementation of an Urban Design and Landscaping Plan for the AWRC site which will stabilise the area. **PO1-PO5 in section 9.6.2** Sydney Water has updated management measure SW05 in Appendix B to refer to these construction phase erosion and sediment control outcomes in the draft Phase 2 DCP. This includes the preparation of an erosion and sediment control plan by a Certified Professional in Erosion and Sediment

Issue raised	Response
	Control. SW05 will be incorporated into the project's Soil and Water Management Plan.
DPE BCD notes that impacts of construction of pipelines across waterways and through shallow aquifers must be revisited, with engineering works and methods of construction agreed by suitably qualified experts in consultation with relevant state and local authorities.	Pipeline crossings of waterways will avoid and minimise impacts by tunnelling where practical, however some crossings will be constructed by open trenching across the waterway. Determining the construction methodology across waterways includes balancing considerations such as environmental constraints, waterway size and flow, geotechnical conditions and cost. Approaches to trenching and tunnelling construction across waterways are detailed in Chapter 4 of the EIS. Sydney Water engaged expert consultants to assess the impacts of pipeline construction, including across waterways and through aquifers. The results of these assessments are included in a range of reports in the EIS including ecohydrology and geomorphology (Appendix G), surface water (Appendix K), aquatic ecology (Appendix H), and groundwater (Appendix M). Table 15-3 of the EIS and Appendix B of this report include a range of management measures to minimise impacts on these matters during construction. These include measures relating to design, construction, consultation, and following relevant government guidelines. Sydney Water uses qualified experts to design and build its infrastructure. Several management measures in Table 15-3 of the EIS relate to seeking input from specific qualified experts where appropriate. This includes management measure WW01 seeking input from a geomorphologist on waterway crossings.
DPE BCD notes that the Appendix H Aquatic and Riparian Ecosystem Assessment identified a high potential risk of habitat and species loss as a result of construction of pipelines and stormwater control measures at the AWRC site. The assessment identifies mitigation measures that are supported by DPE EES, with exception of construction phase recommendations related to sediment and erosion control which state standard methods are adequate.	As noted above, Sydney Water has updated management measure SW05 in Appendix B to refer to the construction phase erosion and sediment control outcomes in the draft Phase 2 DCP.

5.4.18 Surface water – modelling and assessment approach

Issue description

DPE BCD notes several comments relating to the surface water assessment in Appendix K in the EIS. Table 5-15 responds to each of these issues.

Response

Table 5-15 Response to DPE BCD comments on the Surface Water Impact Assessment

Issue raised	Response
DPE BCD notes Sydney Water has not used the stormwater targets or MUSIC modelling toolkit provided to the consultant for managing stormwater quality and flows in South Creek. For this reason, surface water assessment and other relevant assessments dependent on it cannot be supported by DPE BCD at this stage. This toolkit is being provided to State significant development applications and DPE BCD maintains there should be no exception for Sydney Water. DPE BCD notes that Sydney Water's MUSIC modelling for the stormwater assessment was based on an uncalibrated model, with rainfall-runoff parameters different from those specified in DPE EES's MUSIC modelling toolkit. It should be noted DPE EES provided this toolkit to Sydney Water in preparation of this EIS. The differences in model parameters means that it is difficult to determine whether the assessment represents compliance with DPE EES's objectives. It is strongly recommended that the assessment be revised using the rainfall runoff parameters in the toolkit, and the parameters for water sensitive urban design (WSUD) treatment nodes specified in DPE EES's draft technical guide for achieving the objectives. Sydney Water was provided access to the draft technical guide during preparation of this EIS.	DPE EES's MUSIC modelling toolkit was not provided to Sydney Water until after the project SEARs were issued and the surface water impact assessment in Appendix K of the EIS was prepared. The assessment described in section 9.2 and Appendix K of the EIS is based on guidelines received from DPE BCD in October 2020. The assessment in Appendix K used MUSIC to model the performance of stormwater management measures, by developing flow metrics from modelled results and comparing these against the objectives described in Table 7-3 of Appendix K. Sydney Water has undertaken additional assessment using DPE EES's calibrated MUSIC modelling toolkit and DPE EES's draft technical guide to assess the performance of stormwater management measures described in Appendix K. This additional assessment is included in Appendix F of this report which demonstrates compliance with operational targets to achieve DPE EES's waterway objectives.
DPE BCD recommends that compliance assessment be revised to demonstrate compliance with DPE EES's stormwater flow targets in the Mamre Road Precinct DCP and draft Phase 2 DCP. DPE BCD notes that compliance with the stormwater flow targets, especially 95%ile will help manage erosive flows more effectively than the	Given the AWRC site is located in the Aerotropolis, Sydney Water considers that the draft Phase 2 DCP is most relevant to the project. At the time of writing, the Phase 2 DCP remains in draft. However, the assessment below considers the stormwater targets in that document. Sydney Water also notes that the Mamre Road Precinct DCP was finalised during public exhibition of the EIS.

Issue raised	Response
specified stream erosion index of 3.5 (shown in Tables 7-5, 7-6).	Sydney Water completed additional assessment in Appendix F to compare stormwater performance at the AWRC site (Figure 7-3 in Appendix K of the EIS) with DPE EES's stormwater flow targets in the draft Phase 2 DCP. The modelled results show that: • daily flows of 5,871 L/d/ha occur 95% of the time, demonstrating the 95%ile 3,000-15,000 L/d/ha target range is met • the 10%ile, 50%ile, and 75%ile flow duration and cease to flow targets are also met. The modelled results indicate that the potential impact of erosive flows associated with surface water runoff from the AWRC can be effectively managed and DPE EES's healthy waterway flow objectives can be achieved. Sydney Water considers that this additional assessment confirms the conclusions of the assessment described in Appendix K of the EIS.
DPE BCD recommends that compliance assessment be revised to demonstrate compliance with DPE EES's stormwater water quality objectives, in the Mamre Road Precinct DCP and the draft Phase 2 DCP. DPE BCD notes that compliance with DPE EES water quality objectives should be based on achieving the DPE EES pollution load reduction targets. Results in Appendix K indicate Gross Pollutant and total nitrogen load reductions achieved at the AWRC site comply with respective DPE EES targets. The total suspended solids and total phosphorus load reduction targets at the site do not comply.	Given Aerotropolis DCP pollution load reduction targets were not finalised during preparation of the EIS, Sydney Water demonstrated compliance of the AWRC site with Penrith City Council pollution load reduction targets. The additional assessment in Appendix F models the AWRC site against the DPE EES pollution load reduction targets (Appendix F) in the draft Phase 2 DCP. The modelled results demonstrate compliance with these targets by: • 93% load reduction in total suspended solids (TSS kg/yr) • 81% load reduction in total phosphorus (TP kg/yr) • 65% load reduction in total nitrogen (TN kg/yr). The results mean that the potential impact to water quality in South Creek associated with surface water runoff from the AWRC can be effectively managed and DPE EES's Wianamatta South Creek water quality objectives can be achieved.

Issue raised	Response
DPE BCD makes various comments about reflecting the updated waterway objectives: • Headers for Table 7-3 need to be updated to be consistent with those shown in this submission under Appendix I comments. • Also note changes to frequency and duration of various flow metrics, which affect the comparisons with the freshes. • Replace Table 2-2 in the Low Flow and Water Quality Assessment with the final DPE EES flow objectives provided in this submission in Appendix I comments.	The additional assessment in Appendix F uses the updated version of DPE EES's waterway objectives. Sydney Water has updated management measure SW02 in Appendix B to refer to the stormwater flow and quality targets within the draft Phase 2 DCP.
DPE BCD notes that Tables 4-3, 4-4 in the Low Flow and Water Quality Assessment are empty.	Tables 4-3 and 4-4 of the low flow and water quality assessment are Stream Erosion Index results. These are included as Table 5-16 and Table 5-17 below but the additional assessment in Appendix F now supersedes these.

Table 5-16 Table 4-3 from Appendix K in the EIS

Parameter	Volume Exceeding $Q_2/2$	Stream Erosion Index	Penrith Council target	Penrith Council Target Met
Reference design	9.4	1.4	SEI < 3.5	Yes
Pre-development / Rural	6.7			

Table 5-17 Table 4-4 from Appendix K in the EIS

Parameter	Volume Exceeding $Q_2/2$	Stream Erosion Index	Penrith Council target	Penrith Council Target Met
Reference design	14.8	1.6	SEI < 3.5	Yes
Pre-development / Rural	9.5			

5.4.19 Surface water – impacts of irrigation on salinity

Issue description

DPE BCD recommends that a soil and salinity assessment be undertaken to confirm that the impact of irrigation rates on salinity at the AWRC site is low, as specified in the Surface Water Impact Assessment in Appendix K of the EIS.

Response

The Soils and Contamination Impact Assessment (Appendix N) and section 9.5 of the EIS detail the intrusive investigation undertaken at the AWRC site. This included laboratory analysis of soil samples for salinity and sodicity. The assessment concluded that the upper layers (0.5 m below ground level) of soil at the site were not saline. However, the Groundwater Impact Assessment (Appendix M) and section 9.4 of the EIS indicated that the groundwater at the AWRC site is expected to be saline. Section 7.1.2 in Appendix M of the EIS indicates the potential for localised increased groundwater recharge from irrigation. This means that groundwater levels may increase salinity within the soils at the AWRC site. To manage this potential impact, the Surface Water Impact Assessment (Appendix K) and section 9.2 of the EIS recommends an irrigation rate of 4.5 ML/year which is the deficit between local rainfall and potential evapotranspiration, to minimise the potential for localised increases in groundwater levels.

Management measure UD01 in Table 15-3 of the EIS commits to an Urban Design and Landscaping Plan for the AWRC site, including the green space area. Irrigation requirements for the green space area will need to consider the operational landscape design including soil and vegetation conditions established under this plan. Management measure SW04 in Table 15-3 of the EIS commits to the development and implementation of an irrigation procedure that will be tailored to suit the ultimate landscape and site design. These measures will ensure the impact significance of irrigation rates on salinity at the AWRC site will be low.

5.4.20 Hydrodynamics and water quality, socio-economics and World and National heritage – general interest

Issue description

DPE BCD (National Parks and Wildlife Service - NPWS) notes a strong interest in the proposal given the pipeline alignment traverses south of Western Sydney Regional Park, north of Kemps Creek Nature Reserve and north of lands acquired under the *National Parks and Wildlife Act 1974* (NPW Act) for future reservation. The environmental flows pipeline and water release area is close to Blue Mountains National Park and north of Burragorang State Conservation Area. Changes to water levels, flows and water quality along the Nepean River as a result of the proposal have the potential to impact Blue Mountains National Park.

The submission also notes that the matters raised for the Blue Mountains area apply to the Blue Mountains National Park and the Greater Blue Mountains World Heritage Area given their boundaries largely overlap.

Response

Sydney Water notes National Parks and Wildlife Service's interest in the project. Section 5.4 addresses specific issues raised in the submission.

5.4.21 Hydrodynamics and water quality - alignment with Strategic Plan

Issue description

NPWS notes anomalies in modelling and coarseness of data available. It notes if the EIS is relying on modelling for flows and nutrient load levels, an increased effort to determine potential flows and nutrient loads (across spatial, temporal and climate scenarios) entering the Greater Blue Mountains Area (GBMA) would be recommended to ensure proposal aligns with Management Response 2.4 (p28 of Greater Blue Mountains World Heritage Area (GBMWHA) Strategic Plan) which requires the precautionary principle to be applied where there is doubt about any potential impacts of an action on World Heritage values.

Response

Sydney Water has completed complex and industry best practice modelling in Chapter 8 and Appendix F of the EIS, to assess potential flows and nutrient loads from the project, including the stretch of Nepean River that runs through the GBMA. This modelling provides a robust assessment of the relative impacts of the AWRC release, verified by independent peer review in Appendix I of the EIS. For brevity and commentary purposes, only a selection of results were presented in the main body of the Hydrodynamic and Water Quality Impact Assessment report, with a complete set of results provided in Appendix D for representative scenarios. Complete sets of results for all the scenarios were issued to DPE in December 2021.

The modelling results have been used to inform the assessment of the project's impact on World Heritage values in section 10.3 and Appendix Q of the EIS. Sydney Water has committed to supplementing the modelling with a comprehensive water quality monitoring program to verify impacts, as outlined in Table 15-4 of the EIS and Appendix B of this report.

The modelling predicts that AWRC releases will have an overall positive impact on the stretch of Nepean River that runs through the GBMA. Additional analysis relating to the flows and nutrient loads entering the GBMA is presented below.

The EIS presents results for a series of eight analysis points located throughout the Hawkesbury Nepean River system as shown in Figure 5-1 below. With respect to the GBMA, two of the Nepean River analysis sites are considered to be representative. These are Warragamba River confluence (referred to as DS Warragamba Rivulet in Appendix F) and 14 km downstream (referred to as DS 14 km in Appendix F). The Warragamba River confluence site is in the immediate vicinity of the upstream boundary of the GBMA, and the 14 km downstream site is located within the gorge reach of the GBMA. The focus of this additional analysis is the Warragamba River confluence as the model results are representative of 'flow and loads entering the GBMA'.

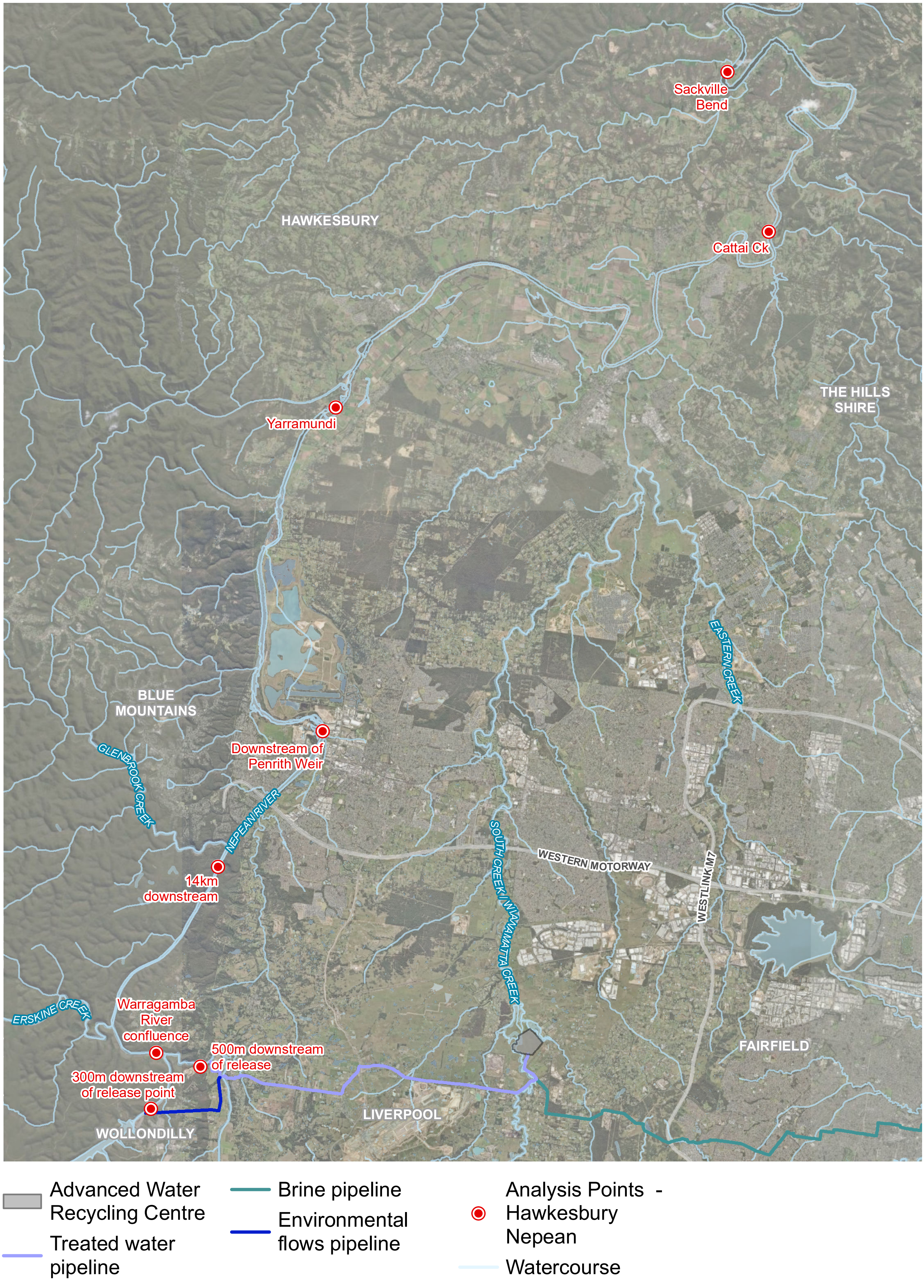


Figure 5-1 Analysis sites for reporting timeseries and box plot results on the Hawkesbury Nepean River

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

Figure 5-2 presents the predicted timeseries of daily flow entering the GBMA (at the Warragamba River confluence site), with Figure 5-3 presenting the lower 'base flows' predicted during dry weather. Figure 5-4 presents the predicted loads of total nitrogen entering the GBMA, with Figure 5-5 focusing on the base flow loads. Similarly, Figure 5-7 presents the predicted total phosphorus loads, with Figure 5-8 focusing on the base flow loads.

From these results, flows near the upstream boundary of the GBMA are predicted to increase by an average of about 25%. In line with existing environmental flow strategies for the river, such increases in the flow regime have potential environmental benefits by counteracting the presence of the upstream weirs and dams, and significant levels of water demand. Treated water releases may therefore have the following benefits in the GBMA:

- Protection of aquatic ecosystems and reduction of aquatic weeds and frequency of algal blooms.
- Improvement in river health including conditions for native fauna and river-dependent plants that rely on different flows to trigger migration and breeding.
- Protection of river condition for recreation such as boating and swimming.

Daily loads of total nitrogen entering the GBMA are predicted to increase by an average of about 20% over the two years analysed. These increases in load are generally driven by the additional flows and not increases in concentration. Therefore, despite the increase in loads, the concentrations of total nitrogen (TN) are predicted to reduce as presented in Figure 5-6. As discussed in section 6.1.2.5.3 of the Hydrodynamic and Water Quality Impact Assessment report, these reductions are due to increased dilution of the river water with the lower concentrations of the advanced treated water from the AWRC being released into the Wallacia Weir pool, and then overflowing downstream.

Similar patterns are exhibited for the inorganic fractions of nitrogen, however as discussed in section 6.1.2.5.3 of the Hydrodynamic and Water Quality Impact Assessment report, concentrations are predicted to be similar to, or marginally elevated relative to, the background conditions.

Daily loads of total phosphorus (TP) entering the GBMA are predicted to increase by an average of about 7% over the two years analysed. Concentrations are predicted to be reduced within the GBMA for both total phosphorus and filterable reactive phosphorus, due to the increased dilution of the river water with the lower concentrations of advanced treated water from the AWRC being released upstream.

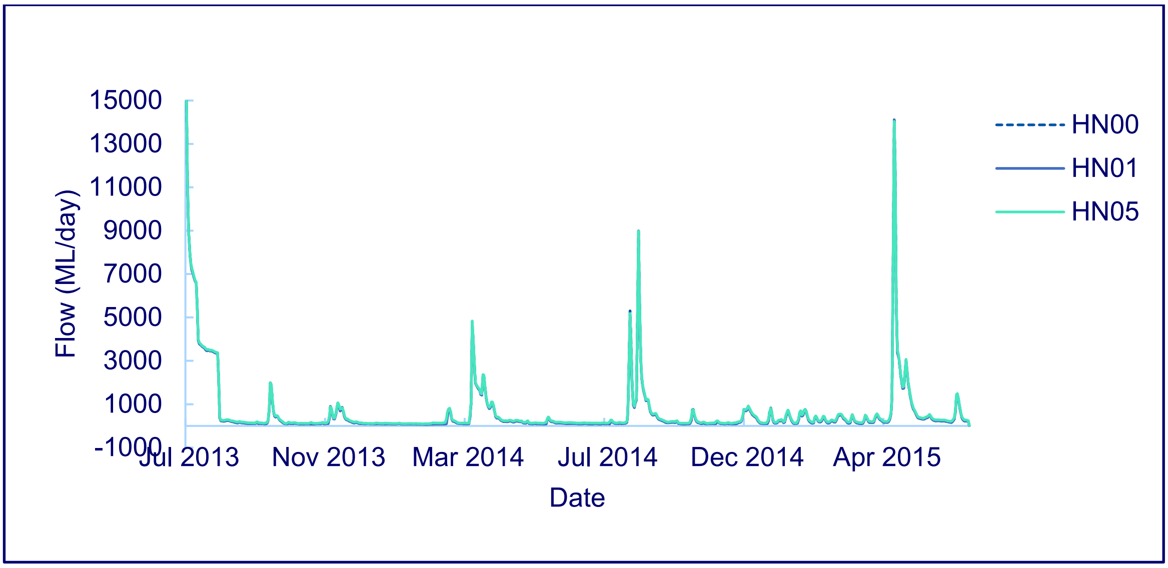


Figure 5-2 Timeseries of predicted daily flows entering the GBMA (2036 releases/dry and wet years)

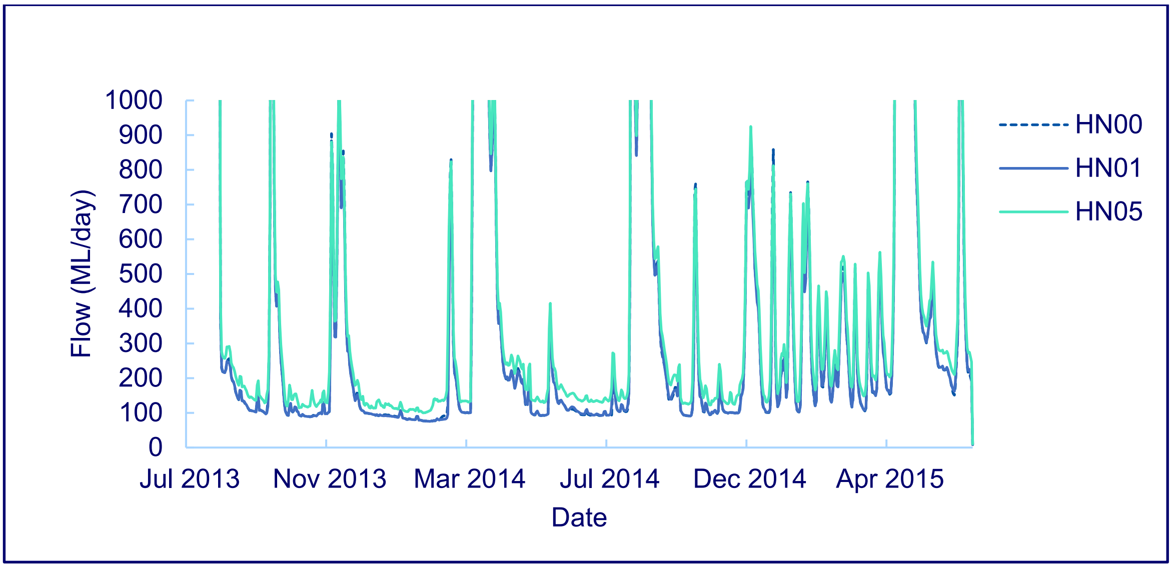


Figure 5-3 Timeseries of predicted daily base flows entering the GBMA (2036 releases/wet year)

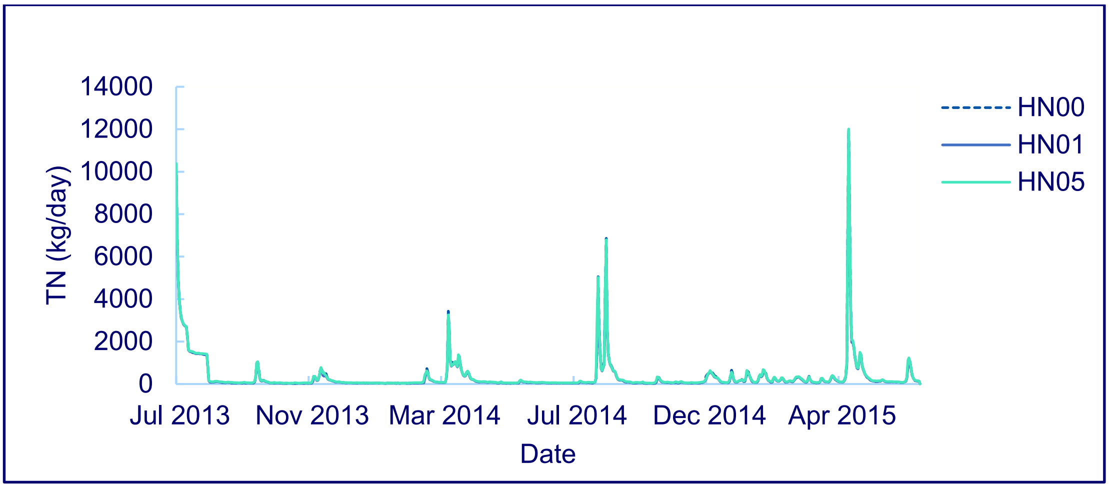


Figure 5-4 Timeseries of predicted daily loads of TN entering the GBMA (2036 releases/dry and wet years)

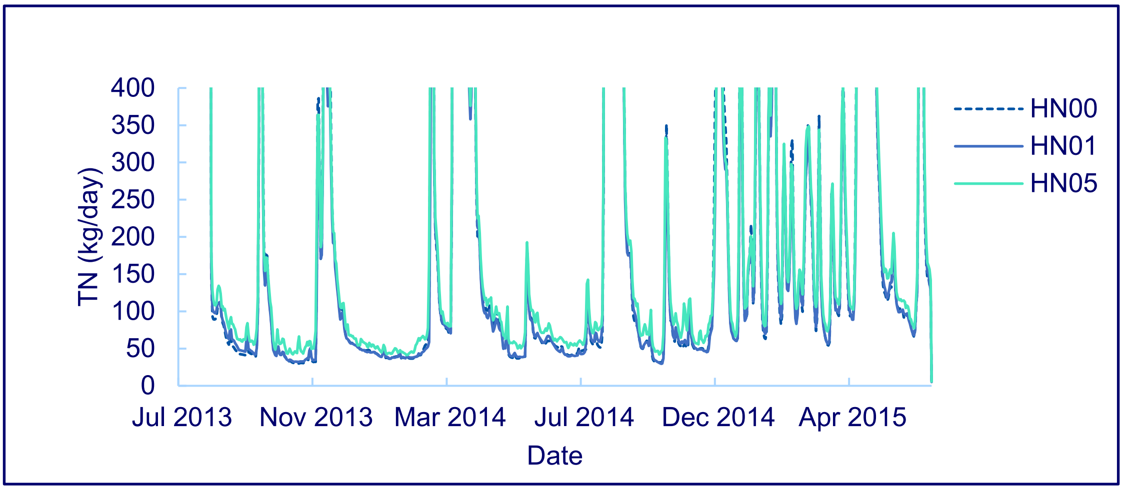


Figure 5-5 Timeseries of predicted daily base flow loads of TN entering the GBMA (2036 releases/dry and wet years)

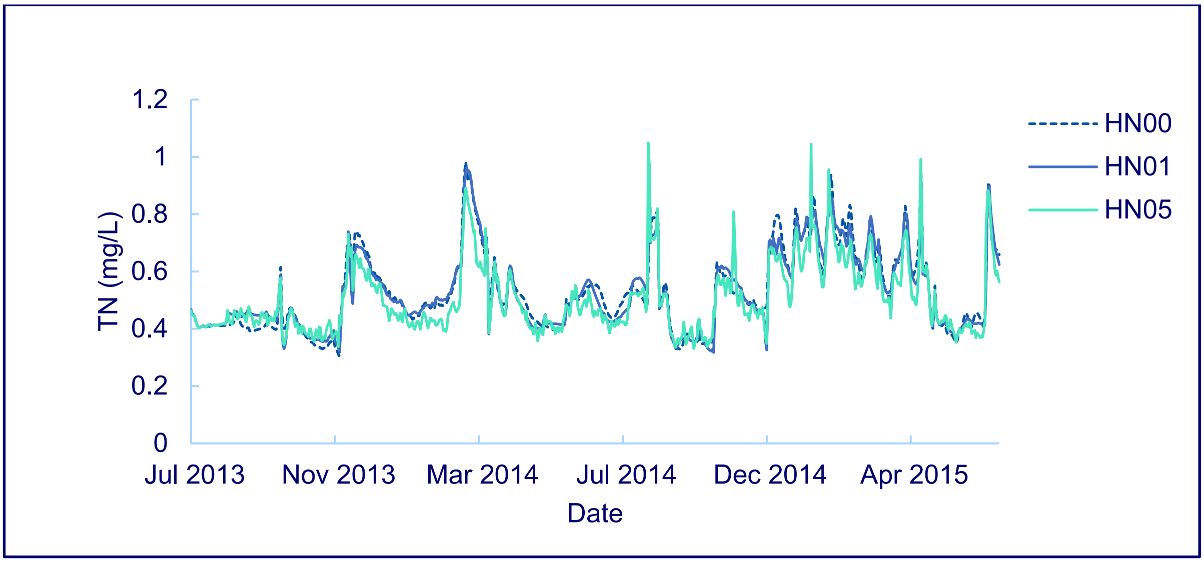


Figure 5-6 Timeseries of predicted TN concentrations entering the GBMA (2036 releases/dry and wet years)

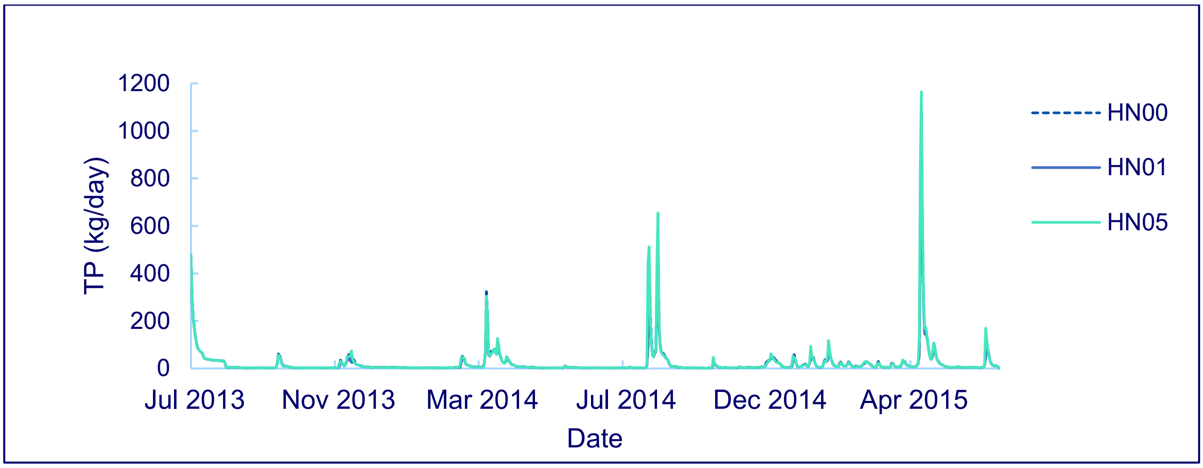


Figure 5-7 Timeseries of predicted daily loads of TP entering the GBMA (2036 releases/dry and wet years)

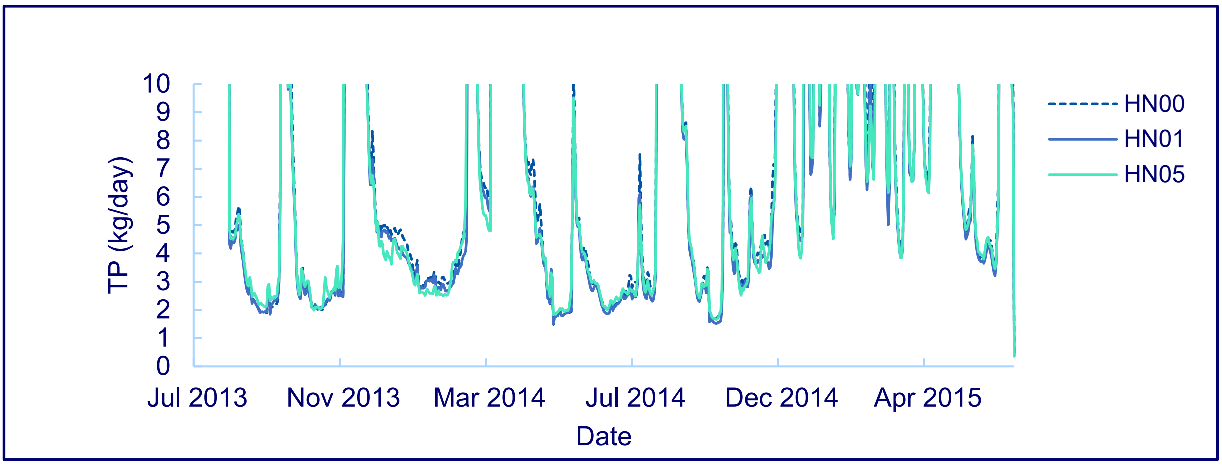


Figure 5-8 Timeseries of predicted daily base flow loads of TP entering the GBMA (2036 releases/dry and wet years)

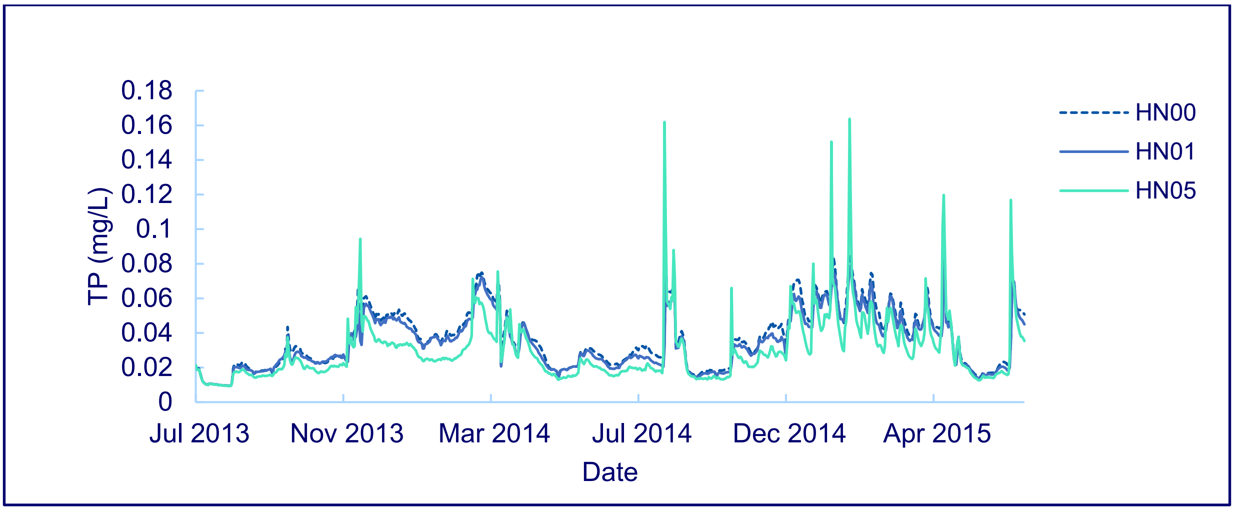


Figure 5-9 Timeseries of predicted TP concentrations entering the GBMA (2036 releases/dry and wet years)

5.4.22 Hydrodynamics and water quality - climate change impacts

Issue description

NPWS notes that the assessment of water quality in Appendix Q identifies higher concentrations of nutrients in more severe wet weather, due to higher content of tertiary treated water. Higher concentration of nutrients will impact aquatic and riparian species, part of the outstanding universal value (OUV) of the World Heritage property. There are predicted to be more severe wet weather events resulting from climate change, but assessment of climate change impacts appears to have been limited to a section on climate change in Chapter 12 of the EIS. Given size and complexity of the EIS, a section on how climate change would exacerbate risks to each consideration might also be appropriate in the assessment of each factor (eg World Heritage) to make it easier to understand how these processes would interact.

Response

The higher concentrations of nutrients in wet weather flows are short-lived and do not persist for long at a given site, or downstream of the release location. This is because before and after the wet weather releases the concentrations are generally improved relative to baseline. As the mixing processes are quick, the short spike of high nutrients is quickly mixed. This is demonstrated by comparison of the impact scenario HN06 (the green line) and the background scenario HN02 (the blue line) in Figure 5-10 and Figure 5-11. Scenario HN06 represents the 2056 (100 ML/day) under low loading from other WWTP/Water Recycling Plant (WRP) sources (refer section 4.6.3 of the Hydrodynamic and Water Quality Impact Scenario).

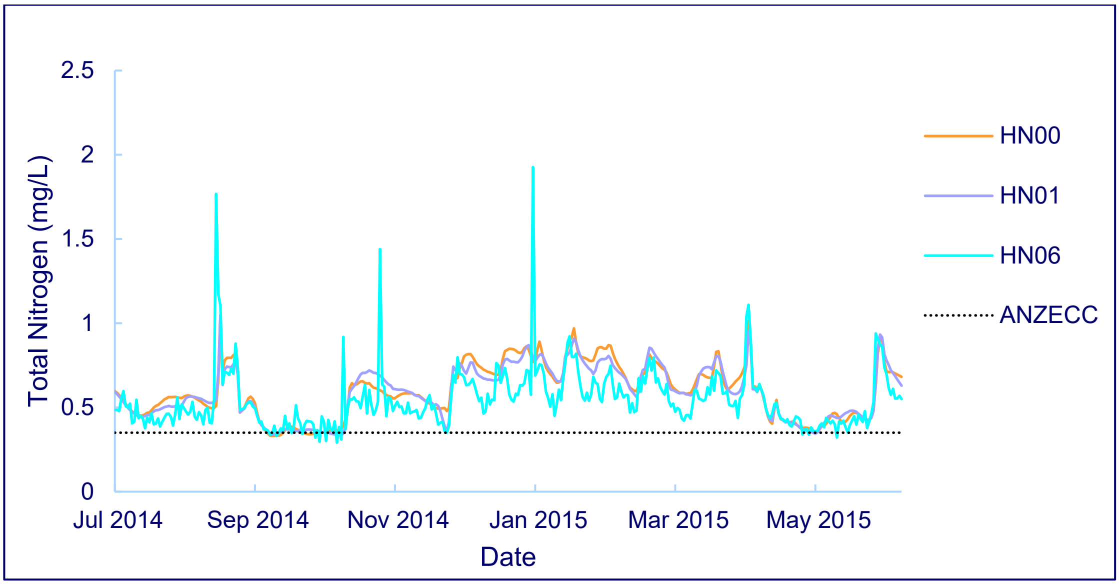


Figure 5-10 Timeseries of predicted TN concentrations downstream of Wallacia Weir

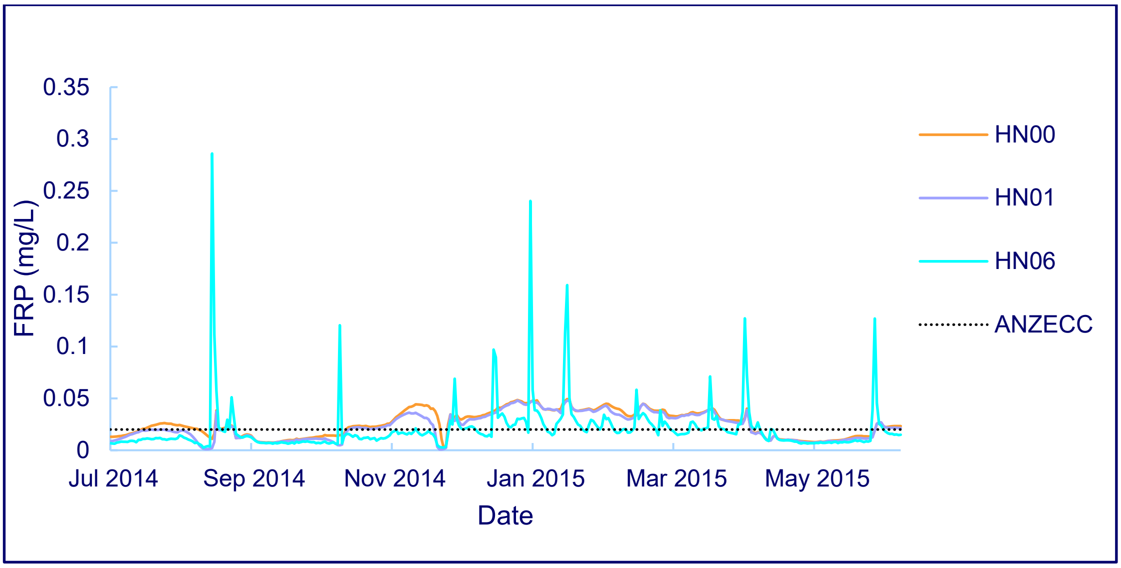


Figure 5-11 Timeseries of predicted FRP concentrations downstream of Wallacia Weir

The treated water releases also tend to be cooler in summer than ambient water, and have higher oxygen content. The addition of cooler water is beneficial in the context of preventing high summer water temperatures and associated undesirable impacts on water quality including algal blooms. Adding well aerated water can also mitigate water quality concerns originating from higher sediment oxygen demands that may potentially occur in warmer climate.

As noted by NPWS, section 12.1.7 of the EIS includes a climate change risk assessment. Section 5.10.17 discusses the implications of the AWRC releases in the context of climate change in more detail.

5.4.23 Hydrodynamics and water quality - recreation at Nortons Basin

Issue description

NPWS notes that Table 8-24 on p.351 of EIS identifies Nortons Basin as a recreational destination along Nepean River. Impacts of water quality changes on recreational value of this swimming area do not appear to be assessed in EIS.

Response

The EIS focused on the recreational areas of Wallacia Weir and Penrith Weir. However, results from the WQRMs can be extracted and analysed at alternative locations as required. The timeseries results for enterococci (as a representation of impacts on recreational value) at Nortons Basin are presented in Figure 5-12 and Figure 5-13 for the 2036 dry and wet years respectively.

Under all the scenarios and climatic conditions assessed, the AWRC releases are predicted to reduce the concentrations of enterococci at Nortons Basin. This is due to the level of treatment, including reverse osmosis and disinfection that is provided to the AWRC releases.

The NHMRC (2008) guidelines specify a 95th percentile for intestinal enterococci ≤ 40 cfu/100 mL for primary contact and > 40 and ≤ 200 cfu/100 mL for secondary contact. While not statistically comparable to the daily concentrations, Figure 5-12 and Figure 5-13 show that for much of the time concentrations are predicted to exceed the guideline values for primary and secondary contact. This occurs under all scenarios (baseline, background and impact). The AWRC releases are predicted to slightly improve compliance with the guidelines.

Similar results are also predicted for *E. coli* as presented in Figure 5-14.

The predicted reduction in concentrations of enterococci and *E. coli* increase with AWRC release volumes as demonstrated in Figure 5-16 for the 2056 dry weather release scenario.

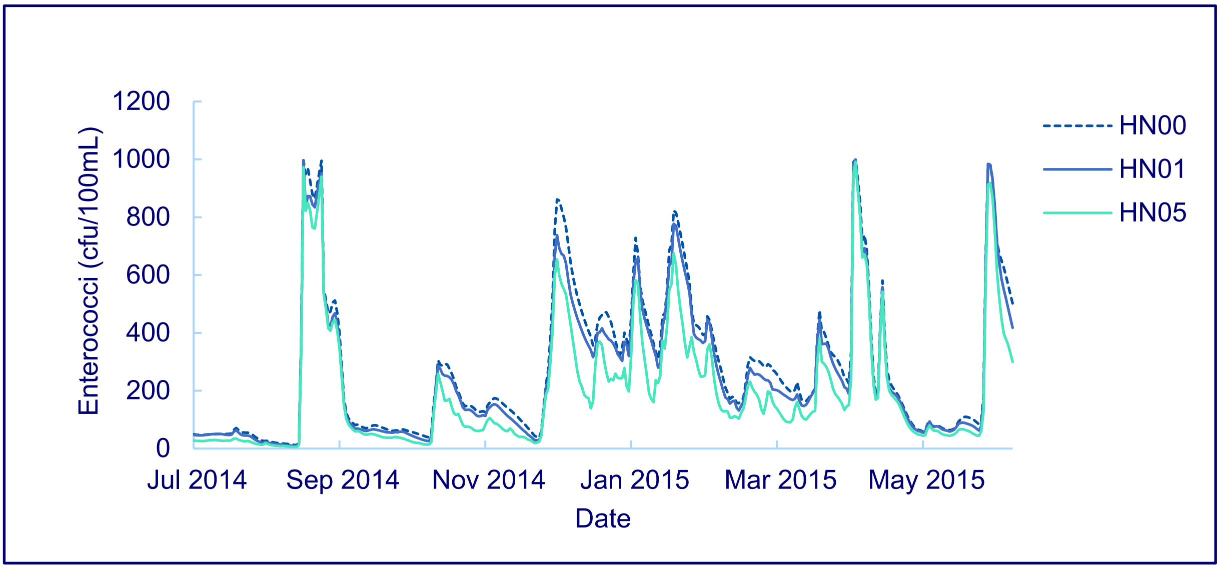


Figure 5-12 Timeseries of predicted enterococci concentrations at Nortons Basin (2036 releases/dry year)

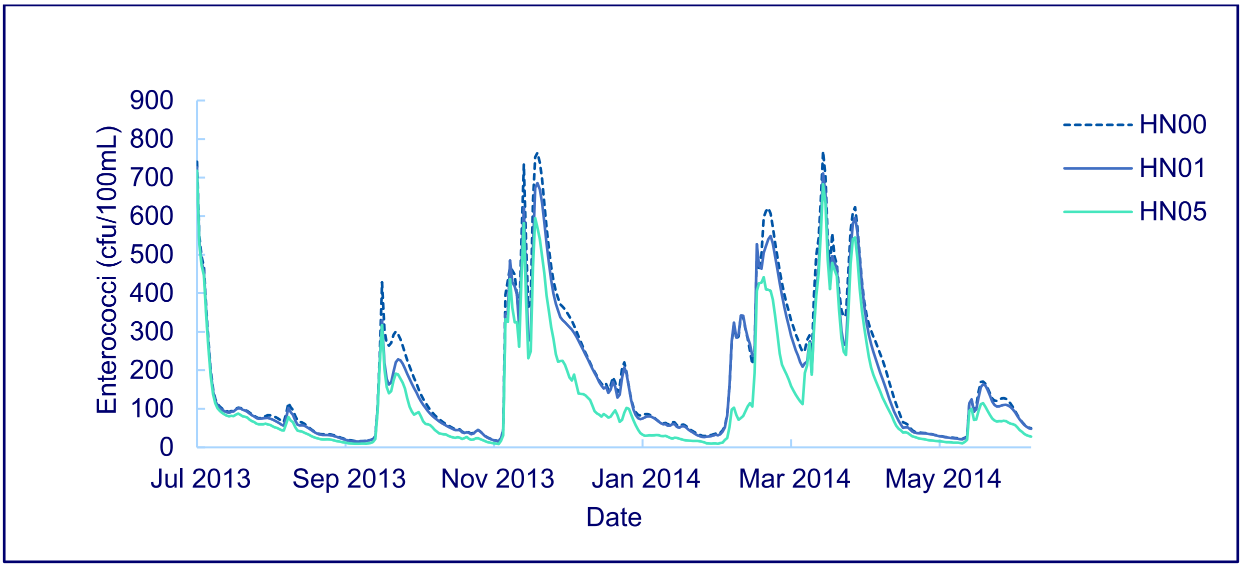


Figure 5-13 Timeseries of predicted enterococci concentrations at Nortons Basin (2036 releases/wet year)

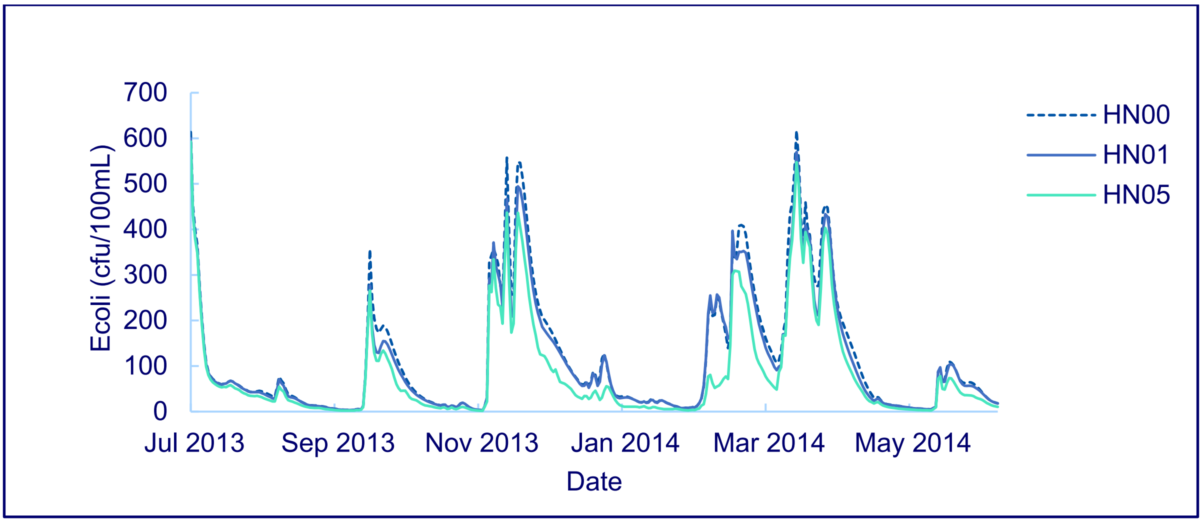


Figure 5-14 Timeseries of predicted *E. coli* concentrations at Nortons Basin (2036 releases/dry year)

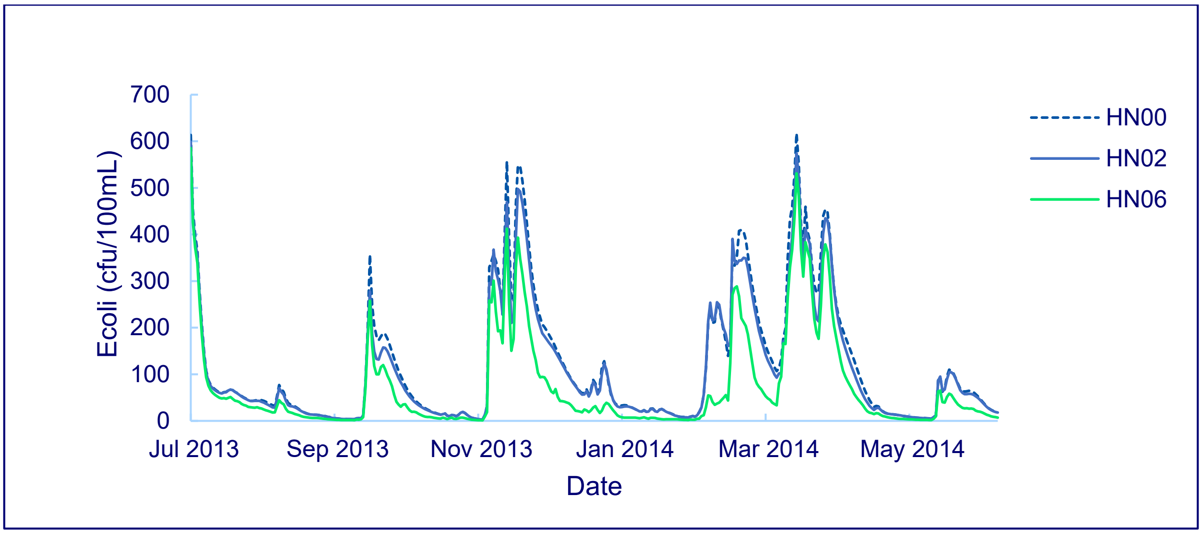


Figure 5-15 Timeseries of predicted *E. coli* concentrations at Nortons Basin (2056 releases/wet year)

5.4.24 World and National heritage - outstanding universal values (OUV)

Issue description

NPWS notes that the Statement of OUV for the GBMWHA also includes indigenous relationships, water systems and natural beauty. It notes that an expanded analysis to include these would contribute to a more robust assessment. It also suggests referencing the Statement of OUV to ensure a more complete list of references.

NPWS notes that the assessment in Table 4.1 of Appendix Q appears appropriate but could be strengthened by considering the other values that support the integrity of the property described in the Statement of OUV. These other values include indigenous associations, water systems, geodiversity, wilderness and adjacent lands and natural beauty. Similarly assessments in Table 5.1 and Table 5.4 could also be strengthened by considering the other values in the Statement of OUV given the 13 km stretch along the Nepean River (plus unmapped areas of tributaries) contain outstanding natural values that would be impacted.

Response

Table 4.2 in Appendix Q of the EIS includes additional significance assessment that captures indigenous relationships, water systems and natural beauty.

- Indigenous relationships are included in:
  - criterion B, columns 3 and 5
  - criterion C, columns 2, 3 and 5
  - criterion F, columns 3 and 5
  - criterion G, columns 2, 3, 4, and 5
  - criterion I, columns 2, 3, 4, and 5.
- Water systems are included in:
  - criterion A, columns 3 and 5
  - criterion B, columns 2 and 5.
- Natural beauty is captured using different terminology such as aesthetic values and views and is included in:
  - criterion A, column 4 (implicit in changing views towards hostile wilderness areas)
  - criterion E, columns 2 and 5
  - criterion G, column 2 (implicit).

The 'Other Heritage Values' have been drawn from the comments in the OUV, as well as additional research and assessment, particularly those contained within 'Values for a new generation: Greater Blue Mountains World Heritage Area'. The reference to the Statement of OUV is the last item in the reference list: "World Heritage Centre. 2000. “Greater Blue Mountains Area.” 2000. https://whc.unesco.org/en/list/917/.

The other values that support the OUV integrity, including water systems, Indigenous association, geodiversity and natural beauty are outlined in Table 4.2 in Appendix Q of the EIS. These have been outlined separately to differentiate between the official values and the additional values that are still under consideration.

The purpose of Table 5.1 in Appendix Q of the EIS is to assess the impacts against the official OUV only and Table 5.2 addresses the other values. The second column 'Attribute' articulates the values being considered. In comparing these values (attributes) to those contained within the OUV it is clear that the other values have been incorporated and addressed. Similarly, Table 5.4 addresses the other values that have been identified in Table 4.2 that go beyond those identified in the OUV.

Table 5.2 provides a comprehensive analysis of the other values identified in Table 4.2 and the potential for the project to impact on the other values. Identified other values include Indigenous associations (see under Criteria A, G and I), water systems (see under Criteria A and B), geodiversity (see under Criteria A, D and E), wilderness (see under Criteria A, D and E) and natural beauty (see under Criteria A and D). The official values have been kept distinct from the other values.

5.4.25 World and National heritage - impacts on integrity

Issue description

NPWS notes that treated water releases have potential to impact riparian vegetation and aquatic ecology along the Nepean River as it flows through GBMA and that these are attributes of OUV. The GBMWHA Strategic Plan requires that where developments might have an unknown but potentially significant impact on the World Heritage and other values they should be modified to minimise the risk of impact on those values or they are not to proceed. The submission also notes that the Strategic Plan states that terrestrial and aquatic ecosystems and their associated ecological processes, species, populations and genetic diversity should all be protected and conserved in-situ.

NPWS acknowledges that Appendix Q of the EIS states the project would only have indirect impacts on the GBMWHA from proposed water releases through small portion of Blue Mountains National Park. While the project may only relate to a small portion of the National Park, the submission notes that the integrity of the World Heritage property refers to wholeness and intactness and the proposal will contribute to cumulative impacts on the OUV, both within and adjacent to the GBMA Warragamba and Nepean River make a contribution to integrity of the World heritage property so assessment of impacts (if any) on integrity of the World Heritage property with regard to 'wholeness and intactness' would serve to strengthen EIS and its conclusions.

Response

Indirect impacts have been used to describe project impacts in the GBMA because there will be no construction within the World Heritage Area and therefore no direct impacts. Page 2 of Appendix Q of the EIS notes the potential to impact on riparian vegetation and aquatic ecology as these are, among other matters, the indirect impacts investigated by the assessment. This is essentially a statement that frames what the assessment will be investigating. The conclusion of the investigation is that the project will have negligible impacts on terrestial and aquatic ecosystems, including the associated processes, species, populations or genetic diversity (with the potential for increased genetic diversity for the Macquarie Perch through increased connectivity of populations being noted). The 'wholeness and intactness' will therefore not be altered.

5.4.26 World and National heritage - additional reference materials

Issue description

NPWS notes that documentation and reference list of Appendix Q (p11) and the EIS could be strengthened by referencing State of Conservation Report 2004 Greater Blue Mountains Area. The World Heritage Committee encourages the prevention of any developments that could have adverse effects on the World Heritage Property. The conservation issues presented to the World Heritage Committee in 2004 also identify that under the EPBC Act, undesirable actions are to be discouraged not only within a World Heritage area but also outside the area (ie values and impacts to the values do not stop at World Heritage area boundaries).

Response

Discouragement of undesirable actions is covered within the Strategic Plan and Plan of Management as addressed in Appendix Q of the EIS (Appendix A). The State of Conservation report was considered during development of this report, but as it did not introduce additional considerations it was not included for simplicity. As negligible impacts have been identified, the project is not considered to be an undesirable action.

5.4.27 World and National heritage - visual impacts

Issue description

NPWS notes that in Table 5.4 of Appendix Q, aesthetics (visual) is assessed as having high integrity and authenticity and low value. This is based on the area not being identified as one of the key lookouts in Blue Mountains. Regardless of Table Rock being a key lookout, the natural beauty of the Greater Blue Mountains Area contributes to integrity of the property and so the low value assessment needs revisiting.

Response

Sydney Water acknowledges the natural beauty of the GBMA is important to its integrity. The aesthetic qualities of the GBMA are not uniform throughout the area, with some areas having higher scenic qualities (such as Govetts Leap, Three Sisters) and Sydney Water has reflected this in the assessment. In any case, given the project would not visually alter the GBMA, there would be no impact on natural beauty.

5.4.28 Aquatic ecology - wetted perimeter impacts

Issue description

NPWS notes that Table 8-46 in the EIS identifies that in some locations increases in wetted perimeter would be up to 11 m. It notes that it appears inaccurate for the EIS to focus on 'positive impact' based on benefits to aquatic fauna. Given coarseness of the data and anomalies referenced, potential increases to water levels could also be higher in areas where the river narrows.

NPWS notes that an increase in wetted area of 11 m has potential to cause additional shading of the bed of the river, that if flowing quickly the river would scour the benthic habitat, if slow moving would result in deposition of silt and sediment in the GBMA and Erskine and Euroka Creeks would also hold water for longer periods during high rainfall. These are likely impacts on aquatic ecology and riparian vegetation (part of OUV) that would occur in a number of waterways in the GBMA as a result of the proposal.

Response

Hydraulic modelling predicts that the location of the greatest changes in the hydraulic conditions in the Nepean River (such as increased wetted perimeter) are highly localised to sections of the river of less than 100 m. The hydraulic model used to derive the metric has an average cross-section spacing of 43 m as shown in Figure 5-16 and therefore has provided a reasonable representation of the longitudinal and cross-section variation in the river at this scale. Any changes in conditions where the river cross-section narrows have been included in the model and the resultant changes in wetted perimeter, velocity and shear stress have been assessed. Sydney Water has acknowledged limitations of the modelling in the EIS and it is the nature of modelling to provide a representation and comparison of impacts rather than being able to exactly predict them. Sydney Water considers the model provides a good representation of likely impacts.

Modelling indicates that changes in wetted perimeter by up to 11 m (as noted in the issue) can be related to specific in-channel features such as riffles or benches (as shown in Figure 5-17) which can become more inundated at marginally higher flows. These changes do not extend over significant distances and will vary over time with flows.

The stretch of the Nepean River downstream of Warragamba River confluence and Penrith Weir is controlled by the weir structure and as a result has formed an extensive weir pool which is a low flow, low energy environment.

Modelling predicts that between Warragamba River and Penrith Weir the change in velocity as a result of the 50 ML/d treated water releases is less than 0.05 m/s. This is well below the mobilisation threshold of sand, leaf litter and benthic macroinvertebrates. It is therefore unlikely there will be any noticeable effect on erosion, sediment transport rates or potential for deposition in the GBMA, Nepean River, Euroka or Erskine Creeks.

Modelling predicts that the changes to the wetted perimeter, water level, velocity and shear stress at Erskine Creek and Euroka Creek confluences will be negligible. There is the potential for localised increases in the water surface of Nepean River (in the order of 0.04 m) and wetted perimeter (about 11 m) at Glenbrook Creek confluence but these changes do not extend upstream in Nepean River for more than 100 m. The changes at Glenbrook Creek occur as a result of an existing large in-channel bar at the creek confluence with Nepean River as shown in Figure 5-18.

Given the modelled increase in wetted perimeter affects in-channel riffles and bars as noted above, it is unlikely this will cause significant changes to river shading. This is because water levels in these areas are controlled by Wallacia and Penrith weirs so water is not predicted to rise to a point that would widen the channel to move the wetted areas closer to the areas of the river shaded by existing riparian vegetation. In addition, the gorge section of Nepean River has steep, exposed bedrock banks and for the most part there is some distance between the river and vegetation, which reduces the likelihood of increased shading.

Where the modelling indicates increases in wetted perimeter at the vegetated bar at the confluence of Nepean River and Glenbrook Creek, this may result in some vegetation dieback in this area. This could produce short-term shading of these very localised sections of the river if vegetation falls into or across the water, reducing light penetration in the water column, and therefore photosynthesis and primary production. In this scenario, once dieback is complete and live vegetation retreats, channel shading would reduce. Shading from dieback is also likely to occur naturally in this area during flood events where this vegetated bar can be completely inundated and vegetation damaged. This occurred during the March 2021 flood event, as shown by the aerial image shown in Figure 5-19.

Sydney Water considers it is reasonable for an environmental impact assessment to identify any potential positive impacts of the project on aquatic fauna.

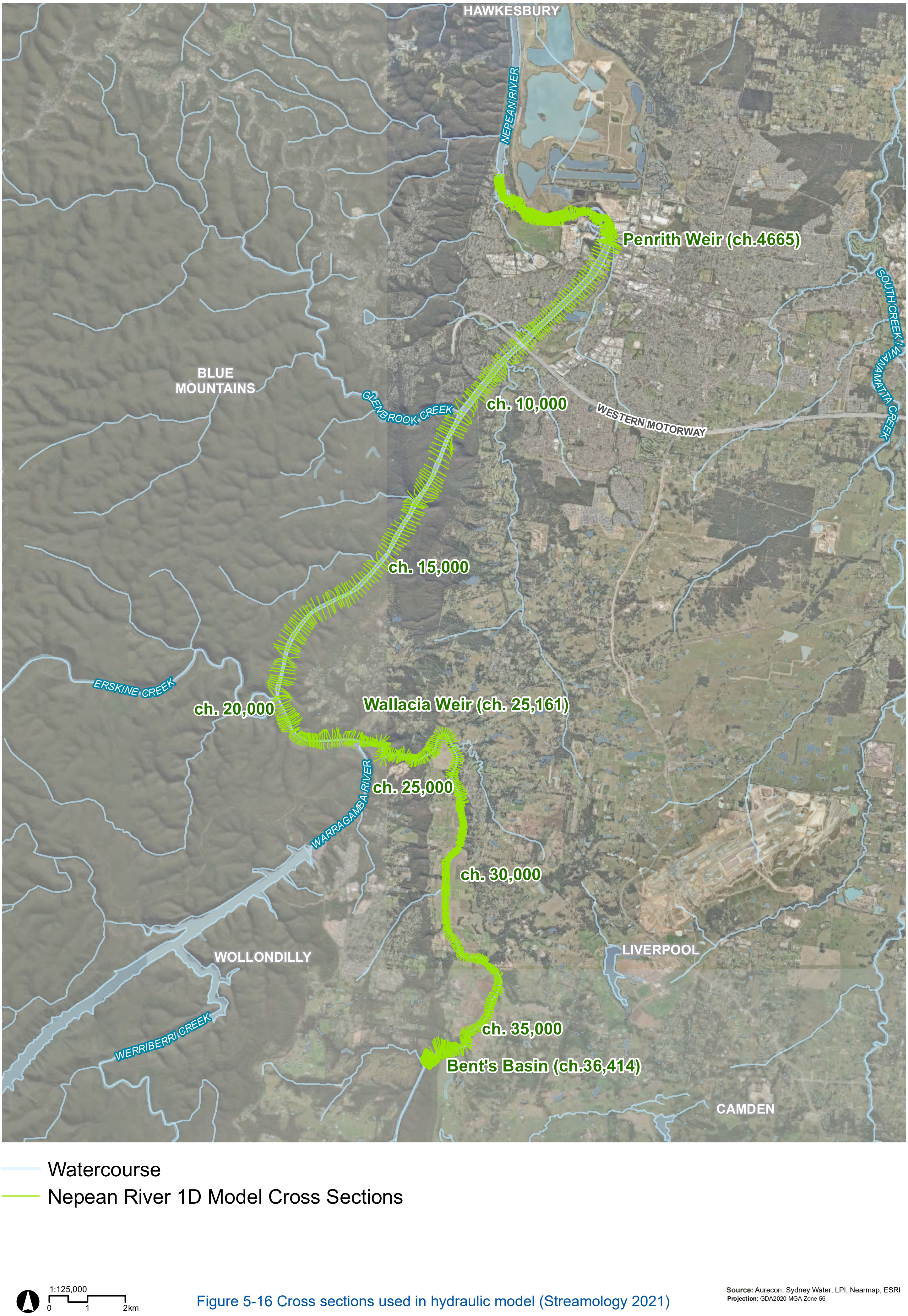


Figure 5-16 Cross sections used in hydraulic model (Streamology 2021)

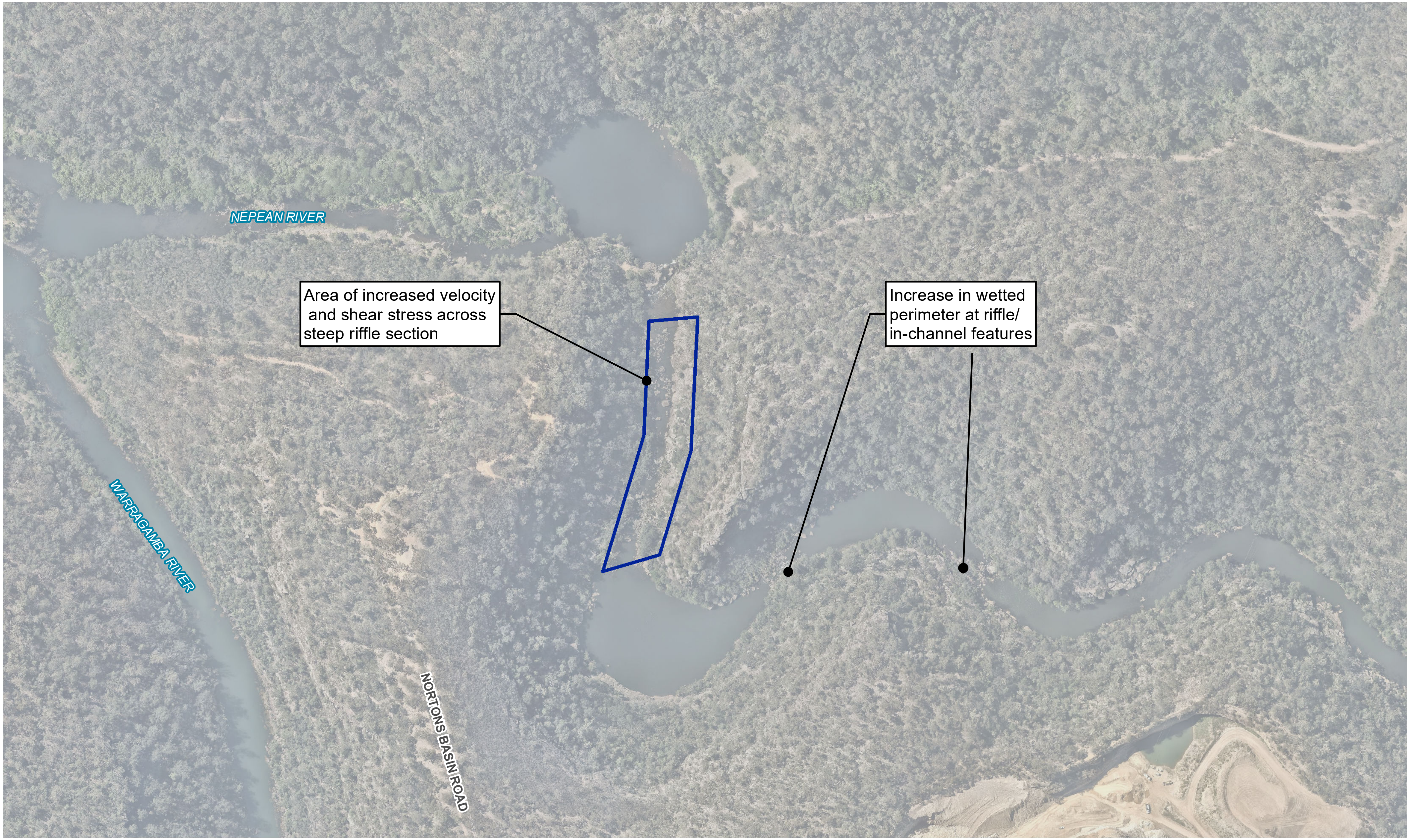


Figure 5-17 Locations where changes in hydraulic metrics are modelled to occur upstream of Norton's Basin

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

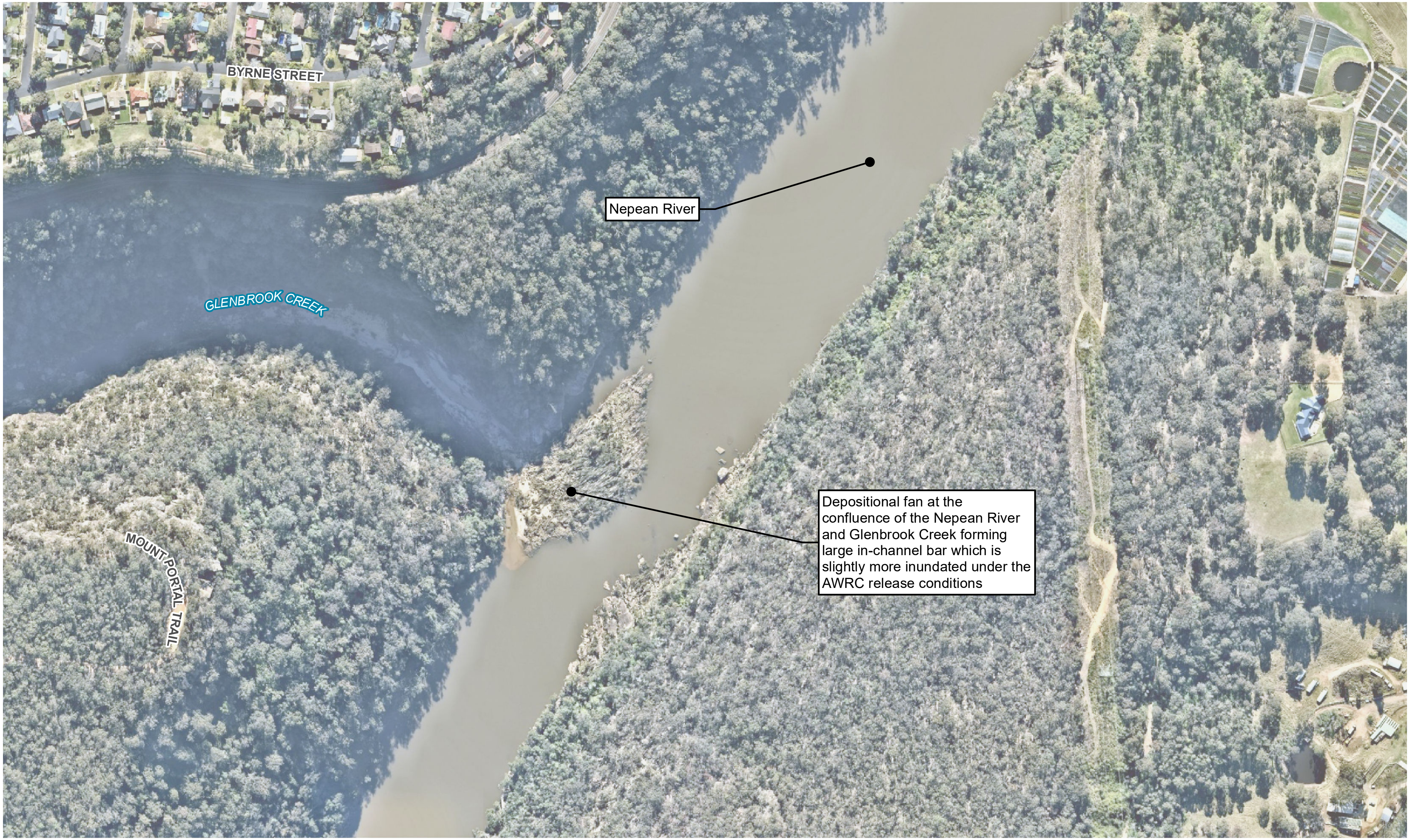


Figure 5-18 Locations of large in-channel bar at the confluence of Glenbrook Creek and the Nepean River

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

Figure 5-19 Glenbrook Creek and Nepean River confluence during March 2021 flood event (Source: NearMap image dated 25 March 2021)

5.4.29 Aquatic ecology – changes to water quality

Issue description

NPWS notes that the Executive Summary of Appendix Q finds the project would result in improved water quality and beneficial outcomes for aquatic ecology. NPWS suggests that this conclusion might need revisiting given the project would increase nutrient loads, particularly nitrogen, and given such changes have potential to cause increased turbidity, algal growth and possibly low DO levels associated with eutrophication. In turn these impacts have potential to affect aquatic and terrestrial species along the riverbank traversing the GBMA and upstream creeks in the event of high rainfall.

Response

As outlined in the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS, flows near the upstream boundary of the GBMA are predicted to increase by an average of about 25%. In line with existing environmental flow strategies for the river, such increases in the flow regime have potential environmental benefits by counteracting the presence of the upstream weirs and dams, and significant levels of water demand.

Advanced treated water releases will have the following benefits in the GBMA:

- Protection of aquatic ecosystems and reduction of aquatic weeds and frequency of algal blooms.
- Improvement in river health including conditions for native fauna and river-dependent plants that rely on different flows to trigger migration and breeding.
- Protection of river condition for recreation such as boating and swimming.

In freshwater, it is typical to assess potential water quality driven impacts in terms of change in concentrations of pollutants and comparison with concentration-based trigger values or background scenarios. Ecotoxicity thresholds are typically reported in concentrations as the impacts to ecology are concentration based, not load based.

Water quality modelling shows that daily loads of total nitrogen entering the GBMA will increase by an average of about 20% over the two-year period analysed. These increases in load are generally driven by the additional flows and do not equate in significant increases in concentration. Modelling also shows that despite the increase in loads, the concentrations of TN are predicted to decrease.

This reduction in concentration is due to increased dilution of existing river water with advanced treated water from the AWRC being released into the Wallacia Weir pool, and then overflowing downstream into the GBMA.

As discussed in section 6.1.2.5.3 of the Hydrodynamic and Water Quality Impact Assessment report, concentrations of inorganic fractions of nitrogen are predicted to be similar to, or marginally elevated relative to, the background river conditions. As a result, significant impacts driven by inorganic nitrogen species are not expected. This is important because the dissolved inorganic species are the most readily consumed by algae and macrophytes and, when excessive, may drive increases in primary productivity which can trigger increased turbidity, reduced dissolved oxygen impacts for multiple trophic levels.

A similar case was modelled for total phosphorus where daily loads entering the GBMA are predicted to increase by an average of about 7% over the two year modelling period. However, concentrations are predicted to be reduced within the GBMA for both TP and filterable reactive phosphorus, due to the increased dilution of the river water with the lower concentrations of advanced treated water being releases from the AWRC.

As is the case with available forms of nitrogen, the dissolved inorganic fraction of phosphorus is most readily consumed by algae and macrophytes and, when excessive, may drive a significant in primary productivity which can trigger increased turbidity, reduced dissolved oxygen impacts for multiple trophic levels.

Assessment of the potential for nutrient driven impacts within the GBMA does not predict a significant impact in the concentration of bioavailable nutrients which means the availability to aquatic plants and algae is also unlikely to change.

Modelling has identified a risk of short-term localised impacts to water quality during wet weather events when the quality of releases from the AWRC to Nepean River will shift from advanced treated water to tertiary treated water. These impacts are driven by nutrient influx, which may affect primary production. Depending on the magnitude and duration of these spikes dissolved oxygen depletion of the water column may occur which can cause knock on effects to higher trophic level organisms, particularly fish species that are not particularly mobile.

There is also potential for an increase in primary production response, particularly by benthic species of diatoms and algae. This could drive a shift in the community assemblage which in turn may increase or decrease favoured food resources of benthic macroinvertebrate species which may result in a shift in community composition.

As a result, this may then affect food resources of higher order species that rely on invertebrate prey as a primary resource for food. However, it must be noted that modelling predicts these spikes to be short lived and therefore long-term impacts are not expected. Most of the time, the advanced treated water releases are expected to reduce the potential for aquatic weeds and algal blooms by diluting the concentration of nutrients.

As noted in section 5.4.45, any benefits and impacts through the GBMA are expected to be within the main stem of Nepean River and are unlikely to affect upstream waterways.

5.4.30 Aquatic ecology – mouth of Glenbrook Creek

Issue description

NPWS notes that the summary of predicted impacts to aquatic ecology in Nepean and Warragamba Rivers (on page 423 of the EIS) identifies potential changes to the vegetated bar at the mouth of Glenbrook Creek, including die back due to increase in wetted perimeter. It notes the EIS should specify the species and vegetation communities that will be affected for ease of assessment. Section 6.4.2 of Appendix Q identifies increased inundation frequency predicted to result in impacts to 0.12 to 0.19 ha of native vegetation. NPWS notes it is difficult to adequately assess the level of impact without the EIS explicitly identifying the species and communities that would be affected so the EIS should make this clear.

NPWS recommends considering the potential for increased weeds resulting from higher nutrient loads as a potential impact on the OUV of the GBMA.

Response

The mouth of Glenbrook Creek is located between the Wallacia and Penrith Weirs on Nepean River at Lapstone. Vegetation at the mouth of Glenbrook Creek is mapped as being Sandstone Riparian Scrub fringed by an area of Hinterland Sandstone Gully Forest. As outlined in section 5.4.32, potential impacts to biodiversity as a result of altered hydrology from the project is assessed in section 9.5 of the BDAR (Appendix J of the EIS).

The BDAR used modelling outputs the ecolohydrology and geomorphology assessment in Appendix G of the EIS to assess potential impacts to biodiversity. The maximum increased inundation depth and duration have been modelled at the proposed project outflow rate of 50 ML/day and as a worst case 100 ML/day scenario. The worst case 100 ML/ day scenario was predicted to result in an up to 14 cm increase in depth downstream of Wallacia Weir to Penrith Weir. Assessed against a median background flow and accounting for the variability of that flow, this is modelled to result in an increase of inundation between Wallacia and Penrith Weirs, including at the bar at the mouth of Glenbrook Creek from between 27% - 50% of the time, to 50% - 75%. Even using this conservative assessment approach it was concluded that this would not result in a significant impact on biodiversity values. This is because all vegetation and habitats identified as being present in this area are already subject to some form of dynamic and periodic inundation. Therefore the minor changes that may result from the project are unlikely to result in a change in to the current hydraulic equilibrium that could result in negative impacts.

In addition, the vegetated bar is a depositional fan where sediment settles as it reaches the waters of the Nepean River. A depositional fan is by its nature a dynamic feature of the river and subject to change due to natural processes. For example, Figure 5-19 shows inundation of this bar with substantial damage to vegetation during large floods in Nepean River in early 2021. Sections 8.7.2 and 8.7.3 of the EIS assessed potential impacts on this location from an ecohydrology and geomorphological perspective which concluded that impact to the Nepean downstream of Wallacia Weir would be minor relative to background conditions.

In relation to potential for increased weeds as a result of higher nutrient loads, Chapter 8 of the EIS provided a detailed assessment of the potential water quality impacts as a result of the project supported by a range of specialist studies in Appendices F, G and H.

The assessment found that in Nepean River, treated water releases (either advanced treated water or a blend of advanced and tertiary treated water) are expected to typically improve water quality for some indicators (such as total nitrogen, total phosphorus, salinity, dissolved oxygen and enterococci) with slight increases in bioavailable forms of nitrogen. During infrequent wet weather events, elevated nutrient concentrations are predicted downstream of the releases due to the higher proportion of tertiary treated water in the releases. These ‘spikes’ result in localised and short-lived downstream impacts on water quality. Nutrient concentrations are predicted to drop quickly to levels lower than the background scenario within a few days as a result of dilution. The potential for increased weed recruitment along areas adjoining NPWS estate and Nepean River more generally is therefore considered negligible.

5.4.31 Terrestrial biodiversity - impacts on River-flat Eucalypt Forest

Issue description

NPWS notes that Table 8-2 of Appendix Q identifies more frequent inundation of five PCTs, including PCT835 Forest Red Gum. This has been assessed as slight impact given limited area impacted. This PCT meets key diagnostic criteria of River-flat Eucalypt Forest which is critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and endangered under the *Biodiversity Conservation Act 2016* (BC Act). NPWS notes a 'slight impact' to a critically endangered community appears to be an inaccurate assessment.

Response

Section 11.2.1 of the BDAR (Appendix J of the EIS) provides an analysis of the potential impacts of increased inundation on the vegetation communities. The assessment reviewed potential inundation impact on areas identified as meeting the definition of PCT835 Forest Red Gum when comparing the current median flow of Nepean River which is 229 ML/day against an expected future median flow of up to 279 ML/day based on treated water releases of the project of up to 50 ML/day. Hydraulic modelling indicated that under this scenario, biodiversity values present between the current median flow and future flow with the project would experience a change in inundation from 40% - 50% of the time to inundation >50% - 75% of the time. For PCT 835 this equated to an area of about 0.76 hectares being subject to increased frequency of inundation.

Investigations identified that there is a total of about 256 hectares of PCT 835 within 100 m of the watercourse so the additional impacted area represents only a small fraction of the impacted community leading to the conclusion that these impacts would be slight. In addition, PCT 835 is identified as having moderate tolerance to inundation owing to its typically riparian locations. Given its location, the area of PCT 835 discussed here would likely be already subject to naturally occurring inundation during flood events. As a result, Sydney Water considers that areas impacted by additional periodic inundation as a result of the project are unlikely to result in a significant risk to biodiversity values.

5.4.32 Terrestrial biodiversity - extent of impact area

Issue description

NPWS notes that Figures 2.12 and 2.13 of Appendix J show that areas downstream of release points and subject to inundation are not in the impact assessment area and not considered part of the impact area. Raised water levels have potential to impact biodiversity adjacent to the rivers, however this potential impact does not appear to have been captured in the biodiversity assessment.

Response

The impact area and impact assessment area for the project relate to direct impacts.

Potential impacts to biodiversity as a result of altered hydrology are considered indirect impacts and assessed in section 11.2 of the BDAR in Appendix J of the EIS. The BDAR used modelling outputs from the ecohydrology and geomorphology impact assessment in Appendix G of the EIS to assess potential impacts to biodiversity. The maximum increased inundation depth and duration have been modelled at the proposed treated water releases of 50 ML/day (2036 scenario) and 100 ML/day (2056 scenario). The 100 ML/day scenario was predicted to result in an up to 14 centimetre increase in depth downstream of the Wallacia Weir to the Penrith Weir. Assessed against a median background flow and accounting for the variability of that flow, this is modelled to result in an increase to the frequency of inundation from 27% - 50% of the time to 50% - 75%. This change in inundation frequency is well within the existing channel extents. This is unlikely to have a significant impact on biodiversity values.

5.4.33 Terrestrial biodiversity - impacts on platypus

Issue description

NPWS notes that the EIS assesses the impacts on platypus and echidna to be negligible (section 7.11 of the Executive Summary p 44). However, platypus are wholly dependent on high quality aquatic habitat with good water quality and aquatic flora and fauna including intact riparian areas. If any platypus are present (or likely to be present) in the affected area it is considered the impact would be significant given platypus are part of the OUV for the area.

Response

The project’s World heritage assessment in Appendix Q of the EIS considered the project’s potential impacts to platypus and it found that although platypus are likely to be present, the changes in flow regime in Nepean River is unlikely to result in negative impacts to the species’ forage or breeding habitat. It also noted that the release of treated water to the Nepean and Warragamba Rivers would generally result in a net positive effect on water quality. Accordingly, negative impacts to platypus and any other amphibious fauna as a result of a reduction in water quality are considered unlikely. The memo supporting this conclusion has been included as Appendix G of this report.

5.4.34 Terrestrial biodiversity - impacts on fauna

Issue description

NPWS suggests it should also be noted in the EIS, to ensure all impacts are captured, that all fauna (ie not just platypus and echidna) are considered attributes of OUV.

Response

Sydney Water notes that all fauna contribute to World heritage values. Sydney Water has completed a detailed assessment of the potential biodiversity impacts of the project on fauna in the BDAR in Appendix J of the EIS. Given the platypus and echidna are species specifically mentioned in the OUV attributes, they have been addressed directly in the World Heritage Assessment. However, this report should be reviewed alongside the BDAR including section 11.2 that assesses impacts to fauna habitat more broadly, as a result of changes in inundation frequency from treated water releases. This concludes that no substantial impacts are expected.

5.4.35 World, National and Aboriginal heritage - AHIMS sites

Issue description

NPWS notes that the Aboriginal Heritage Information Management System (AHIMS) sites referenced in Appendix Q are not mentioned in the Aboriginal Cultural Heritage Assessment (ACHAR) (Appendix O) and that the two assessments are by different consultants.

NPWS notes that AHIMS sites erroneously mapped should be corrected and updated on AHIMS. NPWS also notes that in the publicly exhibited version Figure 5.1 was redacted. While the redaction of AHIMS details is supported, it is noted that the Gundungurra Indigenous Land Use Agreement (ILUA) map is publicly available online. The inclusion of coordinates of Aboriginal cultural heritage sites (see section 5.8.2 on page 53) is not appropriate.

Section 5.8.2 of World heritage assessment states that over 1,000 AHIMS sites are located in GBMWHA, however this figure is now over 1,500 sites.

Response

Sydney Water acknowledges that different consultants have prepared Appendix Q and Appendix O. In relation to specific points on the AHIMS sites:

- Sydney Water (via EMM Consulting) has notified AHIMS of erroneously mapped AHIMS sites.
- Figure 5.1 in Appendix Q was redacted because it shows the location of AHIMS sites, not because it shows the boundary of the Gundungurra ILUA.
- The inclusion of coordinates for an AHIMS site in Appendix Q of the public version of the EIS was an oversight. Sydney Water has provided DPE with an updated version of Appendix Q to replace the version on its website.
- Sydney Water notes the advice that there are more than 1,500 Aboriginal sites in the GBMWHA and considers this does not change the outcomes of the assessment.

5.4.36 Aboriginal heritage - consultation

Issue description

NPWS notes it is unclear whether the Registered Aboriginal Parties (RAPs) in the ACHAR were involved in the world heritage assessment, or whether comments from the ACHAR were used. The process followed should be clarified. NPWS also notes it is unclear from the ACHAR whether the two sites above the raised water level were checked or inspected. The impact assessment states that the sites would not be impacted but the Heritage Impact Assessment states that field inspections were not undertaken as previous sites were adequately assessed to allow for determination of impacts. This is of concern as it implies the Aboriginal community were not involved in determining the impacts to those sites stated to be above the increased water level. If the ACHAR did not inspect the two sites above the raised water level this would mean there was no confirmation of their location or if the Aboriginal community had any concerns on the impacts to these two shelters with Art. It is recommended this is undertaken.

National heritage is a matter of national environmental significance (MNES) and controlling provision for this proposal. Therefore EPBC Schedule 5B applies and includes that 'Indigenous people are the primary source of information on the value of their heritage and the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.' Whether this assessment is adequate is a matter for the Aboriginal groups involved.

Response

Comments from RAPs on the ACHAR were considered in preparing the heritage assessment in Appendix Q of the EIS, including specific information sought about values along the Nepean River. No inspection of the two identified sites was undertaken due to the difficulty in accessing these sites. This approach was considered appropriate as there would be no direct or indirect impacts to these two shelters with art given the site cards indicate they are located well beyond the water level and the area potentially impacted by treated water releases. Changes to wetted perimeter associated with the project are limited to the existing channel and well within areas already impacted by historical flooding that is likely to have resulted in loss of integrity or complete loss of any sites that may have been present around the existing water level of the river. The project's releases are therefore unlikely to result in impacts to Aboriginal heritage sites.

Sydney Water has consulted with a range of Aboriginal groups and individuals throughout project development, including:

- consulting with the 26 RAPs through the ACHAR
- speaking with the Chair of the Consultative Committee for the Gundungurra Indigenous Land Use Agreement and offering to brief the committee about the project
- separate to the project, progressing an Aboriginal Cultural Values Study in consultation with local Aboriginal communities to better understand intangible Aboriginal cultural values of the Western Sydney region, focused on the cultural values of water in the South Creek catchment and parts of Nepean River. Sydney Water has contacted a broad range of

Aboriginal stakeholders (including Gundungurra and Darug people) inviting them to a workshop and to nominate cultural knowledge holders to be involved in the study. In November 2021, Sydney Water sent further information about the study to this broad range of stakeholders, including information about the Upper South Creek Advanced Water Recycling Centre project. This included contact details, for people who want to be involved or would like more information.

5.4.37 Aboriginal heritage - value of sites

Issue description

NPWS notes that the assessment of unknown integrity and authenticity and attribution of a low value to indigenous sites (Table 5.4 of World heritage assessment, p55) is a misleading statement and potentially offensive to Aboriginal people and should be rated high and high, noting that the EIS states 'the study area does not contain art or open sites of research'. It is clear that the EIS relies on AHIMS reports and no additional Aboriginal cultural heritage assessment was carried out for the area that will be inundated along the Nepean River.

Response

Sydney Water acknowledges the important cultural and associative values of the sites to Aboriginal people, which is captured in Table 5.4 of Appendix Q as Indigenous connections, and rated as high. Scientific and archaeological research value is a separate value and it is this aspect that has been rated as low. This is because sites originally existing immediately adjacent to existing water levels on the banks of Nepean River (ie areas potentially impacted by the project) are expected to have been significantly impacted by historical flooding along Nepean River (most recently 2021 and 2022) and in the case of artefact scatters would not reflect the original spatial arrangement or use of the site due to erosion and translocation of artefacts within sediment.

5.4.38 Terrestrial biodiversity - general

Issue description

DPE BCD raises a range of general terrestrial biodiversity issues which are addressed in Table 5-18.

Response

Table 5-18 Response to DPE BCD general comments on terrestrial biodiversity

Issue raised	Response
The calculator for the Wollemi Interim Biogeographic Regionalisation for Australia (IBRA) subregion has not been finalised in the Biodiversity Assessment Method – Calculator (BAM-C).	Based on the following guidance from the Biodiversity Assessment Method 2020 Operational Manual – Stage 1 (DPIE, 2020a), only the BAM-C case relating to the Cumberland IBRA subregion requires finalisation: ‘If the subject land is located within more than one IBRA subregion, the IBRA subregion selected should be the one

Issue raised	Response
The BDAR includes a credit summary report for the Cumberland IBRA subregion but no similar report has been included for the Wollemi IBRA subregion.	within where the largest proportion of impact/area of BSA will occur, with justifications provided in the BAR. For linear-shaped developments that cross multiple IBRA subregions, the assessor must conduct separate habitat suitability assessments for each IBRA subregion. However, vegetation zones may extend across each IBRA subregion. This option can only be applied where the whole project is within a single IBRA region with one or more IBRA subregions. If the proposal crosses an IBRA boundary, a new case will be required in the BAM-C for each new IBRA region'. (p.10, section 2.2.1). This is the case for the project, where the Cumberland IBRA subregion has been selected in the BAM-C, and a separate habitat assessment has been undertaken for all candidate species generated by the vegetation zones present within the Wollemi IBRA subregion (all of which also occur in the Cumberland subregion within the project footprint). The BDAR includes a credit summary report for the Cumberland IBRA subregion but no equivalent report has been included for the Wollemi IBRA subregion. Based on the guidance from the operational manual above, a credit summary report is only required for the Cumberland IBRA subregion as the primary region in which the project is located.
To be compliant with section 6.15 of the *Biodiversity Conservation Act 2016* a BDAR must be certified within 14 days of the date shown on the finalised credit report. It is noted the date of the BDAR is 23/9/21, and the date on the credit summary report is 19/10/21, which is longer than 14 days. Also, when the credit report is printed from the BAM-C, the date is 27/10/21.	Sydney Water acknowledges DPE BCD's comments about the date on the BDAR document and the date on the credit summary report being more than 14 days apart. The cause of this discrepancy was the time needed to apply the web accessibility formatting to the BDAR as part of the consolidated EIS and the subsequent submission of the EIS. An updated finalised credit report was inserted into the report, however updating the date on the cover and the certification page was overlooked. The case was re-opened post finalisation so that a copy could be made to update the credit requirements for the project's Amendment Report (Sydney Water, 2022). Once the updates were made to the alternative version of the calculator case, the case was then finalised again, resulting in a discrepancy in the dates.
Concern that the project will lead to major biodiversity impacts. For example, the proposal will lead to the direct removal of 13.77 ha (non-certified) of vegetation and habitats, which includes 4.37 hectares of the critically endangered ecological community Cumberland Plain	Sydney Water has made substantial efforts to minimise impacts on terrestrial biodiversity during project optioneering and reference design as outlined in Chapter 3 of the EIS. Terrestrial biodiversity was a critical factor in balancing environment, heritage, community, constructability and cost. Since the EIS was finalised, Sydney Water has further reduced terrestrial biodiversity impacts through several pipeline re-alignments as outlined in the project's Amendment Report

Issue raised	Response
Woodland of which 0.93 ha is classed as being in 'intact' condition. A number of other threatened ecological communities, threatened flora species and threatened fauna habitats will also be lost. DPE BCD recommends that further avoidance of biodiversity values be considered.	(Sydney Water, 2022). The most significant reduction is around Kemps Creek, where impacts to threatened ecological communities (TECs) and threatened species habitat have been substantially reduced. In addition, Table 15-3 of the EIS includes a range of terrestrial biodiversity management measures committing to investigate opportunities to further reduce impacts as design and construction progress.

5.4.39 Terrestrial biodiversity – Sydney Region Growth Centres Biodiversity Certification

Issue description

DPE BCD raises several issues related to the project's interaction with Sydney Growth Centres Biodiversity Certification. Table 5-19 responds to each of these.

Response

Table 5-19 Response to DPE BCD comments on Sydney Growth Centres Biodiversity Certification

Issue raised	Response
ENV and red hatched areas DPE BCD notes that section 14.1.1 of the BDAR states that the project will impact 0.33 ha of Existing Native Vegetation (ENV) subject to Relevant Biodiversity Measure (RBM) 8, RBM 11 and RBM 12, where the impact area crosses Kemps Creek. The maps in the BDAR do not depict the location of the validated ENV within the non-certified land to be impacted. There is also a second red-hatched area containing ENV located on Elizabeth Drive at Cross Street that also appears to be impacted by the proposed development that has not been identified on the maps in the BDAR. In regard to the red hatched areas, it is important to note that the two red hatched areas of land are zoned Public Recreation – Regional under Part 3 of the Growth Centres SEPP. The acquisition of red hatched land is a commitment under the Biodiversity Certification Order and the	The Growth Centres SEPP referenced in this submission has been repealed since the EIS was on public exhibition and its provisions incorporated into State Environmental Planning Policy (Precincts – Western Parkland City) 2021. Sydney Water has amended the project in an Amendment Report (Sydney Water, 2022), so the project will no longer impact existing native vegetation mapped within areas subject to RBM 12. Project amendments following public exhibition of the EIS have resulted in a re-alignment to the impact area through the red hatched area crossing Kemps Creek, to avoid impact on existing native vegetation. The changes also mean that the brine pipeline will be installed through existing concrete encasing across Kemps Creek and will not require trenching of Kemps Creek in this location. However, the remainder of the pipeline in this area is proposed to built using open trenching. The brine pipeline alignment and impact area were designed to ensure no impact to the red hatched

Issue raised	Response
Commonwealth Growth Centres Strategic Assessment Approval. RBM 12 specifies 'in the lands marked by a red hatching on the biodiversity certification maps existing native vegetation must not be cleared unless it is in accordance with a plan of management or unless such clearance has been agreed to by the DECC'. To determine the impacts on non-certified ENV and red hatched areas, DPE BCD seeks finer scale maps and shape files depicting the location of the ENV and red hatched areas and the proposed direct and indirect impacts from the development. The revised information should also include details about the proposed construction methods and mitigation measures to minimise impacts. This information is required to inform DPE BCD's consideration of the proposal and decision in regard to RBM 12.	area along Cross Street and this has not changed from the assessment in the EIS. The project will not remove existing native vegetation in the red hatched area in that location. Impacts to ENV as a result of the project are negligible and comprise a total of about 6 m^2 of impact to PCT 849, on Existing Non-Certified land, at the southern access route into Western Sydney Parklands, and about 1.3 m^2 of impact to PCT 849, on Existing Certified land, at Badgerys Creek. GIS shapefiles for project alignments, impact areas and terrestrial biodiversity were provided to DPE as part of Sydney Water's EIS submission. Updated project alignments and impact areas were provided to DPE as part of Sydney Water's Amendment Report submission. Table 15-3 of the EIS outlines measures to manage and mitigate project impacts with measures specific to terrestrial biodiversity in TB01 – TB10. In addition, measure G05 includes developing and implementing a Rehabilitation Management Plan including requirements for rehabilitating areas of native vegetation.
Black Hatched lands DPE BCD notes that the BDAR states that 'The impact area also occurs along the boundary of an area identified by RBM 17 as holding a potential population of Downy Wattle, along Cross St, Kemps Creek, the vegetation was surveyed as per the BAM guidelines Surveying threatened plants and their habitats (DPIE, 2020e), therefore addressing the requirements of this RBM'. RBM 17 requires *Acacia pubescens* to be surveyed to confirm the presence of the species and if present, provide for the protection of the area of suitable habitat for the species to DPE BCD's satisfaction. In order to adequately address RBM 17, DPE BCD seeks further details about the survey undertaken in this specific location including survey method and maps.	The survey effort for *Acacia pubescens* is described in section 8.2 of the BDAR, with survey tracks presented on Figure 9 (pages 9.14 and 9.15). Surveys were undertaken on 12 November 2020 by Biosis experienced botanists Nicola Trulock and Heather Lee-Kiorgaard, and involved parallel transects through areas of potential habitat in that location.

Issue raised	Response
Biodiversity Certification Offset Strategy DPE BCD notes that section 15 in the BDAR states offsets will be secured though either revegetation / restoration at an offsetting ratio of 3:1 (in accordance with the requirements of RBM 8), or through the transfer and retirement of biodiversity credits under the Biodiversity Offset Scheme (BOS), generated from a Biodiversity Stewardship Site within the Growth Centres. DPE BCD requires additional information in regard to the Growth Centres Biodiversity Certification offset strategy including: • the location of the proposed 3:1 restoration including tenure, funding arrangements and proposed measures to ensure long protection, and/or • the location of the Biodiversity Stewardship Site/s within the Growth Centres.	Offsets in accordance with Growth Centres Biodiversity Certification offset strategy are no longer required following the project amendments described above and the avoidance of impacts to existing native vegetation at Kemps Creek.
Growth Centres SEPP – Clause 18A DPE BCD recommends DPE PAG consult with the DPE Infrastructure Planning Team in regard to clause 18A in the Growth Centres SEPP.	Sydney Water considers this is a request for DPE to address. Sydney Water can provide support to these discussions if needed to provide further clarity about the project.

5.4.40 Terrestrial biodiversity - matters of National Environmental Significance

Issue description

DPE BCD raises several issues related to the project's potential impact on matters of National Environmental Significance (MNES). Table 5-20 responds to each of these.

Response

Table 5-20 Response to DPE BCD comments on MNES

Issue raised	Response
General DPE BCD notes that the BDAR outlines that the project was declared a controlled action on 3 December 2020 (EPBC Act referral 2020/8816) as	Sydney Water has addressed DPE BCD's specific comments on these matters in this table.

Issue raised	Response
there are likely to be significant impacts on the following controlling provisions: • Listed threatened species and communities (sections 18 and 18A). • World Heritage properties (s12 and 15A). • National Heritage places (s15B and 15C).	
EPBC Act - Listed threatened species and communities (sections 18 and 18A) DPE BCD's bilateral assessment is detailed in Attachment 2 and has been prepared considering the EPBC notes. As outlined in the advice, DPE BCD does not agree with the conclusion that the project will not have a significant impact on two EPBC Act-listed entities, being Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest and the Spiked Rice-flower (*Pimelea spicata*). Where significant impacts are likely, offsets are required. DPE BCD notes that in accordance with the BAM, like-for-like offsets will be provided for both these entities.	The BDAR (Appendix J to the EIS) concluded that potential impacts to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest and the Spiked Rice-flower (*Pimelea spicata*) would not be significant given the small size of the impacts and presence of other larger higher quality areas of this vegetation community and habitat for the Spiked Rice-flower. In any case, as noted by DPE BCD, Sydney Water will offset these impacts in accordance with the requirements of the BAM. Sydney Water has also proposed amendments to the project in an Amendment Report (Sydney Water, 2022) that reduce impacts on these two entities: • Impacts on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest are reduced from 4.83 ha to 4.48 ha, which is a 7% reduction. • Impacts on suitable habitat for the Spiked Rice-flower are reduced from 2.99 ha to 1.64 ha which is a 26% reduction. This also accounts for an error identified in the original BDAR which overstated the impacts on this species. The Amendment Report provides more detail on these impacts and the identified error. Sydney Water considers this reduction in impacts reinforces the EIS findings that impacts to these biodiversity attributes would not be significant.

5.4.41 Terrestrial biodiversity - work adjacent to National Parks

Issue description

NPWS notes that Appendix J (section 14.4, p408) refers to an outdated 2013 version of NPWS Adjacent development guidelines and recommends the EIS is updated to refer to these current 2020 guidelines.

Response

Sydney Water has reviewed the project against the *NSW Developments adjacent to National Parks and Wildlife Service lands* (NPWS, 2020). Table 5-21 summarises key issues for consideration identified by the guidelines and how these have been addressed by the project.

Table 5-21 Development adjacent to NPWS land – key issues

Key issues	Response
Erosion and sediment control Stormwater runoff	The Soil and Contamination Assessment in Appendix N of the EIS assessed potential erosion and sediment impacts and the Surface Water Impact Assessment in Appendix K assessed potential stormwater runoff impacts. Erosion and sediment impacts would generally be associated with construction activities and therefore be short term and temporary. Stormwater on the AWRC site will be managed using a range of water sensitive urban design measures and there is no adjoining NPWS land downstream of the site. The surface water and soil management measures in Table 15-3 of the EIS will minimise potential for offsite impacts including to NPWS property.
Wastewater	The Hydrodynamics and Water Quality Assessment in Appendix F of the EIS assessed potential water quality impacts of treated water releases. Due to the high level of treatment proposed, overall impacts to water in receiving environments were found to be negligible or positive. The water quality management measures in Table 15-3 of the EIS will minimise potential for offsite impacts including to NPWS property.
Pests, weeds and edge effects	The BDAR in Appendix J of the EIS assessed potential biodiversity impacts including from pests, weeds and edge effects. These impacts would generally be associated with construction activities and therefore be short term and temporary. The terrestrial biodiversity management measures in Table 15-3 of the EIS will minimise potential for offsite impacts including to NPWS property.
Fire and the location of asset protection zones (APZs)	The Health Impact Assessment in Appendix V of the EIS and the Preliminary Hazard Analysis in Appendix W assessed bushfire impacts and potential risk of fire. No APZs are proposed on or adjacent to any NPWS land so there will be no clearing impacts from proposed APZs. The health impact management measures in Table 15-3 of the EIS (and the updates in Appendix B) will minimise potential for bushfire risk including to NPWS property.
Boundary encroachments and access through NPWS land Access to parks	The project will not encroach any NPWS land boundaries or impact access through or to parks or NPWS property.

Key issues	Response
Visual, odour, noise, vibration air quality and amenity impacts	The EIS included a range of studies aimed at addressing potential amenity impacts including: • Landscape Character and Visual Impact Assessment – Appendix T of the EIS • Air Quality and Odour Assessment – Appendix R of the EIS • Noise and Vibration Assessment – Appendix S of the EIS. These assessments concluded that there is potential for some short term offsite amenity impacts during construction. Operational impacts would primarily be from the AWRC site and unlikely to impact any NPWS property. The visual, air quality and noise management measures in Table 15-3 of the EIS will minimise potential for offsite impacts including to NPWS property.
Threats to ecological connectivity and groundwater dependent ecosystems (GDEs)	The BDAR in Appendix J of the EIS assessed biodiversity impacts including to GDEs and ecological connectivity. These impacts would generally be associated with construction activities and therefore be short term and temporary. No GDE or connectivity impacts have been identified in relation to NPWS land. The terrestrial biodiversity management measures in Table 15-3 of the EIS will minimise potential for offsite impacts including to NPWS property.
Cultural heritage	The EIS assessed potential cultural heritage impacts in studies including: • Aboriginal Cultural Heritage Assessment Report – Appendix O of the EIS • Statement of Heritage Impact – Appendix P of the EIS. These assessments identified there would be no impacts to cultural heritage located on NPWS property. However, the heritage management measures in Table 15-3 of the EIS will minimise potential for impacts on cultural heritage not located on NPWS land.

5.4.42 Terrestrial biodiversity - impact on National Park lands

Issue description

NPWS notes that the EIS fails to identify whether the impacts of raised water levels of 5-10 cm would impact NPWS lands, or whether they would occur adjacent to NPWS estate, on other tenures. This is an essential question to answer before undertaking an assessment of impacts to NPWS lands. It is also noted that the Biodiversity Assessment contained in Appendix J (section 14.4, p 408) contains only a very limited discussion of potential impacts to NPWS lands.

Response

The biodiversity assessment has been prepared in accordance with the BAM and examines potential biodiversity impacts that may result from the project regardless of land ownership and does not specific impacts by property owner. The waterways assessments, as detailed in Chapter 8 of the EIS, apply the same approach and have considered impacts regardless of land ownership.

Sydney Water has reviewed the Geographic Information System (GIS) layer available for the NPWS boundary and compared it to modelling undertaken as part of the Ecohydrology and Geomorphology Impact Assessment (Appendix G of the EIS). There are some areas of overlap which generally occur where the NPWS boundary extends into the waterways. As outlined in section 8.7.2 of the EIS there is very little difference between the baseline and impact scenarios, as demonstrated by changes in surface water levels and wetted perimeter in this reach. The water levels in this reach are controlled by the weir and impacts are limited to areas within the main channel that are already subject to periodic inundation. Increases in median surface water levels are predicted to be about three centimetres. Generally, the predicted changes in wetted perimeter are minor (less than one metre), with the exception of a short section about 500 m downstream of the confluence of Warragamba and Nepean rivers, where the increase is predicted to be up to seven metres. This may occur where a slight increase in surface water elevation could inundate a bench or engage a wider cross-section which is reflected in larger changes in wetted perimeter.

Section 14.4 of the BDAR identified that the project would be partly on land adjoining NPWS conservation lands, specifically at the western end of the impact area. Most of the project does not adjoin NPWS property. The impact assessment concluded that there may be some minor indirect impacts to NPWS land during construction of the environmental flows pipeline such as noise and light spill. Appropriate measures have been identified in the EIS to manage these impacts.

Section 5.4.41 assesses impacts to adjoining NPWS land in accordance with the *NSW Developments adjacent to National Parks and Wildlife Service lands* (NPWS 2020).

5.4.43 Terrestrial biodiversity - future reserve at Kemps Creek

Issue description

NPWS notes an area north of the land reserved as Kemps Creek Nature Reserve has been acquired under the NPW Act for future reservation. This land is not shown on maps in the EIS, including those showing other open spaces and conservation lands. NPWS recommends the EIS mapping is updated to also show lands acquired but not yet reserved under NPW Act, as the alignment runs proximate to this NPWS managed land.

Response

Sydney Water has consulted NPWS who advised it has acquired the following two lots under the *National Parks and Wildlife Act 1974*:

- Lot 13 DP1065416.
- Lot 14 DP1065416.

Figure 5-20 shows the land acquired by NPWS in relation to the location of the proposed brine pipeline alignment (as amended in the project's Amendment Report (Sydney Water, 2022)). The brine pipeline will be located about 250 m north of these acquired lots and is therefore not expected to impact them during construction or operation.

Figure 5-20 Additional NPWS acquired land

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

5.4.44 Terrestrial biodiversity - impact on wildlife corridors

Issue description

NPWS notes that as identified in Appendix J, pipeline construction and recovery of areas where the pipeline will be constructed will result in impacts to wildlife corridors (such as South Creek and Kemps Creek corridors). Potential impacts of this loss of connectivity has potential to impact fauna that also use habitat on park, particularly corridors north and east of Kemps Creek Nature Reserve and north and east of lands acquired under NPW Act. Pipeline siting, design and construction methods that minimise extent of this loss of connectivity are required, such as limiting the pipeline corridor and construction footprint to already disturbed areas in this locality.

Response

South Creek and Kemps Creek form potential corridors to wildlife resulting from their riparian vegetation providing cover for fauna movement. As noted in Chapter 3 of the EIS and the BDAR in Appendix J, design teams and ecologists worked collaboratively during early design phases to seek opportunities to minimise impacts on biodiversity values. This is included avoiding impacts in some areas by realigning infrastructure, using different construction methods or narrowing the construction corridor to the minimum safe width through sensitive areas.

In relation to Kemps Creek, Sydney Water has prepared an Amendment Report for the project (Sydney Water, 2022) proposing a realignment of the brine pipeline into an existing disturbed pipeline corridor. This avoids any further disruption to wildlife corridors along Kemps Creek.

Some impacts to vegetation will still occur in constructing the pipeline under South Creek. The impact area was reduced in this area during reference design to minimise impacts.

Sydney Water proposed a range of management measures in Table 15-3 of the EIS to minimise biodiversity impacts during project construction including:

- TB02 – written authorisation required from Sydney Water for all vegetation trimming and clearing.
- TB03 – requirement for the contractor to minimise clearing to the extent practical in the riparian zone.
- TB04 - requiring construction methodologies to be adjusted to further minimise vegetation clearing to the extent practical during construction works.

In addition, both locations will be rehabilitated after construction in accordance with management measure in G05 in Table 15-3 of the EIS, which commits to preparing and implementing a Rehabilitation Management Plan. This will minimise the ongoing impacts of vegetation removal on wildlife connectivity.

5.4.45 Socio-economics - recreational access to Blue Mountains National Park

Issue description

NPWS suggests that increased water levels in the Nepean River would in turn increase water levels at Glenbrook Creek, causing high water levels for longer periods over the causeway crossing to Euroka. Inundation of this causeway impacts visitation levels and so higher water levels are anticipated to impact NPWS visitors' ability (bushwalking and vehicle access) to access certain sections of Blue Mountains National Park.

Response

The hydrologic changes will have no effect on the Glenbrook Creek causeway (Oaks Trail Crossing) to Euroka. The steep longitudinal gradient of Glenbrook Creek upstream of the Nepean River confluence means that the effects of increased water levels in Nepean River as a result of treated water releases are negligible. This is because the causeway is about 2.8 km upstream of Nepean River and at an elevation of about 45 m higher than the area potentially impacted by the project. This is shown in Figure 5-21 which highlights the potential zone of increased water levels relative to the gradient along Glenbrook Creek. The location of the Oaks Trail crossing is also shown for context. The figure was created using available 2017 one-metre LiDAR. Any changes in flow levels in Glenbrook Creek will be localised to the confluence with the Nepean River and will not impact on bushwalking or vehicle access upstream.

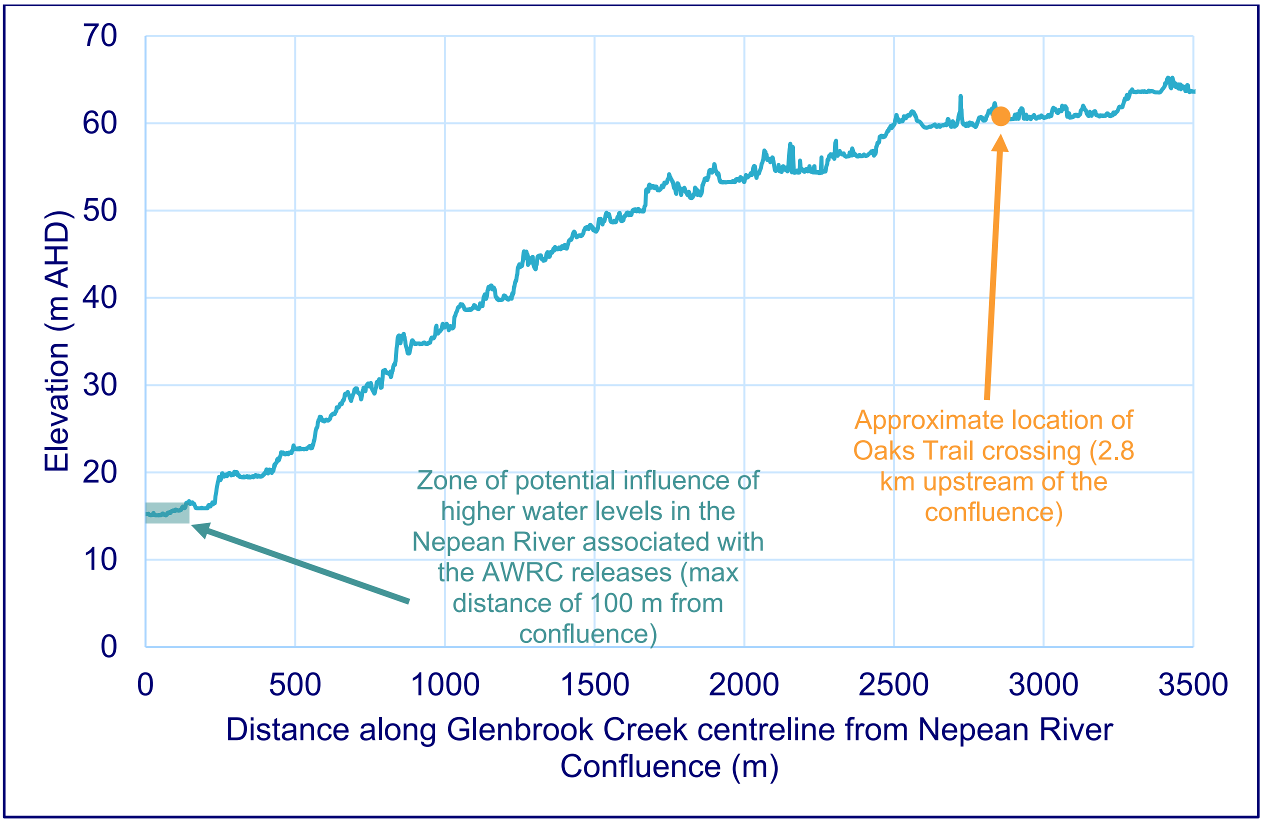


Figure 5-21 Longitudinal profile for Glenbrook Creek

5.4.46 Terrestrial biodiversity - cumulative impacts with Warragamba Dam wall raising

Issue description

NPWS notes that Table 7-5 (Appendix L, p161) provides that Warragamba Dam Raising EIS is still under development and impacts have not been published, however Warragamba Dam EIS is currently on public exhibition. The International Union for Conservation of Nature (IUCN) has noted alarm at the proposed raising of Warragamba Dam would inundate over 1,000 ha of the GBMWHA and 3,700 ha of the surrounding national park. The EIS should be updated to also consider the cumulative impacts of the subject proposal alongside the dam raising proposal.

Response

The Warragamba Dam Raising EIS went on public exhibition on 29 September 2021, shortly before the Upper South Creek AWRC EIS was submitted to DPE. As a result, the EIS did not include a detailed assessment of potential cumulative impacts associated with the Warragamba Dam Raising. Sydney Water has since reviewed the Warragamba Dam Raising EIS and provides the following assessment of potential cumulative impacts, focused on matters most relevant to impacts on the World heritage area. Sydney Water considers that the cumulative impacts on other environmental matters are minor, as described in the EIS. The Warragamba Dam Raising EIS assesses impacts upstream and downstream of the Warragamba Dam.

Water quality, geomorphology and aquatic ecology

The assessment of cumulative waterway impacts has focused on downstream impacts, given that the AWRC releases are located on Nepean River and Warragamba River downstream of Warragamba Dam.

There is potential for cumulative impacts to occur if construction of both projects occurs at the same time and contaminated runoff from construction activities enters waterways, impacting water quality and aquatic ecology. There is also the cumulative impact of direct impacts to aquatic habitat for works within waterways or immediately adjacent to waterways. The project has a relatively small footprint compared to the Warragamba Dam Raising and is therefore expected to have only negligible to minor contributions to cumulative impacts during construction. Impacts can be effectively managed through the use of standard management and restoration measures.

During operation, the Warragamba Dam Raising would provide about 1000 GL of storage in the Flood Management Zone (FMZ) and would reduce peak flows and water levels downstream during flood events. Flood water stored in the FMZ would be discharged from the dam in a controlled manner. The protocol for this has not yet been finalised, however Chapter 15 of the Warragamba Dam Raising EIS assessed a discharge of 100 GL/day during flood events. The EIS also noted a discharge of about 48 GL/day following minor rainfall events.

The Warragamba Dam Raising will reduce the overall floodplain inundation extent during flood events but result in an increase in the flood duration of low level flooding as the FMZ is released slowly following the event. AWRC releases to Nepean River and/or Warragamba River would continue to occur during these flood events and during FMZ discharges from the dam. However, even at the maximum release rate of 1.7*ADWF (85 ML/day), this only represents about 0.1 to 0.2% of the potential releases from the Dam.

The Warragamba Dam Raising EIS predicted negligible impacts on the downstream environment from changes in water quality from the FMZ discharges, however it did predict an increase in the risk of bank erosion downstream due to the prolonged release of FMZ flows. AWRC releases were predicted in Appendix G of the EIS to result in negligible changes in velocity and shear stress in Nepean River downstream of Warragamba River. Given the small changes in the hydraulic metrics and the planform-controlled nature of the channel and banks geomorphic implications are predicted to be minor. Therefore, cumulative geomorphic impacts are predicted to be negligible.

The Warragamba Dam Raising EIS identified that aquatic ecology may be impacted by the modified flood regime. For example, existing wetland and flood plain habitats that are dependent on a specific long-term flooding regime may be impacted due to the reduction in frequency of flooding. Given the small flow contribution of AWRC releases during flood events and the predicted negligible cumulative impacts to water quality and geomorphology, cumulative impacts to aquatic ecology are also predicted to be negligible.

Terrestrial biodiversity

The Warragamba Dam Raising project is likely to impact some of the same biodiversity values as the project. However impacts associated with the project are a small fraction of the impacts associated with Warragamba Dam Raising project. Accordingly, the conclusions in the project's BDAR remain valid. That is, the Upper South Creek AWRC project does not make a significant contribution to cumulative impacts on biodiversity values in the Western Sydney region.

Table 5-22 provides a revised cumulative impact assessment incorporating impacts from the Warragamba Dam Raising EIS and revised impacts for the Upper South Creek AWRC project as detailed in the Amendment Report (Sydney Water, 2022) which has resulted in a net reduction in biodiversity impacts.

Flooding

The assessment described in Appendix L of the EIS identified potential impacts to the flood environment from the treated water and environment flow releases to the Nepean and Warragamba Rivers. The assessment considered a range of flood flows obtained from existing flood study information and identified the proportion of releases to flood flows within both the Nepean and Warragamba rivers would be negligible and therefore a negligible impact. For the Nepean River this proportion is about 0.04% of the 1% AEP event and 0.02% the PMF. For the Warragamba River this proportion is about 0.04% of the 1 % AEP event and about 0.007% of the 0.001% AEP events.

For the range of flood flows considered, the increase in flood level is less than 5 mm for each event. Therefore, there is a negligible impact to existing flood levels.

Given the impact of the project’s releases on the existing flood environment is negligible, any cumulative impacts with the Warragamba Dam Raising remain negligible.

Table 5-22 Revised cumulative terrestrial biodiversity assessment

Projects	Western Sydney International Airport	Sydney Metro Western Sydney Airport	M12 Motorway	The Northern Road Upgrade – Glenmore to Bringelly	Warragamba Dam Raising	Upper South Creek AWRC	Cumulative impact
Plant Community Type and fauna habitat (ha) impacted							
PCT 724 Castlereagh Shale – Gravel Transition Forest	10.6	7.27	6.91	-	46.9	1.58	26.36
PCT 725 Castlereagh Ironbark Forest	-	-	-	-	-	0.01	0.01
PCT 781 Coastal Freshwater Wetland	35.4	-	-	-	907.42	0.02	35.42
PCT 835 Cumberland River-flat Forest	110.7	15.93	3.23	4.29	1215.56	4.56	138.71
PCT 849 Cumberland Shale Plains Woodland	250.9	33.32	6.09	6.67	182.56	4.83	301.81
PCT 1083 Coastal Sandstone Ridgetop Woodland	-	-	-	-	28.63	1.38	1.38
PCT 1105 River Oak Open Forest	-	-	-	-	67.31	0.40	0.40
PCT 1181 Hinterland Sandstone Gully Forest	-	-	-	-	228.02	0.07	0.07
PCT 1800 Cumberland Swamp Oak Riparian Forest	-	4.11	2.53	2.53	164.96	0.92	10.09

Projects	Western Sydney International Airport	Sydney Metro Western Sydney Airport	M12 Motorway	The Northern Road Upgrade – Glenmore to Bringelly	Warragamba Dam Raising	Upper South Creek AWRC	Cumulative impact
Threatened ecological communities (ha) impacted - BC Act							
Cumberland Plain Woodland CEEC	242.8	11.67	60.16	29.14	182.56	4.37	348.14
Freshwater wetlands on coastal floodplains EEC	-	-	-	-	917.73	0.02	0.02
River-flat Eucalypt Forest EEC	42.1	6.64	3.23	4.29	1313.46	4.39	60.65
Shale Gravel Transition Forest EEC	5.0	7.27	6.91		46.9	1.54	20.72
Swamp Oak Floodplain Forest EEC	-	4.11	2.53	-	-	0.88	7.56
Threatened ecological communities (Ha) impacted - EPBC Act							
Coastal Swamp Oak Forest EEC	Not listed at time of assessment	3.67	Not listed at time of assessment	Not listed at time of assessment	-	0.22	3.89
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC	158.4	6.12	38.48	16.37	229.46	1.88	221.25
Acacia pubescens	5.0	12.27	-	-	35	0.16	17.4

Projects	Western Sydney International Airport	Sydney Metro Western Sydney Airport	M12 Motorway	The Northern Road Upgrade – Glenmore to Bringelly	Warragamba Dam Raising	Upper South Creek AWRC	Cumulative impact
Pultenaea parviflora	-	4.18	-	0.98	7	0.01	5.2
Callistemon linearifolius	-	-	-	-	-	0.46	0.5
Dillwynia tenuifolia	5.0	21.48	3.63	-	-	0.05	30.2
Grevillea juniperina subsp. juniperina	255.7	18.43	-	-	-	0.05	274.2
Marsdenia viridiflora subsp. viridiflora	255.7	14.79	-	0.68	Medium	0.54	271.7
Pultenaea pedunculata	-	-	-	-	-	0.05	0.1
Pimelea spicata	-	8.06	-	-	Medium	2.99	11.0
Known threatened fauna impacts (Ha)							
Chalinolobus dwyeri	-	-	-	26.25	1203.02	3.48	29.7
Meridolum corneovirens	141.8	1.64	1.86	16.37	Medium	8.95	170.6
Miniopterus orianae oceanensis	-	-	-	-	-	1.56	1.5
Myotis macropus	-	9.83	0.92	-	863.79	7.62	18.4

Notes on Warragamba Dam Raising assessment data:

- Impacts to PCTs and TECs are a combined total of upstream and downstream impacts. Downstream impacts are less certain due to the main vector of these impacts being altered flooding regimes only, rather than assumed permanent inundation as is the impact vector upstream of the dam.
- Impacts to species upstream of the dam wall have been presented in the EIS as an area of impact based on assumed permanent inundation, impacts to species downstream of the dam wall have been presented in the EIS as ‘impact risk’ only. Where no impacts are expected to occur upstream of the dam, only the potential downstream impacts are presented above.

Aboriginal heritage

The EIS for the Warragamba Dam Raising project identified the following Aboriginal heritage impacts:

- **Archaeological findings:** The survey extent identified 334 archaeological sites in the upstream study area and adjoining land, comprising previously recorded sites and new sites.
- **Sites within the upstream impact area:** Representative survey sampling allowed for the development of a predicative model to estimate the potential of 174 sites (including 43 identified sites) to be within the upstream impact area. The construction works at the dam will not harm any known Aboriginal sites.
- **Archaeological scientific significance:** The archaeological significance of sites identified within the upstream impact area is categorised as low, medium or high scientific significance. However, the sites are all assessed by the Registered Aboriginal Parties as high from a cultural significance perspective.

In comparison the ACHAR (KNC, 2021) for the project identified 15 artefact sites or Potential Archaeological Deposits (PADs) that would be partially impacted by the project. All Aboriginal heritage sites that may be impacted by the project have been deemed to be of lower moderate significance with impacts to all site of high significance identified in the impact area having been avoided during project development.

Given the relatively small level of impacts from the project compared with the Warragamba Dam Raising project, the project's contribution to cumulative Aboriginal heritage impacts is considered minor.

Non-Aboriginal heritage

The Warragamba Dam Raising project EIS identified three non-Aboriginal heritage items that would potentially be impacted by the dam raising:

- Warragamba Dam - Haviland Park (SHR No. 01375)
- Warragamba Emergency Scheme (SHR No. 01376)
- Warragamba Supply Scheme (WaterNSW s170 No. 4580161).

Table 5-23 summarises the potential cumulative non-Aboriginal heritage impacts associated with the Warragamba Dam Raising project when considered in conjunction with the AWRC project.

Table 5-23 Cumulative non-Aboriginal heritage impacts with Warragamba Dam Raising project

Heritage item	Warragamba Dam Raising impact	USC AWRC impact	Cumulative impact
Warragamba Dam - Haviland Park (State Heritage Register (SHR) No. 01375)	High direct (physical) and moderate indirect (visual) impacts	No direct or indirect impacts	None

Heritage item	Warragamba Dam Raising impact	USC AWRC impact	Cumulative impact
Warragamba Emergency Scheme (SHR No. 01376)	Low direct (physical) and low indirect (visual) impacts	No direct (physical) and low indirect (visual) impacts	Negligible
Warragamba Supply Scheme (WaterNSW s170 No. 4580161).	High direct (physical) and moderate indirect (visual) impacts	No direct (physical) and low indirect (visual) impacts	Negligible.

World and National heritage

The Warragamba Dam Raising EIS has identified that project may result in degradation or damage to the World Heritage values under Criterion X, while impacts to Criterion IX have been identified as being capable of being mitigated through offsets. Additionally, the Warragamba Dam Raising EIS would have impacts on Aboriginal heritage and other additional values, not formally identified within the OUVs. As noted in Appendix Q of the EIS, the Upper South Creek AWRC project will not have a significant impact on World heritage values or other additional values, as it will not result in the loss of, damage/degrade or notably alter, modify, obscure or diminish a heritage value. Although a slight negative impact to biodiversity has been identified, related to an increased inundation frequency for a 0.19 ha area, this is negligible compared with the upstream impact area of about 1,400 hectares potentially impacted by the Warragamba Dam Raising project. Accordingly, the project's cumulative impacts with the Warragamba Dam Raising project are considered to be negligible.

5.5 Department of Planning and Environment - Water

5.5.1 Groundwater - extraction

Issue description

DPE Water requests an estimated take from each relevant groundwater source due to groundwater interference. It notes that the project crosses multiple water sources, and notes that Sydney Basin Central Groundwater Source is over allocated.

DPE Water also requests that Sydney Water demonstrate adequate groundwater entitlements can be obtained for the project's expected water take or provide evidence that an exemption applies under Clause 7 of Schedule 4 of the Water Management (General) Regulation 2018. DPE Water notes that a Water Access Licence must be obtained from the Natural Resources Access Regulator (NRAR) prior to water take unless an exemption to this regulation applies.

Response

The assessment in Appendix M and section 9.4 of the EIS estimates water take for the project from the Sydney Basin Central groundwater source. To address comments from DPE Water, Sydney Water has revised the groundwater assessment to include the two groundwater sources indicated within the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. Table 5-24 summarises the revised water take predictions. Appendix H of this report includes the revised calculations.

Table 5-24 Revised water take predictions for the project

Project element	Groundwater Source	Predicted water take (for duration of the project)
Advanced Water Recycling Centre (AWRC) site	Sydney Basin Central	57 ML
Brine pipeline and treated water pipeline to Nepean River	Sydney Basin Central	7 ML
Environmental flows pipeline	Sydney Basin Nepean	1.9 ML

Modelling described in Appendix N and section 9.4 of the EIS and Appendix H of this report indicates that during construction the predicted water take for the Sydney Basin Central groundwater source will exceed 3 ML/year so the project is not exempt and a Water Access Licence under Clause 7 of Schedule 4 of the Water Management (General) Regulation 2018 will be required. Predicted water take from the Sydney Basin Nepean groundwater source is 1.9 ML/year and is therefore exempt.

Sydney Water holds a water access licence (entitlement) for the Sydney Central basin groundwater source. The Controlled Allocation Order (Various Groundwater Sources) 2021 has indicated that 693 water share units are available from the Sydney Central Basin groundwater source. Sydney Water is currently seeking to secure continuing water share units under this order for 2021/2022 to meet project needs across the business.

For 2022/2023, if a shortfall in water share units occurs, Sydney Water will seek to secure additional water share units in the next available Controlled Allocation, or under Section 71T (assignment of water allocations) of the *Water Management Act 2000* to ensure project needs across the business, including for this project, are met. Sydney Water has secured temporary water assignments in the past under Section 71T, and currently holds 24 ML for the 2021/2022 water year on its water access licence for the Sydney Central Basin.

Sydney Water has also updated the Groundwater Impact Assessment and included it as Appendix H of this Submissions Report. The key changes include:

- Executive summary includes a summary of water take volumes from each groundwater source.

- Section 2.0, Table 2-1 includes detail on the ‘Sydney Basin Nepean groundwater source’ as described in the Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2011.
- Section 4.9 includes information about the ‘Sydney Basin Nepean groundwater source’.
- In section 7.2.1, the groundwater source is now defined in each summary section of the pipeline assessment.
- In section 7.13, an additional column for ‘groundwater source’ is included in the calculation summary table so that the water take from each source is defined.
- In Appendix B, an additional column for ‘ground water source’ is included in the calculation table so that the water take from each source is defined.
- Section 11 includes a summary of water take volumes from each groundwater source.

5.5.2 Design requirements and aquatic ecology - works on waterfront land

Issue description

DPE Water requests confirmation that the launch site for tunnelling the pipeline under watercourses is outside of the riparian area and setback in accordance with the NRAR Guidelines for Controlled Activities. It also requests details of rehabilitation measures proposed for the trenched pipeline installed across watercourses and the duration the trench will be present.

DPE Water also notes that all works on waterfront land (as defined in the *Water Management Act 2000*) must be in accordance with the NRAR Guidelines for Controlled Activities on Waterfront Land, including outlets, setbacks and riparian planting.

Response

Sydney Water has cross checked the proposed tunnelling launch and receival pit locations for waterway crossings against the NRAR Guidelines for Controlled Activities. Table 5-25 shows that some launch and receival pits for tunnelled waterway crossings are located outside the riparian corridors as specified in the NRAR Guidelines for Controlled Activities. The exceptions to this are Clear Paddock Creek, Green Valley Creek, Jerrys Creek and Nepean River crossings. Clear Paddock Creek and Green Valley Creek are stormwater pipelines in highly urban environments at the brine pipeline crossing locations. Accordingly, no impacts to riparian corridors are expected. For Jerrys Creek and Nepean River crossings, the launch and receival pits will be located in previously cleared areas and will not impact riparian vegetation.

Table 5-25 Works on waterfront land

Waterway	Watercourse type	Total riparian corridor width	Pipeline tunnel launch/receival pit located within riparian corridor (Y/N)
Clear Paddock Creek	1st order	20 m + channel width	Y
Green Valley Creek	1st order	20 m + channel width	Y
Prospect Creek	5th order	80 m + channel width	N
Badgerys Creek	4th order	80 m + channel width	N
Jerrys Creek	4th order	80 m + channel width	Y
Nepean River	7th order	80 m + channel width	Y
Megarritys Creek	3rd order	60 m + channel width	N

Management measure G05 commits to developing and implementing a Rehabilitation Management Plan to restore pipeline work sites. This includes enhancing aquatic habitat and restoring creeks to an improved state when trenching is required. Section 4.9.1 of the EIS outlines the construction phases and timing for pipeline construction. Open trench construction will progress at a rate of about 12 m – 24 m per day and have a duration of between eight to 10 weeks in any given area. The timing and duration of construction at each location will be confirmed during construction planning in detailed design.

Sydney Water has added an additional management measure (WW21A) in Appendix B to incorporate recommendations in the 'Guidelines for controlled activities on waterfront land' (NRAR 2018), where reasonable and practicable.

5.5.3 Terrestrial biodiversity - groundwater dependent ecosystems

Issue description

DPE Water requests that Sydney Water identify whether any groundwater dependent ecosystems (GDEs), determined to have high or very high conservation/ecological values, are likely to be impacted by groundwater drawdowns from the project. For context, the submission notes that the NSW Aquifer Interference Policy refers to impacts to high-priority GDEs listed in the relevant Water Sharing Plan - distinguished from GDE potential depicted in the Bureau of Meteorology Atlas. While the project is not likely to impact any GDEs listed in the current Water Sharing Plan (WSP), additional GDEs with high ecological value have been identified since commencement of the WSP which, upon the plan remake, will likely also be listed as high-priority GDEs.

DPE Water also notes that if any of these GDEs are identified, Sydney Water should provide further detail of drawdown impacts on these GDEs to give DPE Water confidence that long-term viability of these GDEs will not be compromised by the project. This should include consideration of the magnitude and duration of predicted drawdowns at relevant locations and may result in the need for pre- and post- development floristic monitoring.

Response

Section 9.4 and Table 7-13 in Appendix M of the EIS detail the approach taken to assess impacts to GDEs from drawdown during construction. The approach assesses potential impacts on the long term viability of GDEs in accordance with criteria set out within the NSW Aquifer Interference Policy and includes estimates for inflow, drawdown and the maximum radius of influence for the duration of construction. The project does not impact high priority GDEs listed within the Water Sharing Plan for Greater Metropolitan Region Groundwater Sources 2011, so the assessment is based on GDEs identified by the Bureau of Meteorology Atlas within the study area. The assessment concluded that because drawdown impacts were temporary the long term viability of GDEs identified within the study area would not be impacted by the project.

During operation, the proposed AWRC and pipelines have the potential to impact the groundwater systems by causing induced drawdowns from any sub surface drainage systems employed for underground structure floatation management, reducing the availability of groundwater for GDEs and surrounding groundwater users (as detailed in Appendix M of the EIS). Despite this, due to the relatively small size of the excavated areas required during construction and lack of ongoing operational impacts to groundwater, any induced drawdown that may occur is likely to result in an equilibrium that would ultimately preclude ongoing impact. Floristic monitoring is therefore not considered necessary.

Sydney Water notes the assessment in Appendix M and section 9-4 of the EIS is based on the Water Sharing Plan for Greater Metropolitan Region Groundwater Sources 2011 and notes DPE Water's comments that additional GDEs with high ecological value will likely be listed as high priority GDEs in future revisions. As GDEs which may be listed in the future are currently unknown it is not possible to assess impacts on them. However, the EIS demonstrated the project will have minor impacts to groundwater, with most impacts temporary during the construction phase. Impacts to additional GDEs listed in the future are therefore considered unlikely.

5.5.4 Groundwater - legibility of tables in groundwater impact assessment

Issue description

DPE Water requests Sydney Water check and rectify the legibility of all tables contained in Appendix M Groundwater Impact Assessment - Part 2, sub-Appendix A.

Response

Sydney Water has revised Appendix M Groundwater Impact Assessment – Part 2, sub Appendix A of the EIS to ensure all tables are legible. This is included in Appendix H of this report.

5.5.5 Groundwater - management measures

Issue description

DPE Water provides a list of other groundwater requirements that it recommends be applied to the project post-determination:

- Prepare a Dewatering Management Plan consistent with the requirements set out in the NSW Government guideline 'Minimum requirements for building site groundwater investigations and reporting' (DPIE 2021b), in consultation with DPE Water.
- Prepare a groundwater management and monitoring plan as proposed in the EIS.
- Prepare an Acid Sulfate Soils Management Plan in the event that acid sulfate soils are likely to be intercepted during construction-related activities, particularly around Georges River and Prospect Creek in the eastern portion of the desktop assessment area.

Response

During construction, impacts to groundwater will be effectively managed by groundwater management measures GW01 - GW13 in Table 15-3 of the EIS. These include commitments to manage drawdown from dewatering activities including groundwater monitoring prior to and during construction, which will be included in the Soil and Water Management Plan as part of the overall Construction Environmental Management Plan (CEMP) for the project. As outlined in measure G01 in Table 15-3 of the EIS, the CEMP will be in place prior to construction and prepared in accordance with Environmental Management Plan Guideline – Guideline for Infrastructure Projects (DPIE, 2020b) which requires stakeholder consultation.

Sydney Water has included an additional groundwater management measure (GW14) in Appendix B to ensure the dewatering approach to manage drawdown is consistent with the NSW Government guideline '*Minimum requirements for building site groundwater investigations and reporting* (DPIE, 2021b)'.

Section 9.5 and Appendix N of the EIS identified potential for acid sulfate soils (ASS) around Georges River and Prospect Creek. Management measure CLS01 in Table 15-3 of the EIS commits to developing an ASS management plan in accordance with NSW ASSMAC (1998) guidelines if soil sampling during detailed design confirms this is required.

5.5.6 Ecohydrology and geomorphology - release structure design

Issue description

DPE Water raises several matters relating to the design of release structures to waterways:

- The recommendation for constructed toe armouring for the release chute into river channel at Warragamba release location is supported and should be adopted for all outlet release structures.

- Detailed design for the release structure should consider if constructed energy dissipation controls are also required for the Warragamba River outlet and revegetation requirements to protect and maintain any bank attached bars and/or benches along the river.
- Additional mitigation measures should be incorporated into the detailed design to ensure releases into South Creek do not increase bank shear stress or unit stream power on the bed of South Creek. This should include bed controls, energy dissipation structures and revegetation along South Creek at a minimum from Kemps Creek junction upstream to the vegetated riparian corridor between the AWRC site and Elizabeth Drive.

Response

Sydney Water provides the following response to the three issues raised above:

- Management measure WW12 in Appendix B has been modified to apply to all release locations and to include the requirement for sufficient armouring.
- The reference design for the Warragamba River release structure includes energy dissipation controls, as outlined in section 4.4.2 of the EIS. Management measure WW11 in Table 15-3 of the EIS states that riparian planting and natural bank stabilisation measures will be considered for disturbed areas during detailed design. Environmental flows to Warragamba River will be consistent with current or future dam releases so no additional impact to the river bed or bank is predicted. In addition, the releases represent a negligible flow compared to spill events from Warragamba Dam. Therefore, no revegetation is proposed to protect and maintain any bank attached bars and/or benches along the river. Bars are naturally mobile features and Sydney Water considers they should therefore not be a target of revegetation efforts.
- For South Creek, releases will only occur during wet weather and will represent only a small percentage of flows in the creek. Releases are unlikely to result in more than a negligible change to shear stress or unit stream power. As noted in the first dot point above, management measure WW12 in Appendix B has been expanded to include South Creek. This management measure requires that sufficient erosion control and armouring (for example bed controls, energy dissipation structures) extends sufficiently into the waterway. Revegetation adjacent to South Creek, within the AWRC site, is proposed as part of landscaping plans for the site, as outlined in section 4.4.1 of the EIS.

5.5.7 Ecohydrology and geomorphology - design of pipeline waterway crossings

Issue description

DPE Water notes that Appendix G of the EIS nominates specific river reaches as being of moderate or high sensitivity, using the NSW River Styles database. This is used to select waterway pipeline crossings and, to some extent, outlet release structures for treated wastewater. The selection for pipeline crossing options set out in Table 32 of Appendix G appears reasonable in the context of watercourse stability and sensitivity to further disturbance.

Response

Sydney Water acknowledges DPE Water's comments on waterway sensitivity and considers that no further response is required.

5.5.8 Ecohydrology and geomorphology – urban stream

Issue description

DPE Water notes that Sydney Water has contributed to developing eco-servicing measures and priorities for urban stream networks, focused on South Creek and its tributaries (Tippler et al 2016, Tippler et al 2018, Kermode et al 2020). The priorities outlined in these papers should form the basis for mitigation and management of impacted watercourses and stream corridors in the South Creek catchment that may be impacted by treated wastewater release or may transmit lower energy to the release point from the AWRC.

Response

Table 5-26 summarises key papers on eco-servicing measures to which Sydney Water has contributed and their application to the project, in particular to the mitigation and management of waterways impacted by AWRC releases to South Creek.

Table 5-26 Summary of eco-servicing papers and application to project

Paper	Summary	Application to project
Eco-servicing South Creek Catchment: A case study from Australia's largest urban growth precincts (Tippler et al 2016)	• This paper provides an alternate framework for assessing catchment health by combining ecosystem services, community values and iconic species and ecological communities. The focus for the study is the South Creek catchment. • The framework is presented as an alternative to the application of default ANZECC water quality guidelines.	Section 8.2.1 and 8.4 of the EIS describe the waterway objectives adopted for the project. The development of the waterway objectives included identification of community values and uses, management goals, key risks and the selection of appropriate indicators and guideline values. This used a combination of default guideline values from ANZG (2018) and ANZECC/ARMCANZ (2000)

Paper	Summary	Application to project
		and water quality objectives derived for the South Creek catchment (Western Sydney Planning Partnership, 2020b). This approach was endorsed by the expert panel (refer to Appendix I of the EIS). Sydney Water also sought feedback from stakeholders on the draft objectives at a Waterways Workshop held in December 2020. Impacts to ecological communities and iconic species were assessed as part of the terrestrial biodiversity assessment (section 9.1 of the EIS) and aquatic ecology impact assessment (Chapter 8 of the EIS).
Setting Appropriate Goals for Urban Stream Restoration: A Case Study from Blacktown City Council (Tippler et al 2018)	• This paper provides results of an aquatic and riparian ecology assessment of three reaches of an urban creek that have been subject to staged creek restoration. Aquatic macroinvertebrate, benthic diatom, creek channel condition and riparian vegetation indices were compared between a non-restored reach and two recently restored reaches. • Results showed no significant gains in aquatic biodiversity. The project did not include stormwater treatment or flow mitigation. Significant changes to water quality and quantity, key drivers of aquatic ecosystem condition, were therefore unlikely. • Significant gains in riparian vegetation condition were evident between the non-restored reach and the restored reaches. • Results of the study provide waterway managers with valuable information on setting realistic and achievable objectives for urban stream restoration projects.	Assessment of the potential water quality and hydrology driven impacts to the aquatic and riparian ecosystems in South Creek are based on comparisons with the water quality and flow objectives for South Creek. Potential water quality impacts to the Nepean River are assessed against ANZG (2018) guideline values and potential hydrological impacts are assessed using modelled baseline and impact scenarios. The combination of the objectives, guideline values and modelled scenarios provide a realistic, waterway specific set of guidelines on which to best quantify the extent and severity of potential impacts to the aquatic and riparian ecosystems within the study area of the EIS.

Paper	Summary	Application to project
Development and application of the Urban Streamflow Impact Assessment (USIA) to inform stream protection and rehabilitation (Vietz et al 2018) Urban Streamflow Impact Assessment (USIA): a novel approach for protecting urbanising waterways and providing the justification for integrated water Management (Kermode et al 2020)	• These papers describe the development and application of a new method termed the 'Urban Streamflow Impact Assessment' (USIA) which assesses the role of streamflow in degrading waterways in urban catchments and identifies risks for planning scenarios. USIA has been applied to case studies in the South Creek catchment and Stonequarry Creek at Picton. • Kermode et al (2020) includes recommendations for further testing and development of USIA.	Relevant USIA metrics developed for South Creek and discussed in these papers were adopted in the Ecohydrology and Geomorphology Assessment and were used to understand the potential for impacts to South Creek from the AWRC releases. The approach is summarised in section 8.2.3 of the EIS.

5.5.9 Ecohydrology and geomorphology - management measures and monitoring

Issue description

DPE Water makes the following comments in relation to mitigation measures and monitoring of geomorphic changes to waterways:

- Mitigation measures should be considered and incorporated into design and operation of discharge release outlets into the affected rivers in accordance with their sensitivity and resilience to increased concentrated flow. Performance monitoring and reporting must be devised for pipeline crossings and downstream from the outlets into rivers.
- Mitigation measures should be developed in post approval management plans and Trigger Action Response Plans (TARPs) to monitor and report on performance of the release mechanisms and the effects of treated water discharge to the Warragamba River, Nepean River and South Creek.
- The monitoring program devised for channel integrity and erosion risk must form part of a TARP for river morphology and channel integrity to the Nepean River, Warragamba River and South Creek. The TARP must provide details on hydrologic and geomorphic monitoring frequency, sites, geomorphic characteristics and duration and specific actions should geomorphic condition deteriorate on South Creek in land under Sydney Water control. The

TARP must also include reporting on monitoring of backfilled pipeline crossings on watercourses classed as having moderate or high geomorphic sensitivity.

Response

Management measures were included in Table 15-3 and Table 15-4 of the EIS to minimise impacts associated with the construction and operation of the release points. Management measures will form part of specific management plans where relevant.

The measures include further investigation during the detailed design phase to minimise the potential for flow related impacts at the release structures and pipeline crossings. The design will consider site specific geomorphic conditions at each waterway as outlined in management measure WW01 in Table 15-3 of the EIS. This will include consideration of the sensitivity and resilience of the waterways, such as through consideration of geology, lithology and hydraulic conditions, as identified in the Ecohydrology and Geomorphology Impact Assessment.

Section 8.11 of the EIS provides an outline of the proposed waterways monitoring, including monitoring during operation of the AWRC. Table 15-4 of the EIS includes details of monitoring locations and frequency. Post commissioning monitoring of flow related impacts in waterways at release structures and all pipeline crossings will be undertaken at regular intervals but will also be triggered following flood events as outlined in management measures WW25-29.

Management measure WW25 requires a monitoring report to document the results and analysis, including identifying changes that can be attributed to the treated water releases. WW26 and WW27 require a risk assessment to be undertaken should any erosion or sedimentation issues be identified. The risk assessment will identify the need for specific remediation measures or additional monitoring.

Although the format of the post commissioning monitoring plan(s) has not yet been developed, Sydney Water considers that the monitoring program and reporting proposed in the EIS is consistent with the outcomes sought from the TARP in DPE Water's submission.

5.5.10 Ecohydrology and geomorphology - hydrologic indicators in monitoring

Issue description

DPE Water recommends that during the post determination phase, Sydney Water should devise hydrologic indicators of potential bed mobilisation and erosion at the following locations:

- Trenched pipeline crossings of watercourses identified as moderately or highly sensitive in Appendix G of the EIS (Ecohydrology and Geomorphology Impact Assessment). DPE Water notes that these waterways may be destabilised due to scour from high flows traversing the backfilled trenches.
- South Creek immediately upstream and downstream of the AWRC.

DPE Water recommends that these indicators should be the basis for ongoing monitoring of the state of channel following high flow events under the catchment development scenarios presented in Tables C1, C2, C6 and C8 of Appendix C of the Geomorphology Assessment (Appendix G of the EIS).

Response

As detailed in Appendix G of the EIS (Ecohydrology and Geomorphology Impact Assessment), construction and operational phase impacts predominantly include the potential for erosion due to removal of vegetation and disturbance of soil layers within the channel, disturbance of floodplain vegetation and sediments, and liberation of sediments and potential sediment smothering downstream. Any changes will be site specific and dependent on the quality of the construction and restoration activities, including permanent erosion control such as armouring and revegetation of the banks and riparian zone. The risk (likelihood and consequence) of these changes cannot be captured within a hydrologic (flow) metric, as it will hold no specificity or relevance to the site (ie this requires hydraulic consideration, not hydrologic). Identification of such issues must be based on site assessments, and the focus will be on identifying geomorphic response through an on-going field monitoring program. This will trigger a response should any bed or bank erosion be observed.

The frequency of the monitoring includes six monthly inspections of the crossings and monitoring after certain rain events as outlined in measure WW27 in Table 15-4 of the EIS. In addition, as there are few (if any) upstream gauge sites for most of the pipeline crossing locations, defining a hydrologic metric or trigger for monitoring would not be possible to implement.

Bed mobilisation and bank erosion are typically associated with flows at bankfull or above (in the order of a one to two year ARI event). Although a hydrologic trigger for on-going bed and bank erosion downstream could be set at this flow level for South Creek, operational flows from the AWRC only occur under wet weather flow conditions and are a relatively small component of flow in the creek under these conditions. This means the relationship between the discharges and bed/bank erosion in the waterway is not direct and identifying how much (if any) erosion is a result of flows from the AWRC would be difficult. Sydney Water considers that the baseline and post-commissioning monitoring proposed in measure WW26 in Table 15-4 of the EIS, is a more effective way of characterising erosion issues in South Creek and will assist in understanding all the potential drivers of erosion in the waterway.

5.5.11 Surface water - site water balance

Issue description

DPE Water requests a consolidated water balance for construction and operational phases including any water take, site water demands, machinery water requirements and where they will be sourced from.

Response

Appendix F of this report includes a consolidated site water balance that includes water take, site water demands, machinery water requirements and water sources.

5.5.12 Construction activities - construction water requirements

Issue description

DPE Water requests details about the water requirements for project construction, including volumes and source. It notes that the EIS states water will be required for the running of equipment but does not provide definite source or volume. It also notes that water demand is mentioned for the environmental flows pipeline but there is no mention for water requirements for construction of other pipelines.

Response

Construction water volume estimates for the AWRC site are about 350 ML over the entire construction timeframe, and about 140 ML for the construction of the pipelines.

Water will be required during construction to operate machinery, suppress dust, hydrotest tanks and pipes, as well as for washing and cleaning. At the AWRC site, construction water will be sourced either from collected stormwater (eg for dust suppression), or from a new drinking water pipeline which will be delivered as part of the access road project which has been assessed under a separate environmental approval. For the pipelines, construction water will mainly be provided by local hydrant connections, or tankered in when required from the local drinking water network. There is potential for about 14 ML of water to be extracted from the Nepean River for construction of the tunnelled section of the environmental flows pipeline between Bents Basin Road and Warragamba River. The need for this will be determined during detailed design and construction planning, if the environmental flows pipeline is built.

5.5.13 Surface water – management measures

Issue description

DPE Water recommends a range of management measures and monitoring to manage surface water and land use impacts of the project. Table 5-27 addresses each of the issues raised.

Response

Table 5-27 Response to DPE Water comments on surface water management

Issue raised	Response
Post-determination. A land use mitigation strategy for the South Creek AWRC site should be developed in concert with the Soil and Water Management Plan proposed by the applicant in consultation with DPE Water. This strategy should be designed to address existing and potential land degradation impacting river channel condition and potential for land use induced increases in water flows entering South Creek, stream flow velocity and unit stream power.	During construction, potential impacts to surface water from land disturbance and erosion are temporary while construction activities are underway and can be effectively managed by erosion and sediment control measures as part of the Soil and Water Management Plan proposed in management measure SW01 in Table 15-3 of the EIS. This includes progressive construction of operational stormwater management measures for potential use and contribution to stormwater

Issue raised	Response
	management during construction to manage land use induced increases in water flows entering South Creek. During operation, changes to surface runoff can be managed effectively by implementing a range of Water Sensitive Urban Design measures on the AWRC site. Management measure SW02 in Table 15-3 of the EIS commits to the design and implementation of a range of Water Sensitive Urban Design (WSUD) measures that ensure the operational releases achieve water quality and flow objectives (Western Sydney Planning Partnership, 2020a) for South Creek. Section 9.2 and Appendix K of the EIS showed that by achieving these objectives stormwater management on the AWRC site contributes to the preservation of existing surface flow conditions, with an acceptable impact on existing hydrology in South Creek. Further work in Appendix F of this document now shows that the cease to flow objective will also be achieved. The Ecohydrology and Geomorphology Impact Assessment considered the impact of treated water releases to South Creek (Appendix G of the EIS). South Creek was identified as a moderately sensitive waterway. Future changes in flow regime are predicted to be dominated by changes to catchment landuse. The additional impact of the wet weather AWRC releases on the geomorphic condition of South Creek (including from any changes related to stream flow velocity and unit stream power) is predicted to be negligible. In addition, Sydney Water has committed to management measures to monitor the geomorphological condition of South Creek including measures WW26 and WW28 in Table 15-4 of the EIS. Sydney Water will consult with DPE Water in accordance with management measure G08.

Issue raised	Response
Post-determination. A watercourse erosion mitigation and management strategy should be developed in concert with the Erosion and Sediment Control Plan for the application. This strategy should include planning and development of the site for affected sections of the South Creek AWRC site, transfer pipelines and outlet structures to the Warragamba River, Nepean River and South Creek. This strategy should be developed in consultation with DPE Water and include stream channel monitoring and reporting on channel geomorphic condition.	During construction, potential impacts to surface water from land disturbance and erosion of surfaces are temporary while construction activities are underway and can be effectively managed by measures such as erosion and sediment control considering the guidance in Managing Urban Stormwater: Soils and Construction Guide Volume 1, 4th Ed. (Landcom, 2004). This and a range of other measures will be included in the Soil and Water Management Plan as part of the CEMP for the project. Measures will include the progressive construction of operational stormwater management measures for potential use and contribution to stormwater management during construction to manage land use induced increases in water flows entering South Creek. During operation, Sydney Water has committed to a range of monitoring measures developed to assess any changes in waterways associated with construction works and ongoing releases as outlined in Table 15-4 of the EIS. This includes monitoring of water quality, aquatic ecology and geomorphological changes. Sydney Water will consult with DPE Water in accordance with management measure G08.
Post-determination Mitigation measures in Tables 8-3 (construction) and 8-4 (operation of Appendix K (Surface Water Assessment) should form the basis for performance measures in a site water management plan. Specifically, stormwater and release criteria during high flow events in measures C8, C12-16 of Table 8-3 and O1-O4 of Table 8-4 should be adopted to design response measures to mitigate increased flows from the AWRC site due to construction of hardstand and outlets to South Creek. Mitigation measures proposed in Table 8-2 and 8-3 of Appendix K (Surface Water Assessment) should be adopted as mitigation and performance measures for the project.	The surface water management measures (including measures SW01-SW07) in Table 15-3 of the EIS commit to the management of surface water during construction and operation. These measures have been informed by the recommendations in Table 8-3 and Table 8-4 in Appendix K of the EIS. These and other measures from the waterways, groundwater and soils and contaminated land sections will be included in the Soil and Water Management Plan which will form part of the project's CEMP. As noted above in this table management measure SW02 commits to a design response that includes installing stormwater management facilities that will manage increases in flows for the AWRC site and management measure SW03 commits to the progressive construction of these stormwater management facilities so that they contribute to

Issue raised	Response
	stormwater management during the construction phase. Sydney Water notes that DPE Water refers to several items from Tables 8-3 and 8-4 in Appendix K of the EIS. Sydney Water incorporated these items into the management measures in Table 15-3 of the EIS, as follows: • Item C8 is covered by measures SW02 and SW03. Construction phase stormwater management is covered by measure SW05. • Item C12 is covered by measures WW02, WW04 and WW05. • Items C13 and C14 are covered by measures WW06, WW14, WW15 and WW16. • Item C15 is covered by measures WW04 to WW07, WW11 and WW18. • Item C16 relates to the visual impact associated with the accumulation of leaf litter during instream works however Appendix K concluded this would be temporary and the impact was identified as low. No additional management measure is required. • Items O1-O3 are covered by measure SW02 (and SW03 during construction). • Item O4 relates to minor increases in surface runoff from the discharge structures during operation. Appendix K concluded that there would likely be a negligible change in flows and the impact was identified as low. No additional surface water management measure is required. Sydney Water notes that management measure SW02 has been amended so that post development flows do not exceed pre development flows for the 50%, and 1% AEP events. The 5% flow has been removed because it was used during modelling described in Appendix K of the EIS to test and size the basins but it is not a requirement to manage impacts at the AWRC site.

5.6 Department of Primary Industries (DPI) - Agriculture

5.6.1 Supports project - adequacy of assessment

Issue description

DPI Agriculture's submission notes that the Land Use Conflict Risk Assessment thoroughly explores potential impacts on surrounding agricultural land uses.

Response

Sydney Water notes DPI Agriculture's support of the adequacy of the Land Use Conflict Risk Assessment and considers that no further response is required.

5.6.2 Management measures and stakeholder and community engagement

Issue description

DPI Agriculture notes support for Sydney Water's proposed management measures for continuing consultation with agricultural landowners and including a bird control and biodiversity strategy as part of a Wildlife Management Plan. It also requests to review the draft Wildlife Management Plan from a biosecurity perspective.

Response

Sydney Water notes DPI Agriculture's support for the proposed management measures. Sydney Water will consult with DPI Agriculture on biosecurity management during preparation of the Wildlife Management Plan. This has been included in management measure AO02 in Appendix B.

5.6.3 Design requirements - environmental flows pipeline

Issue description

DPI Agriculture notes that part of the environmental flows pipeline is in mapped Biophysical Strategic Agricultural Land. It notes that in privately owned agricultural land in this area, the environmental flows pipeline should be at a depth that does not prevent ongoing use of the land for agricultural production. DPI Agriculture also notes that pipeline design should accommodate agricultural activities conducted on the land, in consultation with relevant landowners and be consistent with the terms of any easement over the land.

Response

Sydney Water proposes to use open trenching to build the section of the environmental flows pipeline located on Biophysical Strategic Agricultural Land. The pipeline depth will be determined during detailed design, but is likely to be about two to four metres deep. Sydney Water expects that once built, the pipeline would not preclude existing agricultural uses. If this pipeline is built, Sydney Water will likely take an easement where it is located on private property, to allow access for future maintenance. Sydney Water also has guidelines for building over and next to its pipelines, to minimise the risk of damage to these assets (Building over or next to assets).

Sydney Water will consult landowners in this area in accordance with the Community and Stakeholder Engagement Plan in management measure G08 in Table 15-3 of the EIS. This will include discussions about potential impacts on agricultural activities and options to minimise impacts.

5.7 Department of Primary Industries (DPI) - Fisheries

5.7.1 Stakeholder and community engagement

Issue description

DPI Fisheries requests it be consulted in preparation of several management plans:

- Relevant sections of the Construction Environmental Management Plan (CEMP), including the Biodiversity Management Plan, Soil and Water Management Plan and the Site-Specific Riparian Zone Vegetation Plans.
- The site-specific environment management plan for the waterway crossings at Kemps Creek and Hinchinbrook Creek, due to the increased risk of adverse impacts to aquatic ecology from the proposed open trench methodology.

Response

Sydney Water will consult with DPI Fisheries during development of the CEMP, including the Biodiversity Management Plan and Soil and Water Management Plan. An additional management measure (G12) has been added to the management measures table in Appendix B.

Site specific riparian zone vegetation plans are not proposed in the EIS, however the management of riparian vegetation will be considered in the following plans:

- Urban Design and Landscaping Plan for the Advanced Water Recycling Centre (AWRC) site. This plan will incorporate vegetation management that considers the principles of Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, 2012) and the Western Sydney Aerotropolis Riparian Revegetation Strategy (once finalised).
- Biodiversity Management Plan.
- Rehabilitation Management Plan.

The environmental management of the pipeline waterway crossings at Kemps Creek and Hinchinbrook Creek will be captured in the project CEMP and Soil and Water Management Plan, rather than a separate site-specific management plan. As noted in section 4.1, open trenching at Kemps Creek is no longer proposed and the pipeline will be constructed by pipejacking through an existing concrete encasement. Sydney Water will consult with DPI Fisheries about the proposed management measures at Hinchinbrook Creek (refer to new management measure G12 in Appendix B).

5.7.2 Aquatic ecology - construction in and adjacent to waterways

Issue description

DPI Fisheries makes the following comments and recommendations for construction of infrastructure in and adjacent to waterways:

- The mitigation measures suggested in Section 8 of Appendix H of the EIS relating to the risk of frac-outs should be adopted in the CEMP.
- Construction of coffer dams and temporary in-stream structures associated with open trenching should be consistent with the Policy and Guidelines for Fish Habitat Conservation and Management (2013). DPI Fisheries notes that section 6.2.5 provides detailed information on effective management of instream works.
- Support the adoption of the NSW Office of Water (2021) Guidelines for Vegetation Management Plans, Guidelines for Outlet Structures and Riparian Corridors on Waterfront Land.

Response

Tunnelling of pipeline waterway crossings has the potential to cause frac-outs, resulting in a loss of drilling fluid from the bore into waterways. Section 6.2.5, rather than section 8, of the Aquatic Ecology Impact Assessment (Appendix H) discusses frac-outs and recommends that the steps described in section 9.4 of the EIS be implemented to minimise the risk to aquatic ecology. The management measures included in section 9.4 to address the risks associated with frac-outs will be included in the CEMP as outlined in measures GW09 and GW10 in Table 15-3 of the EIS).

In management measure WW14 in Table 15-3 of the EIS, Sydney Water committed to designing and installing coffer dams and temporary in-stream structures associated with open trenching in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013). Sydney Water will ensure design and construction of these structures considers section 6.2.5 in the guidelines as recommended by DPI Fisheries.

In 2012, the NSW Office of Water, within DPI, released the 'Guidelines for controlled activities on waterfront land' (DPI 2012a). These guidelines consist of a series of guidance notes for controlled activities and the protection of waterfront land and waterways, including:

- Guidelines for outlet structures on waterfront land
- Guidelines for laying pipes and cables in watercourses on waterfront land

- Guidelines for instream works on waterfront land
- Guidelines for riparian corridors on waterfront land.
- Guidelines for vegetation management plans on waterfront land
- Guidelines for watercourse crossings on waterfront land

In 2018, the Natural Resources Access Regulator released the 'Guidelines for controlled activities on waterfront land – Riparian corridors'. This document is an update of the DPI guidance note for riparian corridors.

These guidelines, in particular the guidelines for vegetation management plans, were used to guide the EIS management measures for activities within and adjacent to waterways.

Sydney Water has also committed to the following during design and construction:

- The design of the release structure will consider the guidelines for outlet structures (refer to management measure WW19).
- The establishment of a vegetated riparian zone, including the application an offset where operational areas of the AWRC encroach on this, will be undertaken in accordance with the principles of 'Guideline for controlled activities on waterfront land' (DPI 2012a) (management measure WW18).
- The Urban Design and Landscaping Plan will incorporate vegetation management that considers the principles within the guidelines for vegetation management plans on waterfront land (DPI 2012a) (management measure UD01).

Sydney Water will add a new management measure to ensure any other applicable design and construction considerations from these guidelines are adopted, where applicable (refer to management measure WW21A in Appendix B).

5.7.3 Aquatic ecology - avoiding impacts to Australian Bass

Issue description

DPI Fisheries recommends construction within waterways, particularly South Creek, is avoided between late April and early June and from late October to late December to avoid impacts to Australian Bass migration.

Response

The EIS identified that construction within waterways, particularly South Creek and Kemps Creek, has the potential to impact on Australian Bass migration to and from the estuary. The EIS included a management measure (WW17), consistent with DPI Fisheries above recommendation, that construction be avoided during migration periods, which occur from late April and early June, and from late October to late December.

As noted in section 4.1, the brine pipeline will no longer require trenching across Kemps Creek, so the waterway will not be directly impacted. This management measure will continue to apply to South Creek.

5.8 Greater Sydney Parklands

5.8.1 Support for project and design requirements

Issue description

Greater Sydney Parklands supports flexibility in the pipeline alignment to allow the detailed design to adapt to optimise environmental outcomes and protection of more significant vegetation and old growth trees within the Parklands.

Greater Sydney Parklands requests consultation during the detailed design as the route is refined. Greater Sydney Parklands notes that the route and depth should be developed to ensure the works and pipeline have minimal impact on existing vegetation, particularly old growth trees. Any disturbance to recently constructed infrastructure is not supported by Greater Sydney Parklands.

Response

Sydney Water notes Greater Sydney Parklands' support for flexibility in the pipeline alignment. As outlined in Chapter 4 of the EIS, Sydney Water has allowed for some flexibility in pipeline alignment within a defined impact assessment area. Table 15-3 of the EIS also includes a range of management measures to minimise impacts on Western Sydney Parklands, including SELU06 to look for opportunities to mitigate potential construction impacts, and TB03 and TB04 to minimise vegetation disturbance and look for opportunities to avoid sensitive areas. In addition, in management measure SC03 in Table 15-3 of the EIS, Sydney Water has committed to ongoing consultation with Greater Sydney Parklands, to ensure impacts on the parkland and rehabilitation of disturbed areas are appropriately managed, to coordinate any interactions between project infrastructure and future recreation or other facilities.

Sydney Water notes that Greater Sydney Parklands does not support any disturbance to recently constructed infrastructure. Sydney Water has been consulting with Greater Sydney Parklands about recent construction along Range Road and proposes a minor realignment of the brine pipeline in this location to avoid these works. This project change is assessed as part of the project's Amendment Report (Sydney Water, 2022).

5.8.2 Operation activities

Issue description

Greater Sydney Parklands requests that Sydney Water provide details of the maintenance requirements for the pipeline and any restorative vegetation, and clearly outline requirements for access within the Parklands. Greater Sydney Parklands notes that maintenance of the pipeline should not impact on the public recreation and use of the Parklands, or result in increased costs to Greater Sydney Parklands in order to ensure protection of Sydney Water's asset.

Response

Management measure G05 in Table 15-3 of the EIS commits to restoring impacts associated the construction of the pipelines. Sydney Water will develop and implement a Rehabilitation Management Plan which includes restoring areas to pre-construction condition, and rehabilitating areas of native vegetation removal to the highest ecological condition possible.

As outlined in section 4.14.6 of the EIS, any maintenance, replacement and repair of the infrastructure delivered under this EIS is out of scope of the project and assessed as exempt development or in separate planning approvals if needed. Sydney Water undertakes periodic maintenance and inspections of pipelines to monitor their condition and operational efficiency. This includes visual inspections, traverses and CCTV inspections. If required, maintenance and repairs can include relining, patching and cleaning. Most pipeline maintenance and repair can be done from above ground. However, in the unlikely scenario that a pipeline fails then excavation to exhume and re-lay sections of pipelines may be required.

Maintenance and repair work is conducted within the original construction footprint of the pipeline, which minimises impacts to surrounding sensitive areas and public recreation. Except in emergency situations, maintenance and repair work is planned and undertaken in consultation with relevant landowners. This ensures the impacts on landowners and public uses are minimised. Maintenance work on the pipelines will not result in increased costs to Greater Sydney Parklands.

5.8.3 Management measures – socio-economics and terrestrial biodiversity

Issue description

Greater Sydney Parklands requests that the CEMP consider:

- minimal impact to public access within the Parklands
- emerging weed issues
- Phytophthora issues.

Greater Sydney Parklands requests that a separate section be developed in the CEMP to directly address work within the Parklands, for agreement with Greater Sydney Parklands.

Response

Sydney Water included management measures in Table 15-3 of the EIS to:

- further investigate and minimise impacts on social infrastructure (SELU06) which would capture minimising impacts to public access within Western Sydney Parklands
- prevent the spread of weeds and pathogens (TB01) as part of a Biodiversity Management Plan. This would include Phytophthora.

The CEMP will include any relevant specific management measures in relation to the unique features of Western Sydney Parklands as identified in the EIS or through ongoing consultation with Greater Sydney Parklands. The structure of the CEMP has not yet been determined, however, Sydney Water will ensure it is clear which management measures apply to works in Western Sydney Parklands.

5.8.4 Issues beyond the scope of the project

Issue description

Greater Sydney Parklands welcomes ongoing collaboration during detailed design including consideration of opportunities for water re-use for recreational activities within the parklands (eg water play and swimming holes), to improve environmental outcomes and to ensure positive visitor experiences and future access, development and activation of the Parklands for the community.

Response

In management measure SC03 in Table 15-3 of the EIS, Sydney Water has committed to ongoing consultation with Greater Sydney Parklands, to ensure impacts on the parkland and rehabilitation of disturbed areas are appropriately managed, to coordinate any interactions between project infrastructure and future recreation or other facilities. This consultation will focus on impacts of building the brine pipeline on Western Sydney Parklands.

Opportunities for water reuse in Western Sydney Parklands are outside the scope of the project. However, the Advanced Water Recycling Centre (AWRC) will produce recycled water that is suitable for a range of uses including in open space. Sydney Water's current planning for recycled water produced by the AWRC is focused on establishing recycled water servicing plans for the initial Aerotropolis precincts (Northern Gateway, Aerotropolis Core, South Creek and Agribusiness). Sydney Water can consider other specific requests for commercial arrangements to supply recycled water on a case-by-case basis.

For clarity, the pipeline running through Western Sydney Parklands will be transporting a brine waste stream which is not suitable for re-use in recreational activities in Western Sydney Parklands.

5.9 Heritage Council of NSW

5.9.1 Non-Aboriginal heritage - impacts on Upper Canal

Issue description

Where the pipeline is installed below the Upper Canal, Heritage Council of NSW recommends that the Upper Canal be monitored during installation of the pipeline to ensure there is no damage to the Canal due to vibration or impact. If any damage is noticed, work must stop immediately and only resume following rectification and mitigation measures being put in place.

Response

In accordance with management measure NAH02 in Table 15-3 of the EIS, construction of the brine pipeline below the Upper Canal will be undertaken in accordance with WaterNSW guidelines for the Upper Canal and Warragamba Pipelines (WaterNSW, 2021) and include vibration monitoring during pipeline construction. In accordance with management measure NAH07 in Table 15-3 of the EIS, Sydney Water will treat any accidental damage to heritage items as an incident. Incident management and notification processes will be developed as part of the project's Construction Environmental Management Plan (CEMP).

5.9.2 Non-Aboriginal heritage - support for design approach and management measures

Issue description

Heritage NSW notes supports for the following aspects:

- The demonstrated efforts to achieve avoidance of the State significant archaeology associated with Blaxland's Farm Potential Archaeological Site (PAS) 1.
- The mitigation and management measures in the report address the archaeological potential and significance of PAS 1 to 10.
- The recommendation to conduct archaeological testing to establish the presence/absence of State and/or locally significant archaeological deposits in PAS 1, 2, 3, 8, 9 and 10, and assess their nature, extent and preservation status and inform next steps regarding their management.

Response

Sydney Water notes Heritage NSW's support on the above matters and considers no further response is required.

5.9.3 Non-Aboriginal heritage - archaeological testing

Issue description

Heritage NSW makes the following comments in relation to archaeological testing:

- Testing should ideally be conducted ahead of a decision on the State significant infrastructure (SSI) application, as preservation in situ rather than archaeological salvage is the Heritage Council's preferred approach to managing substantially intact and confirmed State significant archaeology.
- Heritage NSW encourages the applicant to make further efforts to achieve avoidance through redesign in cases where State significant archaeology is identified within the development footprint.

- It would be a preferred outcome to conduct the testing as early as possible prior to finalising design in the area of the State significant archaeology and to commit to avoidance and protection of these remains as part of the project. Heritage NSW seeks confirmation of this approach by the Proponent for the project at response to submissions stage.

Response

Sydney Water is not proposing to undertake archaeological testing prior to project approval for several reasons including:

- Several PAS where testing is proposed also have Aboriginal heritage constraints and would require an Aboriginal Heritage Impact Permit (AHIP) for archaeological testing. Project approval would override the need for an AHIP and facilitate testing. Given the processing times for AHIPs, it is also likely that a determination on the project would be made before an AHIP could be obtained. Sydney Water also considers it important to align any testing programs for Aboriginal and non-Aboriginal heritage as outlined in management measure AH03 in Table 15-3 of the EIS.
- Sydney Water has not yet engaged contractors to progress detailed design and construction planning and is unlikely to do so before a decision is made on the project. It is possible the impacts on some PAS will change once detailed design progresses, including opportunities to further minimise or avoid impact. Sydney Water considers an archaeological testing program is most effectively and efficiently done once contracts are awarded to further progress design.

Sydney Water aims to commence the archaeological testing as soon as practical once the project is approved as part of the early works outlined in section 4.7 of the EIS.

Sydney Water has proposed further measures to minimise impacts where significant archaeology is identified. This includes measure NAH05 in Table 15-3 of the EIS which relates to minimising ground disturbance in PAS where practical.

5.9.4 Stakeholder and community engagement

Issue description

Heritage NSW notes that as the site contains local heritage items, and other local items are in the vicinity, advice should be sought from the relevant local councils.

Response

Sydney Water has consulted extensively with councils for the five local government areas in which the project will be located as outlined in section 6.4.2 of the EIS. All of these councils made submissions on the EIS and any local heritage matters raised in those submissions are addressed in this report. Sydney Water will continue consulting with local councils as the project progresses, as outlined in management measure G08 in Table 15-3 of the EIS.

5.10 NSW Environment Protection Authority

5.10.1 Compliance with legislation, regulation and guidelines

Issue description

The NSW Environment Protection Authority (EPA) notes that the proposal would require an environment protection licence (EPL) under clause 36 of Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act) for sewage treatment. Under clause 36, an activity requires a licence if it has a processing capacity that exceeds 2,500 persons equivalent or 750 kilolitres per day (whichever is greater). Stage 1 would treat wastewater flows up to 50 megalitres (50,000 kilolitres) per day, meaning that an EPL is required.

Response

As outlined in section 5.2.6 of the EIS, Sydney Water agrees that an EPL is required, as the project meets the definition of a scheduled activity under clause 36 of Schedule 1.

5.10.2 Release strategy and hydrodynamics and water quality - justification of wet weather discharges to South Creek

Issue description

The EPA considers that insufficient justification has been provided as to the need for wet weather discharges from the Advanced Water Recycling Centre (AWRC) to South Creek. The EPA requests that additional information is required to justify and assess.

The EPA notes that the Hydrodynamic and Water Quality Impact Assessments states that wet weather discharges to South Creek are estimated to occur for three to 14 days each year during wet weather events. For a new contemporary scheme that is based on best practice, there is limited justification for why it should be designed with such a wet weather discharge regime, especially to South Creek where a high expectation for waterway health is being sought in response to the Parkland City vision.

Response

This response covers:

- why Sydney Water needs to allow for wet weather flows from the wastewater collection network to the AWRC, and the measures it takes to reduce these flows
- the rationale for splitting releases between Nepean River and South Creek.

Justification for wet weather flows to AWRC

Wastewater collection networks typically experience wet weather inflow and infiltration as water enters via defects, cracks and non-compliant private plumbing. Inflow of rainwater also occurs where rainwater is incorrectly directed to the wastewater network such as via roof water connections, paving that drains to a sewer gully point and from swimming pools. A large proportion of the wastewater collection network is on private land and it is beyond Sydney Water's control to maintain and prevent inflow and infiltration in these areas.

The AWRC servicing catchment will include a mix of commercial, industrial and residential developments. Stormwater inflow into the network is expected from the early stages of the AWRC being operational due to the stormwater entering wastewater connections during construction stages of surrounding developments. For example, stormwater inflow is often high during early stages of a development where sewer connections in houses are not properly sealed and are exposed to rainwater during construction. These stormwater inflows may reduce as the servicing area becomes more developed and established. The Upper South Creek Servicing Area is expected to be rapidly developed with relatively low density industrial areas, which means there is significant risk of substantial infiltration to the network from private property relative to dry weather flows.

In 2010, Sydney Water developed a low infiltration specification covering planning, design, construction and quality assurance of new gravity wastewater systems to minimise wet weather inflow and infiltration. The following changes were made in the specification for these low infiltration systems:

- Fully cast insitu or fully precast maintenance holes with no segments.
- Increased use of 225 mm maintenance shafts instead of 1200 mm maintenance holes.
- Private connections at least two metres away from Sydney Water wastewater assets.
- Overflow relief gullies to be fitted with leak proof covers.
- Additional acceptance testing and effects liability testing.
- Pipe material - PVC or Polypropylene (PP) pipe with rubber ring joints.

The changes were included in the Sewerage Code of Australia (published by Water Services Association of Australia, WSAA) and Sydney Water's version of the Code (WSAA, 2018). These changes have enabled Sydney Water to develop new wastewater systems that experience no more than 2% inflow and infiltration for a period of 30 years. Sydney Water has trialled low infiltration systems for Mulgoa, Silverdale, Wallacia and Upper Blue Mountains gravity system catchments under the Priority Sewage Program (PSP). These systems have maintained an inflow and infiltration rate of about 2%. As noted in section 3.6 of the EIS, Sydney Water is designing the wastewater collection network for the Upper South Creek Servicing Area to this specification. The 2% infiltration has been used in Sydney Water's modelling to estimate wet weather flows to the AWRC.

This is a much lower inflow and infiltration rate than is achievable across Sydney Water's older wastewater networks, which can range from about 5-30%, because the whole system is new and can be installed with the latest materials and specifications.

Low infiltration systems are considered industry best practice and there are currently no known solutions in Australia or internationally to effectively implement and maintain 0% inflow and infiltration on wastewater networks. Accordingly, the 2% infiltration is the lowest figure that can be achieved in practice, and Sydney Water cannot commit to a lower value given the design limitations.

Given it is not feasible to achieve 0% inflow and infiltration into the network, the only other option that can be considered to remove wet weather releases is to provide additional storage in the network or at the AWRC site. This would temporarily store wet weather flows until the wet weather event has passed then release them to the AWRC for treatment.

Wet weather storage in the network would require storage at all pump stations within the Upper South Creek Servicing Area. This would require significant storage capacities at each pump station location. This infrastructure required for storage of all wet weather flows would be very expensive, due to land acquisition and construction costs. The additional storage would create visual and odour impacts on the community, given the proximity of pump stations to future residential developments. There is also no guarantee that the implemented storage would be sufficient to capture all wet weather events under future climate change scenarios. Sydney Water does not consider complete network storage of wet weather flows to be a feasible solution.

Storage of wet weather flows at the AWRC site also presents a significant challenge given the large scale infrastructure that would be required and the associated cost and impacts. For example, to hold one peak day's excess flows would require about 165 ML of storage volume, based on 50 ML/day of plant inflow. This is about six times the size of the bioreactors at the site, and would require acquisition of significant additional amounts of land. In addition, this would only provide for some retention through a short wet weather period and would not completely avoid wet weather releases to South Creek. Aside from the significant cost of additional land acquisition and infrastructure, storage would require large structures in the landscape with visual and odour impacts. The huge volumes of stormwater generated from the South Creek catchment during these wet weather periods would dominate the loads and flows in South Creek and Nepean River when the AWRC is in peak flow, as demonstrated in the water quality modelling in Appendix F of the EIS. Sydney Water considers that substantial storage for infrequent wet weather flows at the AWRC site is expected to have a net negative impact, given factors such as large scope 3 carbon emissions, visual amenity and odour impacts.

Separate to the project, Sydney Water is also working on options for stormwater harvesting in the South Creek catchment to reduce the diffuse sources of flows and loads to South Creek. This could also potentially reduce some of the wet weather infiltration into the wastewater collection network. Sydney Water has been identified as the trunk drainage manager to plan, design and implement a regional stormwater harvesting scheme to achieve the water quality and flow-related objectives for South Creek. The regional harvesting scheme would be coupled with on lot and street scale interventions to help improve the quality and reduce the quantity of stormwater run-off. This regional approach would significantly reduce stormwater run-off compared to traditional stormwater management approaches for greenfield development areas and as noted above, potentially reduce stormwater infiltration to the wastewater network. Sydney Water is still planning the detail of how this stormwater management approach would work and it could involve treating and managing stormwater at the AWRC site. However, it would not involve transferring stormwater through the wastewater network.

Rationale for releases to Nepean River and South Creek

Sydney Water has designed the project to release flows to Nepean or Warragamba River during normal conditions and when wet weather flows to South Creek occur, preferentially release advanced treated water. This means that wet weather releases to South Creek are better quality than overflows directly from the wastewater collection network or bypasses at conventional wastewater treatment plants. This is because the wet weather releases are a combination of advanced treated water and primary treated water. This level of treatment minimises pollutants to South Creek, and stormwater will be the main contributor of flows and load to South Creek.

The AWRC and pipelines have been designed to release treated wastewater to Nepean or Warragamba Rivers and South Creek. As outlined in section 4.5 of the EIS, the project has been designed so South Creek will only receive flows from the AWRC during severe wet weather events, which is expected to be between 3-14 days per year. This occurs once incoming flows increase above 1.7 x average dry weather flow (ADWF) and the treated water pipeline is at capacity. At this point, advanced treated releases will be incrementally diverted to South Creek until the incoming flows reach 3.0 x ADWF. As the incoming flows to the AWRC increase, the advanced treated releases to Nepean River will reduce, being replaced by tertiary treated water.

Sydney Water has not traditionally adopted the concept of transferring treated water flows out of catchment due to the very high cost of pump and pipe infrastructure, and the ongoing high energy use required for pumping. However, the importance of protecting South Creek and its environmental values by maintaining an intermittent flow regime has required inclusion of the large pump and pipe infrastructure to Nepean River. Transferring all flows, including wet weather flows, from the AWRC to Nepean River would require construction of a ~2.5 m diameter tunnel. This step change in construction method would substantially increase the cost, community and environmental impact of construction.

Given the project's relatively small flow contribution to flows in South Creek compared to stormwater, and the capacity for advanced treatment of a portion of all South Creek releases, Sydney Water considered that the financial, environmental and community costs outweigh the benefits and this option was ruled out. It should also be noted that advanced treatment of significant additional South Creek releases is not technically possible without building storages greater than 100 ML for a 50 ML/day plant, as the reverse osmosis system cannot ramp up and down to cater for peak flow periods.

Sydney Water considers that it is implementing all feasible measures to reduce incoming wet weather flows and operate the AWRC in a way that minimises pollutant loads to South Creek. Sydney Water has designed the project with the most advanced technology that can be practically implemented for each of the treatment streams, and is making significant investment to transfer dry weather and some wet weather flows out of catchment to protect South Creek. As a result, Sydney Water considers it is unnecessary to impose additional costs and impacts of wet weather storage on its customers for a marginal and infrequent increase in wastewater flows receiving advanced treatment.

5.10.3 Project description - wet weather infiltration into wastewater network

Issue description

The EPA notes that Sydney Water is considering the following key design measures to reduce additional water entering the new network during wet weather events. This should have the effect of limiting the need for wet weather discharges to the environment:

- The network is modelled for a maximum of 10 spill events in 10 years. It is proposed that overflow infrastructure only be provided at pump stations and not along the pipeline network.
- Provide leak tight sewers to minimise infiltration to the wastewater mains. This is based on modelling with 2% infiltration, which is consistent with Sydney Water's wastewater system planning guidelines for new greenfield growth areas.

Response

Sydney Water confirms it is considering these design measures for the wastewater network (as outlined in section 3.6 of the EIS) and these form assumptions for the impact assessment in the EIS.

5.10.4 Project description - wastewater management strategy

Issue description

The EPA provides the following comments on the overall management of wastewater:

- The EPA’s policy for new sewage treatment systems is that there should be no discharge of sewage effluent to waters from STPs during average and dry weather conditions, and only during wet conditions as a last resort.
- There should also be no pollution of waters because of sewage overflows during dry weather and that sewage overflows during wet weather should be avoided wherever reasonably practicable.
- It is also noted that that Volume 2 of the EIS (Project Information and Consultation) gives minimal consideration to increasing the capacity of the AWRC to a level where wet weather flows into South Creek are prevented.
- The proponent should provide further information that can demonstrate that the EPA’s policy around wet conditions are satisfied, that appropriate prevention of stormwater ingress into the upstream sewer network will be implemented, and that alternatives to the current proposal (such as increasing wet weather capacity at the plant and increased reuse) are considered in depth.

Response

The release of treated water to inland waterways during average and dry weather could only be avoided if all water was able to be reused or recycled and/or if wastewater was transferred to the Malabar wastewater network.

While the AWRC will produce treated water that is suitable for a range of recycled water uses there is uncertainty about recycled water demands in terms of location, quantity and timing. There is also uncertainty about the commercial arrangements for delivering recycled water schemes. In addition, even if recycled schemes were in place, demand varies (for example, it is typically lower over winter). Sydney Water must maintain the ability to manage excess recycled water when supply exceeds demand, or if a recycled water scheme stops for any period. The scenarios included in the EIS are conservative and consider the maximum releases to waterways. Sydney Water is actively engaging with developers and businesses to understand their potential recycled water applications and how these can be serviced through optimisation of plant and networks. This includes consideration of the desire to provide recycled water for top-up of stormwater reuse systems.

Sydney Water considered the option of transferring treated wastewater or untreated wastewater to the Malabar Wastewater Treatment Plant (WWTP). The option of transferring treated wastewater to Malabar WWTP involved the following:

- Wastewater from the Upper South Creek Servicing Area would be treated at a new secondary WWTP and transferred to the Malabar ocean outfall.
- Major upgrades to the Malabar tunnel network, including Northern Georges River Submain, Liverpool to Ashfield Pipeline and the Southern and Western Suburbs Ocean Outfall Sewer, are required to transfer treated water to the Malabar WWTP.
- Recycled water may be produced but there is limited opportunity to offset Sydney's bulk drinking water demands. As a 'base case', this option represents the typical business as usual approach.

The transfer of untreated wastewater to the Malabar WWTP would require a new transfer network to carry raw wastewater from the Upper South Creek Servicing Area to the Malabar system, as well as an upgrade to the Malabar WWTP and supporting network. No recycled water would be produced through this option.

The preferred option of a centralised AWRC and dry weather release to Nepean River was selected as it would have significant upstream and downstream benefits compared to transferring wastewater to coastal wastewater networks. These benefits are summarised below:

- The high-quality treated water produced as part of this option would support providing additional environmental flows in natural waterways or providing recycled water for greening and urban cooling, as well as increasing resilience against drought and climate change.
- The preferred option has the potential to improve liveability and support economic growth in Western Sydney, has greater alignment with key NSW Government strategies and provides the ability to establish a circular economy hub.

- The preferred option was the lowest cost of all options, measured as net present value (NPV).

The assessment of the shortlisted options clearly demonstrated the advanced wastewater solution to be the optimal solution to address the project need and achieve superior benefits for Sydney Water's customers and Western Sydney.

As outlined in Table 4-7 of the EIS all flows up to 1.3 x ADWF will be treated to advanced quality and released to Nepean and Warragamba Rivers. Wet weather flows to South Creek will only be required during severe wet weather events when flows are ≥3 x ADWF, and they will be mixed with advanced quality water. Releases to South Creek are expected between 3-14 days per year.

Sydney Water notes that options to manage wet weather flows on a system-wide basis have been considered and outlined in section 3.6 of the EIS. This included storage and increasing the capacity of the advanced treatment. Options considered are summarised below:

- Provide full advanced treatment to all wet weather flows at the AWRC, which is not feasible in this system since the treatment process needs consistent flows to operate effectively. If the AWRC was built to cater for (or store) infrequent wet weather flows, it would need to be several times larger and its full capacity would rarely be used.
- Design the wastewater collection network to reduce wet weather infiltration as far as practical (and therefore reduce wet weather flows reaching the AWRC). This is the most efficient and cost-effective approach to managing wet weather flows. Examples of design measures include leak tight sewers and locating pump stations and pipelines outside the 1% annual exceedance probability (AEP) flood level, where practical) to reduce the likelihood of infiltration.
- Store the wet weather flows in the network and progressively feed them into the AWRC treatment process after the wet weather event, which is considered not feasible due to the high cost and space requirements for storage of such large flow volumes.

Further information about wet weather storage, and justification for wet weather infiltration into the network is provided in section 5.10.2.

5.10.5 Hydrodynamics and water quality - strategic context

Issue description

The EPA recognises that the Upper South Creek AWRC is a significant water infrastructure project with major implications for the future direction of wastewater management in Western Sydney. The operation of the AWRC occurs in tandem with major urban expansion as part of the Western Parkland City. This urban expansion may have significant implications for pollutant loads and inflows into the Hawkesbury Nepean River system, as well as recycled water demand. Consequently, it is critical that the EIS accurately assesses the impacts of the AWRC effluent discharges in different future water quality scenarios using a fit-for-purpose model.

The EPA notes that based on the projected quality and quantity of effluent discharges outlined in the Hydrodynamic and Water Quality Impact Assessment, treated effluent discharges from the AWRC may represent a hugely valuable resource in terms of providing environmental flows to the Hawkesbury Nepean River and also in offsetting or diluting other diffuse and point source discharges.

Response

Sydney Water notes the EPA's recognition of the significance of the project and its potential to provide a valuable resource in terms of providing environmental flows to the Hawkesbury Nepean River and offsetting or diluting other diffuse and point source discharges.

Sydney Water agrees that it is it is important that the EIS assesses the impacts of the AWRC using a fit-for-purpose model. The sections below address the EPA's specific comments on this in more detail.

5.10.6 Hydrodynamics and water quality - model and assessment limitations

Issue description

The EPA notes that the EIS has significant limitations in assessing the impacts of the AWRC's treated water releases and surface water impacts on receiving water quality.

The EPA notes that assessment projections are based on Water Quality Response Models (WQRMs) that are hindered by significant modelling limitations (discussed further in subsequent sections). The EPA notes that while the WQRMs developed as part of this EIS represent a huge investment in the right direction, due to a range of uncertainties associated with the current modelling approach, the EPA is unable to assess whether the Hydrodynamic and Water Quality Assessment in Appendix F adequately quantifies the likely impacts of the AWRC operations on the Hawkesbury Nepean River system.

The EPA notes that the WQRMs are hindered by several key scientific knowledge gaps in our understanding of the Hawkesbury Nepean River system that impede the development of a more robust model. These knowledge gaps have previously been identified by the Hawkesbury Nepean Science Working Group which includes representation from EPA, Sydney Water and Department of Planning and Environment – Environment, Energy and Science (DPE EES). A strategic roadmap has been developed to address these gaps in a prioritised manner.

Response

Sydney Water considers that the water quality modelling in the EIS represents a best practice approach and provides a robust assessment of the project's potential impacts on the receiving waterways. Sydney Water has made substantial investment including a best-practice program of calibration to improve the highest priority areas in these models over the last several years, and enhance their effectiveness in assessing project impacts. Sydney Water acknowledges there are areas of future research and model improvement that were not not feasible to address in the timeframes for this project but considers these are unlikely to affect the overall outcomes and conclusions of the assessment in the EIS. Sydney Water will continue to work closely with the Hawkesbury Nepean Science Working Group to progressively address these matters for use on future projects. The content below explains in more detail the model purpose, recent upgrades, limitations and implications for modelling outputs for the project.

The WQRMs have two main functions:

- To coordinate catchment and discharge inputs (including timing and location) and compute downstream dilution and mixing of this material.
- To estimate internal transformations that occur whilst substances are 'in transit'.

The models used have been under development since the initial build in 2012. Significant upgrades to the WQRMs were undertaken throughout 2019, 2020 and 2021. The upgrades included, but were not limited to:

- updates to the modelling software versioning to apply latest advances in modelling hardware and software
- the development of a new standalone model mesh for South Creek to allow high-resolution predictions
- updates of various model datasets and model elements, including updates to WWTP/water recycling plan (WRP) data and extending all boundary condition datasets (eg nutrient input loads) to cover more recent time periods through to 2018
- updates to the catchment inflows through application of updated Source catchment models
- review of biogeochemical and sediment parameter descriptions, units and assigned values based on local evidence, or otherwise relevant literature
- a rigorous new set of analytics tools, applied to allow model comparison against all available monitoring data, to allow assessment of model error and uncertainty.

A key focus of the upgrades was to ensure that the models would be fit for purpose for application in the EIS for this project. In parallel with the upgrades, Sydney Water has worked closely with the Hawkesbury Nepean Science Working Group (comprising of the EPA, DPE EES and Sydney Water) to:

- communicate the ongoing level of model development, calibration and application
- develop a strategic roadmap for the models to guide future investment and research relating to known knowledge gaps.

With respect to the EIS, the Hawkesbury Nepean Science Working Group has been involved in discussions since December 2019 regarding the approach to model structure, calibration, validation and the selected assessment methods. These discussions have included presentations, the provision of briefing papers and monthly updates on model development and application.

While it is acknowledged by Sydney Water and other members of the Science Working Group that there are scientific knowledge gaps relating to the river system, and associated improvements that could be made to the models, Sydney Water does not consider these as concerns for the modelling undertaken for the EIS.

In particular, the Science Working Group discussions primarily relate to specific focused areas of certain model sub-components, mostly regarding the nuance of internal transformations of nutrients. For example, key knowledge gaps identified by the Science Working Group relate to aspects such as sediment nutrient cycling dynamics, macrophyte interactions and improvements in the biogeochemistry process equations. It is valuable to have identified these gaps and future research is planned as part of current and future Sydney Water investment programs.

However, in the context of the release conditions proposed for the AWRC (in terms of locations, quantity and quality of the treated water), the existing model is highly capable of assessing the relative impacts of these changes on ambient water quality – both the changes in loading and dilution and broad-scale changes in subsequent internal transformations. The model improvements that could be expected to be achieved from the proposed further research and development in the model roadmap, would likely reduce uncertainty in scenario assessment. However, they are considered highly unlikely to significantly affect the outcomes and conclusions of the modelling undertaken for the EIS.

In particular, the following broad outcomes from the modelling are considered unlikely to be changed due to future model refinement:

- The nature of the mean benefit realised from diluting ambient river water with the cleaner treated water releases.
- That the relatively poorer quality wet weather releases that enter the river and creek create short-lived and localised impacts that are quickly attenuated.
- That the shift in bioavailable nutrient concentration does not lead to rapid algal bloom formation or appreciable change in algal bloom risk factors.
- That the AWRC inputs are a small driver of change (and mostly beneficial) relative to the broader catchment pressures, and projected climate change impacts.

The suitability of the model for assessing project impacts has also been independently endorsed by three separate reviews as outlined in section 5.10.7.

5.10.7 Hydrodynamics and water quality - model context and performance

Issue description

The EPA notes that the Hydrodynamic and Water Quality Impact Assessment is based on the results from a complex model suite that generally represents the industry standard for this type of exercise. However, the EPA suggests that there are a number of omissions (as identified by the Hawkesbury Nepean Science Working Group) that compromise this effort. The EPA recommends that recognition of these issues and the wider process being undertaken to address them is provided, as well as some discussion of their implications for model performance (ie the ability of the models to reasonably replicate spatial and temporal patterns in key parameters) and scenario assessments.

The EPA also notes that the Hydrodynamic and Water Quality Impact Assessment states that the modelling suite is 'fit for purpose' based on expert reviews, however none of these reviews have been provided or referenced, nor have any summary statistics on model performance, uncertainty, or sources of error been included. This makes it extremely difficult to determine the validity of the assessments made in the Hydrodynamic and Water Quality Impact Assessment.

The EPA notes that diffuse boundary inputs to the WQRMs are a major driver of the model and are also likely to be one of the major sources of error. The EPA notes that it is not possible to assess the validity of these inputs in the absence of any summary statistics or other information from the Model Calibration Report. It would be preferable to provide these summaries in the Hydrodynamic and Water Quality Impact Assessment, and also to discuss sources of error and their implications for the impact assessments. The EPA notes that this was done in a limited sense to provide a sensitivity analysis of the underprediction of flows at Wallacia Weir.

Response

Model limitations

Sydney Water's response in section 5.10.6 provides information about the limitations of the current model version and describes its current level of performance, as well as its fitness for application for the EIS.

Sydney Water does not agree that important processes in the model are omitted. These processes have been accounted for based on best available approaches in this version of the model, until further data and scientific investigations coordinated through the Hawkesbury Nepean Science Working Group road map can be used to develop more sophisticated approaches.

In addition, the justification and rationale for the model process descriptions and parameter selection in this version of the model was undertaken in consultation with DPE EES representatives and is included as Appendix A in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water, 2021a). This report was available upon request as part of the EIS and was subsequently provided to EPA in December 2021.

The Hawkesbury Nepean Science Working Group discussions have focused on elements including the macrophyte model, sediment biogeochemical cycling and internal biogeochemical rate updates linked to particular issues like resuspension, nutrient sorption and denitrification (termed internal processing). These are accounted for in the present simulations using lumped process rates in particular regions. These rates were subject to a calibration procedure to best fit the model with the available field data.

Therefore, although improvements in the process descriptions will ultimately improve the model's ability to capture changes in fine-scale water quality variability and extend its applicability for a wide range of questions, the model in its current form remains fit for purpose for assessing flow and load changes associated with the AWRC release scenarios.

A comprehensive view of the model's performance is provided in the Model Calibration Report (Sydney Water, 2021a). This sought to bring together all available water quality data across the entire system for the past 10 years. All this data was considered in the model calibration process and to independently test (validate) the model's accuracy in resolving key variables and metrics that describe water quality across the entire domain. A 'traffic-light' summary of performance was also included, highlighting in a simple way, the variables, locations and times when predictions were acceptable or where there were issues. Whilst some geographic regions of the model for some variables get a poor status on this summary performance assessment, the fact that most variables perform adequately for much of the domain does suggest that the current approach is capturing the primary drivers that shape water quality variability.

Expert reviews

The following two independent reviews were undertaken of the modelling completed for the EIS:

- Two independent experts, Dr Chris Gippel and Dr Rick van Dam, who reviewed the waterways assessments, including the Hydrodynamic and Water Quality Impact Assessment. Their review conclusions included:
  - 'The Hydrodynamic and water quality impact assessment adequately described the existing conditions of the receiving waters of South Creek and the Warragamba and Nepean rivers based on the available data.'
  - 'The modelling approach that was adopted for the impact assessment, comparing baseline, background and impact scenarios for a representative dry and wet year was appropriate for assessing potential hydrological and water quality impacts of AWRC releases.'
- Brett Miller, Principal Engineer for Hydraulics and Modelling at the UNSW Water Research Laboratory, who undertook an independent review of the calibration of the Hawkesbury Nepean and South Creek hydrodynamic and water quality modelling. Mr Miller's conclusions included:
  - 'the calibrated model is suitable for running the scenarios that are to be considered for the Environmental Impact Statement for the Upper South Creek Advanced Water Recycling Centre'

The review undertaken by Dr Chris Gippel and Dr Rick van Dam is included in Appendix I of the EIS, with the review undertaken by Mr Brett Miller included in Appendix I of this submission.

The Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report was available upon request as part of the EIS and was subsequently provided to the EPA in December 2021. The following material was also provided to the EPA at this time:

- review documentation provided by Mr Brett Miller
- complete set of model results including all scenarios, presentation formats and statistical plots.

Diffuse boundary inputs

The Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report also provides information about the development of the diffuse catchment boundaries including how these interface with the WQRMs and other modelling tools used in the EIS.

The uncertainties in how these diffuse sources are simulated have been acknowledged by the Hawkesbury Nepean Science Working Group. They were also addressed in the EIS in some detail, following recommendations from the initial modelling peer review by Mr Brett Miller of the UNSW Water Research Laboratory. Sydney Water considers that the modelling is of industry best practice, its predictive capability (including weaknesses and uncertainties) has been clearly communicated and the uncertainties were considered when moving to use the model in scenario assessment mode.

This uncertainty was managed through both statistical and sensitivity analysis of model performance as discussed below and described in more detail in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report.

Statistical analysis

The statistical analysis focused on a wide range of indicators including salinity, temperature, nitrogen, phosphorus (species and totals) and chlorophyll *a*. The statistical metrics that were applied included:

- regression coefficient (R)
- bias of average prediction to the average observation (BIAS)
- root mean square (RMS)
- normalised root mean square (NRMS) calculated as RMS normalised by the average observation values.

Using these metrics, Sydney Water identified the level of model performance in the river/estuary/creek and this helped guide calibration adjustments. The final parameter set was then validated on alternate years to show the loading assumptions remained valid over different hydrologic conditions.

Sensitivity analysis

This involved a detailed review of available local information on catchment diffuse export rates, which was used to frame a range of low, most-likely and high emission rates for each land-use type. Using a range of input loads spanning these reported values, Sydney Water then ran an extensive suite of simulations to develop an ‘envelope’ of likely predictions spanning the range of uncertainty in catchment nutrient emission rates. This exercise allowed sensitivity assessment of the in-river variables to external loading uncertainty (catchment sources from the Source modelling), and uncertainty to internal loading from sediment fluxes.

Sydney Water remains committed to continued further improvement in the model’s capability and accuracy, however, is also satisfied that the updated version used for the EIS has no obvious omissions that would affect the broad outcomes of the scenario analysis.

5.10.8 Hydrodynamics and water quality – stormwater modelling approach

Issue description

The EPA notes that it appears that the modelling does not utilise South Creek MUSIC models developed by DPE EES to assess urban stormwater scenarios. The EPA notes that instead this has been done solely using SOURCE, which is not designed to assess changes in flow and pollutant loads due to urbanisation. The EPA requests that justification be provided regarding the absence of the MUSIC models.

The EPA notes that the generalised values/assumptions utilised for stormwater management in the South Creek catchment (ie 'Parkland' and 'Business as Usual (BaU)') are vague and are unlikely to reflect variation according to developer compliance, development age and maintenance. It would be useful to provide upper and lower estimates and their implications for impacts.

Response

The Source model has been extensively used nationally and internationally to assess changes in runoff and pollutant concentrations and loads resulting from land use change, of which urbanisation is one example. The catchments mode of Source is intentionally designed for these types of applications that spatially explore changes in catchment characteristics on flows and water quality.

A limitation of Source is that fine-scale flow dynamics (eg stormwater pipes and junctions) are not fully resolved, and pollutant assimilation in water sensitive urban design (WSUD) type infrastructure may not be fully accounted for at asset-scale resolution. Although this may mean the event scale dynamics are less well resolved, seasonal shifts in flow and nutrient loading can still be resolved to an accurate level, which is the scale most relevant to the receiving water model being used for the project. In addition, an advantage of using a model like Source is to spatially assess the cumulative impacts across the catchment to the receiving water environment, in addition to more localised effects. MUSIC is not designed to operate at these large spatial scales. In Sydney Water's view, it is also not currently practical to integrate Source and MUSIC models. Sydney Water has used MUSIC to inform the surface water assessment in the EIS.

These issues have similarly been tackled using Source for the Swan-Canning catchments in Perth by having clear urban-relevant flow and nutrient export parameters for urban dominated sub-units relative to more traditional (non-urban) catchment areas (Paraska et al. 2021). Another notable example is the Source modelling completed for the Parramatta River Masterplan (PRM) (Sydney Water 2018). The Source catchments model informed a hydrodynamic model of the River to assess compliance against water quality objectives for primary contact recreation (using Enterococci as an indicator). The modelling methodology adopted for the PRM is very similar to that developed for the Upper South Creek AWRC EIS.

The Parkland and BaU stormwater management scenarios provide a representation of bookends of future urban development scenarios. These scenarios are represented in the Source catchment model through changes to the imperviousness values for Parkland and BaU urban forms. The urban land use areas for future urban development scenarios were generated using a series of Geographic Information System (GIS) based rules based on a combination of datasets including a 2017 land use, the consolidated growth forecast geospatial data and land use typology data prepared by COX Architecture for the Aerotropolis. COX Architecture typology metrics show the amount of land dedicated to a typology within each area, precinct, and sub-catchment. The percentage of imperviousness was based on draft data available from the Aerotropolis precinct planning (November 2020). Changes to both the land use and imperviousness for the future urban development scenarios results in a change in catchment runoff and pollutant loads. Appendix A of the Hydrodynamic and Water Quality Assessment in Appendix F of the EIS provides further information about imperviousness values and maps of baseline and future land uses.

It is difficult to assess the influence of developer compliance, development age and maintenance on impacts given much of the Upper South Creek Servicing Area is not yet developed. However, a measure of the upper and lower bounds of water quality response can be gained from the sensitivity testing of high and low ranges of diffuse catchment inputs (ie external nutrient loadings) on key water quality indicators in the receiving environment.

The Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water, 2021a) documents the sensitivity analysis approach and results. A wide range of catchment loading rates was assessed, with nutrients being a key input from the catchment. These included:

- High scenario - an increase in nutrient export concentrations of between +29% and +66%
- Low scenario - a decrease in nutrient export concentrations of between -27% and 63%.

For South Creek, the sensitivity analysis demonstrated that nutrients have a more uniform variation throughout the catchment, and do not substantially change in wet and dry years. Under a high nutrient loading scenario, the response in the receiving water quality model is relatively moderate. For instance, an average of 47% increase in catchment nitrogen export rates (under the High scenario) leads to a 10 to 30% increase in total nitrogen concentrations in the WQRM.

While the sensitivity analysis primarily assessed changes in ambient catchment loads, the modelling is expected to be similarly responsive to modification in more bioavailable and inorganic point source loading conditions.

5.10.9 Hydrodynamics and water quality - WQRM modelling of an average year

Issue description

The EPA notes that the WQRMs used in the impact assessment were run against a number of scenarios in a wet year and a dry year. However, the model was not run against an average or typical year to give an idea of what impacts could be expected most of the time. The EPA recommends that all three conditions (wet, dry and typical) are necessary to understand the impacts of the discharge comprehensively. The EPA also notes that it is unclear how a wet and a dry year align with the wet, mildly wet, moderately wet, and extreme wet weather conditions that have been used to define the discharge arrangements. The EPA notes that providing this information would assist in understanding typical operating conditions.

Response

Waterway impacts from AWRC releases are relatively minor in both dry and wet years and would therefore also be minor under typical conditions. The use of wet and dry years provides for an upper and lower range of impacts that could be expected, with any given year existing somewhere between these values.

For example, for total nitrogen, Table 5-28 highlights that the AWRC's contribution to the annual load of the combined Hawkesbury Nepean River system varies from 1.26% to 1.33% of the total load under dry and wet years by 2056, so under typical conditions would be ~1.3%. This difference is relatively indistinguishable on the plots presenting conditions at various sites which are dominated by the changes due to land-use and climate. Sydney Water further notes that the AWRC load contribution in the order of 1% generally has a net benefit to river nutrient concentrations in both wet and dry conditions as the accompanying flow acts to dilute the in-stream nutrients into which it is mixing. Variability in loads between the existing (non AWRC) WWTP/WRP releases is a much larger driver of nutrient variability between dry and wet conditions, ranging from 24 to 16% respectively.

The scale of AWRC inputs in both years is also presented in Table 5-28 demonstrating the similar level of loading despite the different climatic conditions.

Further to above, it is noted that this approach was also endorsed by the two independent experts, Dr Chris Gippel and Dr Rick van Dam. In their review of the Hydrodynamic and Water Quality Impact Assessment (Appendix I of the EIS), it was stated: '*The modelling approach that was adopted for the impact assessment, comparing baseline, background and impact scenarios for a representative dry and wet year was appropriate for assessing potential hydrological and water quality impacts of AWRC releases.*'

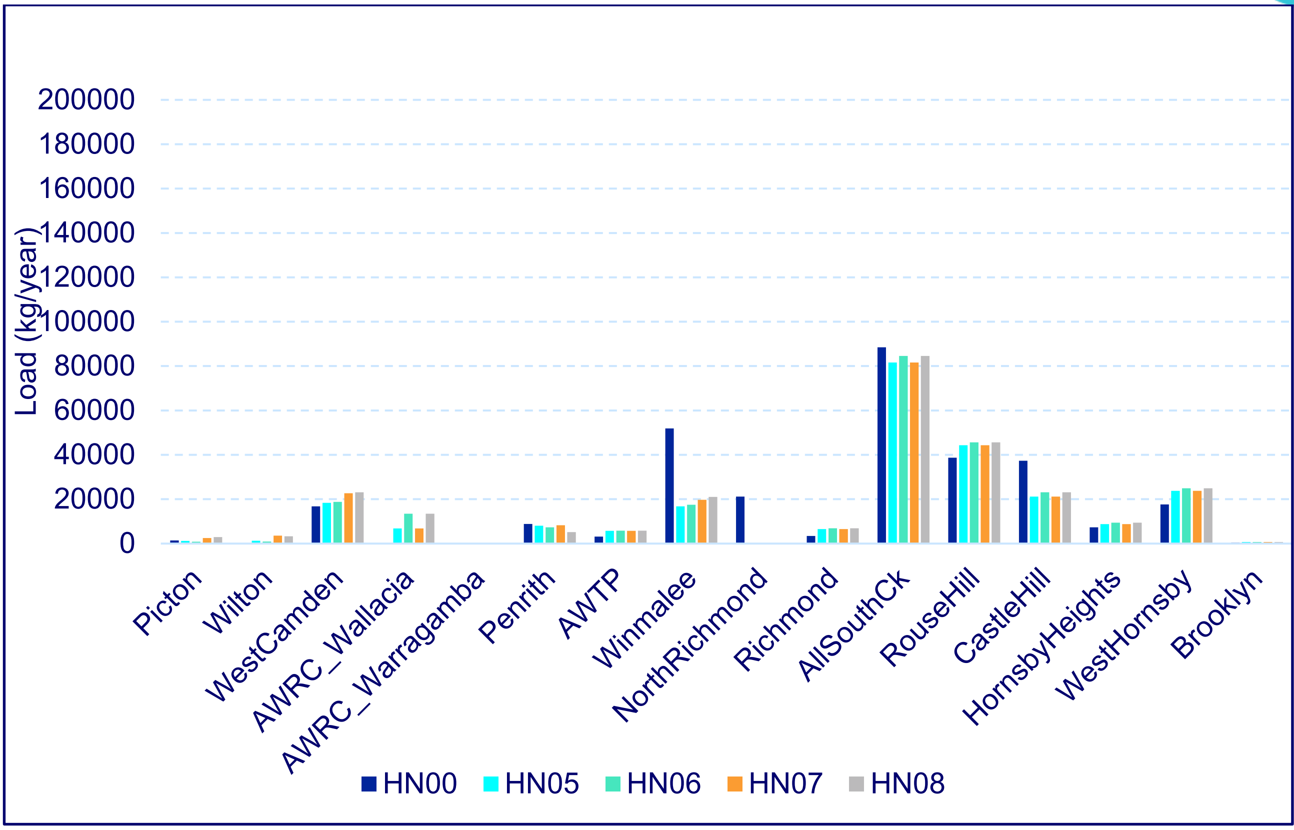
Sydney Water therefore considers that additional modelling and analysis for an average or typical rainfall year would not provide any additional value in assessing impacts, and would not affect the outcomes or conclusions drawn in the EIS. The total loads are also shown in Figure 5-22 for dry and wet year scenarios. The percentage contributions in Table 5-28 are reflected in the minimal difference of the AWRC to total TN loads between a dry and wet year shown in Figure 5-22.

Table 5-28 Percentage contribution of annual total nitrogen load from all non-catchment discharges and the AWRC only releases, relative to the total load into the river domain

Scenario	HN00 2020	HN05 2036 (low)	HN06 2056 (low)	HN07 2036 (high)	HN08 2056 (high)
Dry year – All releases	27.9%	23.0%	23.0%	23.7%	23.6%
Wet year – All releases	19.6%	16.4%	16.6%	16.8%	16.8%
Dry year – AWRC releases	0%	0.66%	1.26%	0.65%	1.24%
Wet year - AWRC releases	0%	0.68%	1.33%	0.67%	1.33%

Note to table:

Section 4.6.3.2 of the Hydrodynamics and Water Quality Impact Assessment (Appendix F of the EIS) provides a detailed outline of each scenario. HN00 relates to background conditions without the project, HN05 and HN07 relate to Stage 1 of the AWRC and HN05 and HN08 relate to the ultimate capacity of the AWRC.



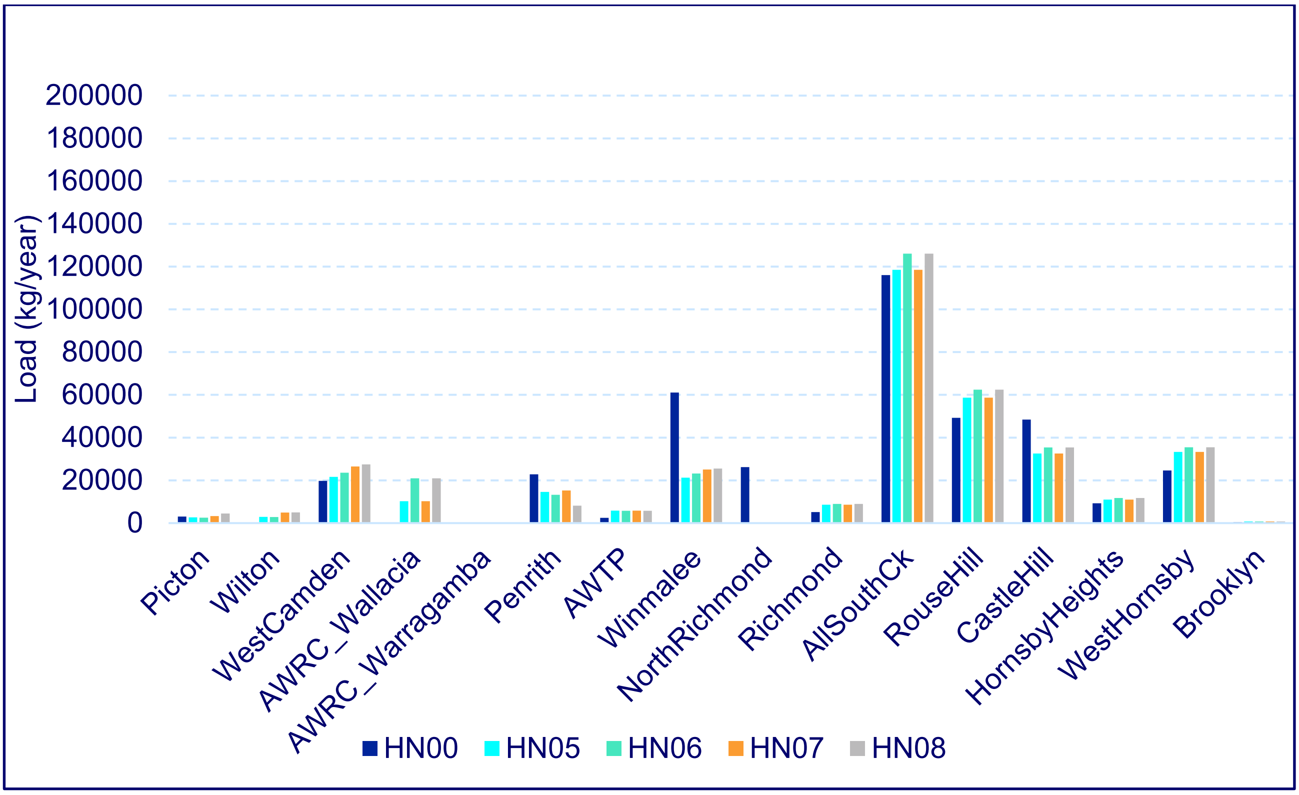


Figure 5-22 Annual loads of Nitrogen (tonnes/yr) in a dry (top) and wet (bottom) year from key discharges, for a range of scenarios.

The classifications of dry, mild, moderate and severe conditions fundamentally relate to the release strategy and how the AWRC treatment and release conditions are modified as a results of inflows to the plant. Section 4.6.3.5.1 of the Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) provides a detailed explanation of these classifications. However, in summary, the classifications relate to the following inflow conditions:

- Dry – <1.3 x ADWF
- Mild – 1.3 to 1.7 x ADWF
- Moderate – 1.7 to 3.0 x ADWF
- Severe – > 3.0 x ADWF

5.10.10 Hydrodynamics and water quality - risk of algal blooms

Issue description

The EPA notes that harmful algal (cyanobacteria) blooms represent a significant risk in the Hawkesbury Nepean River system. The EIS presents a cyanobacteria risk model based on functions of temperature, salinity, nutrients and a proxy for stratification, however there is no justification or references for these functions, nor any validation against the extensive data available for the Hawkesbury Nepean River system. The EPA notes that a previous review of cyanobacteria risk by DPE EES identified that extended dry weather is a major risk factor in the freshwater tidal river, however this cannot be accounted for by the current formulation of the model described in the Hydrodynamic and Water Quality Impact Assessment.

Response

The WQRM simulations include a cyanobacteria group as part of the phytoplankton assemblage, and the model reports this as a component of chlorophyll *a* (refer response 5.10.11 for more detail). As discussed in response 5.10.11, there are uncertainties in simulating the chlorophyll *a* variable so Sydney Water decided to complement this prediction with the more direct risk index calculation. This looks at the primary environmental drivers of cyanobacterial risk without relying on accurate simulation of the more complex processes controlling algae biomass accumulation, species competition, and food web processes. The risk index uses the same parameters for the environmental functions as the main AED phytoplankton model, and these are summarised and justified in Appendix A of the Model Calibration Report (Sydney Water, 2021a).

Given extended dry weather (including extreme drought anticipated under climate change), compounded by high nutrient concentrations, is a major risk factor for cyanobacteria blooms, Sydney Water considers the AWRC release regime can provide some benefits in these circumstances to reduce the existing drivers of cyanobacteria risk:

- diluting the ambient nutrient concentrations (as the advanced treated water has lower nutrient concentrations than the river)
- providing a slight increase in the low flow discharge moving through the system below Wallacia Weir.

The occasional wet weather releases with higher nutrients (tertiary treated water) are very short lived, and do not persist in space or time as they are compensated for by generally lower nutrient levels in the advanced treated water before and after the predicted wet weather spikes. Due to the infrequent occurrence of these events, and the relative small contribution of nutrients from releases, cumulative impacts are unlikely to occur.

Sydney Water acknowledges there is some data on phytoplankton groups in the river that has potential to help understand the risk of cyanobacteria blooms. However, there were many complicating factors making integration of cell count data within the model a task that requires further research and development. This was not achievable in the project timeframes. Sydney Water has committed to fund a PhD at The University of Western Australia on this specific topic from September 2021 to September 2024 which it hopes will help inform a more advanced approach for future modelling.

5.10.11 Hydrodynamics and water quality - chlorophyll *a* model results

Issue description

The EPA notes that chlorophyll (a proxy for phytoplankton biomass) is a primary indicator of stress in response to nutrient loading. The modelled longitudinal median chlorophyll concentrations presented in the Hydrodynamic and Water Quality Impact Assessment (Figures 6-85 and 6-86) indicate a spatial pattern at odds with long term data (Figures 5-46 and 5-47), calling into question the WQRM's ability to accurately represent processes controlling this important indicator. The EPA notes that modelled values throughout the system are well below expected and are lowest in the freshwater tidal pool (Windsor to Wisemans Ferry) which data show to be the chlorophyll maximum reach within the Hawkesbury Nepean River system. These discrepancies need to be discussed, and the implications for model performance and the effects-based assessment must be highlighted.

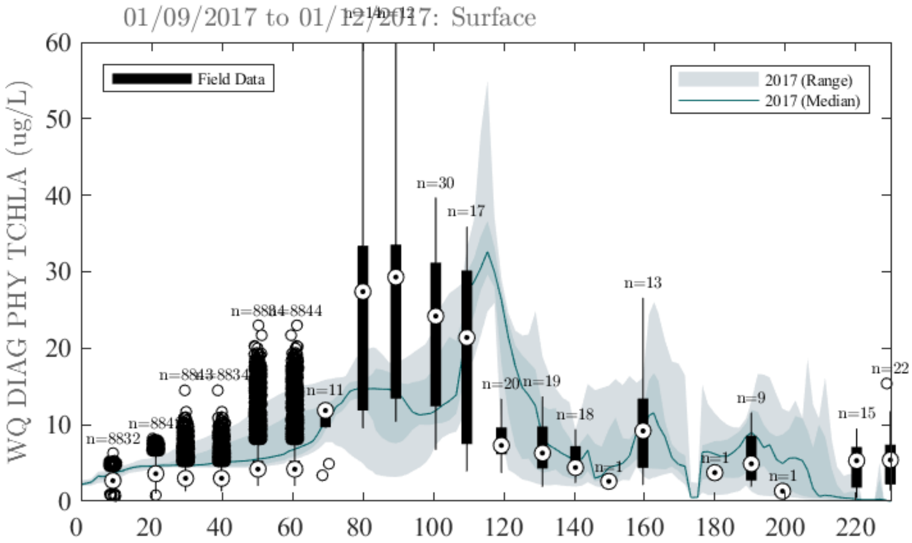
Response

As outlined in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water, 2021a), a total of four years were simulated for calibration and validation purposes, spanning a wide range of hydrological and biogeochemical conditions. From both statistical analysis and visual inspection of the calibration results, the model performs well in capturing chlorophyll *a* during some time periods and less effectively during others. Examples of a well predicted season and a poorly predicted season are shown in Figure 5-23 for context.

The entire Hawkesbury-Nepean domain is a very complex system switching between internal and external controls on productivity, and as stated in the EPA comment, there is generally a biomass peak between 70-120 km upstream of the ocean mouth. The model accurately captured bloom magnitudes here for several seasons of the simulated years but notably under-predicted at this location around 60-70% of the time. Sydney Water's investigations into this disparity showed that a combination of factors were preventing blooms occurring at the right time in the model and it was identified more in-depth analysis and model development is required. This will be part of the PhD at The University of Western Australia outlined in section 5.10.10.

The discrepancies in modelled and measured chlorophyll *a* are also discussed in the Model Calibration Report with performance summarised using a traffic light performance indicator table. Sydney Water acknowledges this limitation in the model's performance but considers this constraint does not alter the conclusions of the model scenario assessment in the EIS for the following reasons:

- The total nitrogen and total phosphorus (and constituent nutrient pool) transects and time-series are generally well predicted. Therefore, the nutrient mass balance is thought to be reasonably well resolved along the river length and from season to season, even though the partitioning of the material into the chlorophyll *a* pool could be improved (refer to section 5.10.12 for more detail).
- The AWRC treated water releases have a low overall nutrient load contribution (as outlined in section 5.10.9) in both wet and dry conditions. The releases are predicted to dilute ambient nutrient levels in the river, therefore reducing the likelihood of downstream algal blooms. Although there are some nutrient spikes and increased bio-available nutrient input, these are short-lived and small compared to the scale of nutrient concentration reduction predicted from the more prevalent and extensive release of advanced treated water. The modelling results also indicate that the region where the chlorophyll *a* biomass is under-predicted is expected to experience a reduction in nutrients due to the AWRC releases.
- Given the uncertainty in chlorophyll *a*, Sydney Water also used the cyanobacteria risk index approach (which looks at the fundamental drivers of nuisance bloom formation) as a complementary approach to assess risk, rather than solely relying on the biomass prediction.



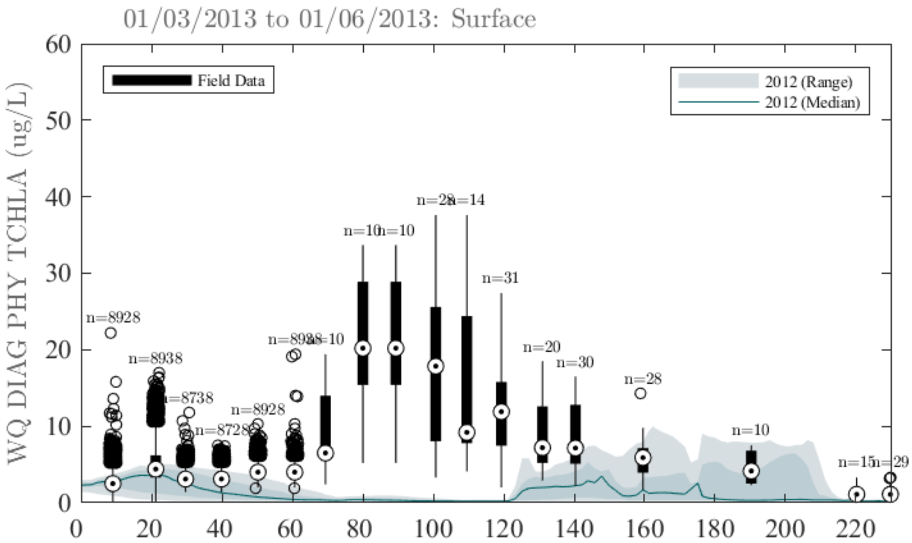


Figure 5-23 Seasonal chlorophyll *a* transects along the Hawkesbury-Nepean River, from the ocean (0 km) to the Upper Nepean

Notes to figure: These plots are an example of a calibration/validation plot included in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report. The plot presents a comparison of the model results against monitoring data within a specific reach of the river. The solid green line represents the median concentrations predicted by the WQRM near the water surface. Around this line, there is also typically a grey shaded band that includes percentile bands of model predictions within the reach. The field data are grouped into the box-whisker plots for each 10 km river reach, and the model is shown in the green line (seasonal median) and the shaded area is the range. In the Autumn 2013 period, the model under-predicts the biomass from 70-120 km.

5.10.12 Hydrodynamics and water quality - discrepancies between modelled and measured nitrogen and phosphorus

Issue description

The EPA notes that there are discrepancies between the spatial variation in modelled and measured nitrogen and phosphorus apparent in the Hydrodynamic and Water Quality Impact Assessment. In the case of phosphorus, the EPA contends that it is not possible to faithfully reproduce spatial and temporal trends without accounting for the transport, settling, and resuspension of sediment along the tidal reaches of the system. The EPA notes that this issue has been identified as a major knowledge gap by the Hawkesbury Nepean Science Working Group.

Response

The model performance at capturing variability in nitrogen and phosphorus has been the major focus of the updated calibration of the WQRM. All available data from WaterNSW, DPE, Sydney Water and Hornsby Council was collated and total nitrogen, total phosphorus, and dissolved nutrients (PO_4, NH_4 and NO_3) were considered in the model calibration and validation. More limited data was available for the South Creek WQRM domain, but nonetheless a large volume of data was available spanning the different reaches of the river system and estuary.

As with chlorophyll *a* (as discussed in section 5.10.11), the model simulations span four years covering a range hydrological and biogeochemical conditions, and the accuracy of the model in resolving the total and dissolved nutrient species is of a high standard.

The accuracy of the nutrient predictions is impacted by several factors including:

- errors and uncertainty in incoming nutrient loads (refer section 5.10.7 for more detail)
- inaccuracies in the model mixing and transport processes (refer to hydrodynamic calibration in the Model Calibration Report (Sydney Water, 2021a))
- errors or uncertainties in the internal processes controlling nutrient attenuation or release as material moves through the river.

Related to the last dot point, the EPA submission suggests that the model is not resolving particulate phosphorus dynamics associated with sediment water exchange and cycling. The model does account for suspended sediment movement throughout the domain (refer to total suspended solids in the Model Calibration Report), and for the periods when a good field dataset was available, the model performed reasonably well as shown in Figure 5-24. More specifically, the model predicts the turbidity maxima well in most seasons, with a limited tendency to over predict within zone 2 (Grose River to Wisemans Ferry as shown in Figure 4-2 of the Model Calibration Report) of the model domain. This means the model does resolve the processes of sediment resuspension and deposition, which are of particular significance in the estuarine reaches due to the prevalent tidally forced water currents.

The model also includes phosphate adsorption to suspended sediment, and associated deposition of this material into the sediment (refer to Appendix A of the Model Calibration Report for the technical description). Sydney Water acknowledges that these processes are captured in a relatively coarse manner and use default literature parameters. There is therefore some uncertainty about how well these processes are resolved in the current model simulations. This is predominantly due to a lack of available field data to definitively set up and validate these model dynamics. The Hawkesbury Nepean Science Working Group has identified this as a future priority for further research and development and a project has been commissioned with Southern Cross University and DPE to collect the necessary data and improve the model functionality in this regard.

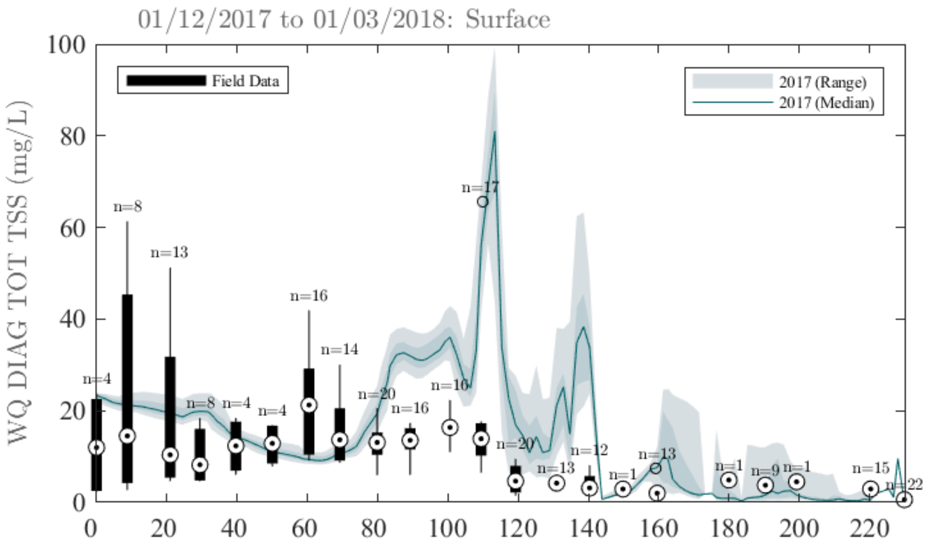


Figure 5-24 Example longitudinal calibration profile for total suspended solids (TSS)

Note to figure: This plot is an example of a calibration/validation plot as included in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report. The plot presents a comparison of the model results against monitoring data within a specific reach of the river. The solid green line represents the median concentrations predicted by the WQRM near the water surface. Around this line, there is also typically a grey shaded band that includes percentile bands of model predictions within the reach

Similar to the response in section 5.10.11, Sydney Water considers that any deficiencies related to internal nutrient recycling does not alter conclusions of the model scenario assessment in the EIS for the following reasons:

- The model reasonably captures the total nitrogen and total phosphorus maxima that occur, suggesting the configuration of nutrient inputs from the catchment, point sources and sediment is accurate to resolve the along-stream variability.
- The model captures the partitioning of the nutrients between organic and bioavailable pools, including the strong gradients in nitrate (NO_3) that occur along the Hawkesbury Nepean River.

- The AWRC treated water releases have a low overall nutrient load contribution (as outlined in section 5.10.9) in both wet and dry conditions. The releases of advanced treated water are predicted to dilute ambient nutrient levels, reducing concentrations in downstream reaches. Even though there are some nutrient spikes and increased bio-available nutrients input, these are short-lived and minor compared to the scale of nutrient concentration reduction predicted from the more prevalent and extensive release of advanced treated water. The tidal region where the resuspension controlled nutrient cycling is dominant is predicted to experience a reduction in nutrients due to the AWRC releases, so even if the model is not fully able to resolve these processes, there is predicted to be less delivery of nutrients into this area.

5.10.13 Hydrodynamics and water quality – macroalgae and submerged macrophyte blooms

Issue description

The EPA notes that there is no consideration given to macroalgae and submerged macrophyte blooms which constitute a major expression of eutrophication in the Hawkesbury Nepean River during extended low flow periods. The EPA recommends that further assessment should be undertaken to determine the impacts.

Response

The WQRM does not currently include a macroalgae or macrophyte sub-model, but specifies enhanced uptake of dissolved nutrients and increased water drag at locations where Egeria has historically been present. This is a simplified approach that does not capture the nuance of how aquatic plants respond within a river ecosystem but was a constraint for inclusion within the model due to a lack of primary data and knowledge about this aspect of the river.

As outlined in other responses (including sections 5.10.10, 5.10.11, 5.10.12), the Hawkesbury Nepean Science Working Group has identified this as a future priority for further research and development and Sydney Water is in the process of commissioning a project to address this model limitation.

Sydney Water considers that any deficiencies related to inadequate resolution of macrophyte dynamics does not alter conclusions of the model scenario assessment in this EIS. This is primarily due to the AWRC treated water releases driving a reduction of ambient dissolved inorganic nutrient concentrations, which constitute the form in which nutrients are most readily consumed by macrophytes and macroalgae.

The effects of this reduction are likely to be of most significance during prolonged dry weather conditions when, historically, macrophyte biomass accumulates due to reduced flows in the Penrith Weir pool. It is therefore considered unlikely that the AWRC releases would worsen the existing issue of macrophyte and macroalgal blooms. Advanced quality releases to Nepean River are likely to have a beneficial impact during periods of low flows by diluting and reducing the concentration of nutrients. This will contribute to reducing the occurrence of macrophyte blooms during extended low flow periods. The short spikes in nutrient concentrations during wet weather (when the quality of releases to Nepean River changes from advanced to tertiary) are unlikely to contribute to eutrophication given flows before and after these events will be of advanced quality.

5.10.14 Hydrodynamics and water quality - clarification of model details for Warragamba River

Issue description

The EPA requests clarification of details concerning the Warragamba River modelling, including:

- The EPA notes that in the Hydrodynamic and Water Quality Impact Assessment, the model boundary starts at Warragamba Weir which is 1.2 km downstream of the dam wall and does not include the stretch of Warragamba River from the dam wall to the weir. The EPA notes that the proposed AWRC discharge is located close to the dam wall and therefore locations upstream and downstream of the release will be outside the boundary of the model. However, time series modelling results are provided for locations labelled as 'Upstream AWRC Warragamba' and 'Downstream AWRC Warragamba' which, considering the location of the model boundary, should not be possible to generate. The EPA note that it is difficult to ascertain whether these locations are in relation to the AWRC discharge point, Megarritys Creek and the discharge from the Wallacia WWTP.
- In addition, the EPA notes that it is not clear if the scenario HN01 which is the background scenario for discharges to Warragamba River includes WaterNSW releases into Megarritys Creek (e-flows).

Response

The mesh of the Hawkesbury Nepean WQRM extends to downstream of the Warragamba Weir. Exclusion of the reach between the dam wall and the weir reduces the potential for model instability, particularly over extended periods of dry weather when there are minimal or zero inflows upstream of the weir.

The model introduces localised catchment inflows at the Warragamba Weir, which represents an upstream nodestring boundary of the model mesh. It also represents the boundary condition for flows from Warragamba Dam during emergency release conditions.

Point sources representing the WaterNSW releases are introduced at a location representative of the confluence with Megarritys Creek, about 200 m downstream from the weir. Similarly, flows representing the treated water releases from the Wallacia WWTP are introduced in the vicinity of the WWTP release point. Both the WaterNSW releases and the discharges from Wallacia WWTP are included in each EIS scenario (including HN01) with the release conditions adapted as required to represent each specific scenario.

The releases from the AWRC are introduced to a mesh element in the downstream vicinity of the weir. The analysis sites are located as follows:

- The site labelled as 'Upstream AWRC Warragamba' is located immediately upstream of the mesh element that includes the AWRC releases.

- The site labelled as 'Downstream AWRC Warragamba' is located about 700 m downstream of the weir, which is also downstream of the current WaterNSW environmental flow release point via Megarritys Creek and Wallacia WWTP release points.

Sydney Water acknowledges that the upstream site may not provide a true representation of the conditions upstream of the AWRC releases. These results may therefore be disregarded.

Conversely, despite the exclusion of the reach upstream of the weir, the downstream site is considered to provide valuable data with respect to expected conditions below the current WaterNSW environmental flow release point via Megarritys Creek, the Wallacia WWTP releases, and where applicable (ie for the impact scenarios), the AWRC releases. Given the consistency of the AWRC release volumes that are modelled for the Warragamba release point, and the limited extents of the reach upstream of the weir, it can be assumed that the flow rates expected over the Warragamba Weir will closely reflect the actual AWRC release rates at the release point. Further details about the assumed release conditions are included in section 4.6.3.5.1 of the Hydrodynamic and Water Quality Assessment (Appendix F of the EIS).

Sydney Water will review the configuration of the mesh and the boundary conditions as part of future model development phases.

Additional analysis relating to the proposed Warragamba release point is presented in the neutral or beneficial effect (NorBE) assessment in section 6.3.1 of the Hydrodynamic and Water Quality Assessment (Appendix F of the EIS).

5.10.15 Hydrodynamics and water quality - assessment of dilution and mixing zones

Issue description

The EPA notes that the Hydrodynamic and Water Quality Impact Assessment has assessed the near field mixing zone for a select group of toxicants in accordance with ANZG (2018) guidance on mixing zone evaluation, with toxicants included based on analysis of effluent in Appendix F Part 2. However, the EPA requires assessment of dilution and mixing zones for all pollutants that are present in the effluent at non-trivial levels to inform its licensing processes. The EPA requests that additional dilution modelling be provided for all pollutants that are above ANZG (2018) guideline values in the highly treated effluent and tertiary effluent and will be discharged to South Creek, Nepean or Warragamba River.

The EPA also notes that dilution modelling has been limited to extreme wet weather for South Creek and the Nepean River even though:

- during dry weather, oxidised nitrogen (NOx) is present in the highly treated effluent discharged to the Nepean and/or Warragamba Rivers at concentrations exceeding ANZG (2018) default guideline values
- during mild and moderately wet weather, tertiary effluent, containing nutrients and pathogens at concentrations above ANZG (2018) or a mix of advanced treated effluent (containing elevated NOx) and tertiary effluent, is discharged to the Nepean River.

The EPA requests that further modelling that estimates the dilution of pollutants discharged in the effluent under dry, mild and moderately wet conditions be undertaken to provide a complete assessment of discharge impacts. The EPA requests that the results provided should also note which conditions are considered ‘typical’ thus indicating what impacts and outcomes will be seen most often.

Response

Application of near field dilution models

Dilution and mixing zone modelling has been undertaken in line with the ANZG (2018) and ANZECC/ARMCANZ (2000) guidelines. These guidelines state that “Mixing zones are generally designated to manage the controlled discharge of soluble, non-bioaccumulatory toxicants whose impacts on local biota are primarily related to their concentration. The use of mixing zones is not appropriate for managing the discharge of nutrients, bioaccumulatory or particulate substances”.

The modelling and analysis in the EIS has therefore focused only on non-bioaccumulatory toxicants that have been assessed to potentially exceed the ANZG toxicant default guideline values (DGVs). This included an assessment of concentrations within each release stream to determine the suite of applicable toxicants. It has also further focused on the specific conditions (release and ambient) when there is a risk of concentrations in the release streams potentially exceeding the ANZG DGVs (ie under severe wet weather events when AWRC inflow rates exceed three times ADWF). Sydney Water considers that additional near field modelling of other release conditions during dry or mild to moderate wet weather conditions, or during normal/typical release conditions is not warranted as the risk of toxicity in the release streams has been identified as low given the higher treatment levels of effluent in these conditions (ie advanced or tertiary treated water).

All other contaminants that were deemed of significance and released at non-trivial levels were modelled and assessed using the WQRMs. Accordingly, the dilution and dispersion of these contaminants have been simulated along with the relevant biogeochemical processes. Compared to the relatively limited mixing and dilution processes simulated in CORMIX, inclusion of these processes provide for a more representative assessment of the impacts on water quality and how ambient concentrations compare to relevant DGVs.

Sydney Water therefore considers that additional near field modelling is not warranted as it would not provide additional value in assessing the project’s environmental impacts.

Sydney Water’s EPLs for wastewater systems do not typically specify mixing zones or required dilutions. Section 5.2.6 of the EIS outlines the proposed treatment levels and water quality that Sydney Water is proposing be licensed in the EPL, consistent with its other wastewater system EPLs.

Nitrate

Oxidised nitrogen (in the form of nitrate, NO_3) was included in the analysis of toxicants in the release streams referenced above. For this parameter, the updated ANZG (2018) guidelines state that the ANZECC/ARMCANZ (2000) DGV of 0.7 mg/L was erroneous and recommend the use of the guideline values published in the NIWA report 'Updating nitrate toxicity effects on freshwater aquatic species' (NIWA, 2013). In this NIWA report, two trigger values are presented including a 'Grading' value of 2.4 mg/L and a 'Surveillance' value of 3.5 mg/L. The Grading value is derived from the species No Observed Effect Concentration (NOEC) values and recommended for compliance assessment based on annual median concentrations. The Surveillance value is derived from the species Threatened Ecological Communities (TEC) values and is recommended for compliance assessment based on the annual 95th percentile of monitoring data.

Conservatively, the Grading value has been adopted in the near field and toxicity assessments for the EIS (as outlined in section 6.2 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F), although it could be contended that the Surveillance value would be more applicable with respect to toxicity and the use of 95th percentile data.

The analysis of toxicants in the release streams determined that 95th percentile concentrations of nitrate in all release streams will be below 0.7 mg/L. Therefore release concentrations are predicted to be below the relevant ANZG (2018) DGV, and did not warrant further evaluation as part of the near field assessments.

5.10.16 Hydrodynamics and water quality - zonal approach for modelling

Issue description

The EPA notes that the innovative zonal approach that aggregates data for comparing model predictions against monitoring data for assessing the impacts of the project is a valid way of dealing with variability in field data introduced by diel environmental factors such as tides.

Response

Sydney Water notes the EPA's support for this approach and considers that no further response is required.

5.10.17 Hydrodynamics and water quality - duration of scenario runs

Issue description

The EPA notes that the analysis of scenarios during the 'wet' and 'dry' year simulations provides an indication of cumulative impacts over an annual timescale during these different hydrological year types, however it is difficult to extrapolate these results to longer timescales where impacts may compound from year to year (eg during extended drought cycles).

The EPA also notes that there appears to be no consideration given to the effects of climate change on the hydrology of the Hawkesbury Nepean River system and the implications of these for the system. While the prediction window is capped at 2056, there are still likely to be significant changes to the frequency and severity of extreme events (droughts and floods) during this timeframe. EPA suggests that it would be useful to discuss the implications of this on water demands, environmental flows, and instream processes.

Response

Simulation of longer term timescales was not viable during the project timelines due to technical limitations and the complexity of the model. However, the general findings and insights from the wet and dry year model simulations can be used to help interpret future hypothetical situations. It is noted that from a nutrient and water quality point of view, the AWRC releases generally result in a positive benefit to waterways due to the treatment and release strategy adopted for the AWRC. It is also considered that the benefits of releasing advanced treated water would compound under a period of extended drought conditions.

Section 12.1.7 of the EIS includes a climate change risk assessment. The risk assessment includes consideration of increases to air temperatures, extreme wet weather events, peak precipitation and time spent in drought.

With respect to the frequency and severity of wet weather conditions, it is acknowledged that the potential for releases of tertiary and primary treated water may increase for the Nepean and South Creek releases respectively. However, the impacts from these releases are not expected to change significantly from what has been predicted in the EIS. Increases in pollutants should remain short term and episodic.

With respect to extended drought conditions and implications on water demands, environmental flows and instream processes, as noted above the proportional contribution of advanced treated water in the river increases and would maintain residual flow velocities during these conditions. Releases would potentially contribute to maintaining environmental flows and supporting water demands and instream processes.

5.10.18 Hydrodynamics and water quality - assessment approach

Issue description

The EPA notes that the qualitative assessment of impacts could be improved by more statistical approaches and provide a more meaningful comparison with guidelines (eg percentage of time a guideline is exceeded).

The EPA suggests that analysis of water quality trends (section 5 of the Hydrodynamic and Water Quality Impact Assessment) and model results (section 6) would be far more useful if binned and summarised according to flow percentile categories. The EPA notes that this allows a more nuanced understanding of processes and aquatic sensitivity along the Hawkesbury Nepean system and avoids making generalisations based on median values which ignore the significance of more extreme events. For example, the large number of outliers shown in the longitudinal boxplots of chlorophyll (Figures 5-46 and 5-47) bely the tendency for large algal blooms to occur during low flow conditions. The EPA notes that recognition of this is an important consideration for maximising environmental benefits, although as mentioned in its submission it appears that the WQRM is not currently capable of faithfully representing phytoplankton response.

Response

Sydney Water has incorporated statistical approaches into the assessment in the EIS. Exceedance plots were developed for each analysis site, for all scenarios and all variables as part of the scenario assessment methodology. Nine analysis sites were selected for Nepean River and eight for South Creek. Box-whisker plots were used to highlight the predicted variable range and the median, 25th and 75th percentile, overlaid with the ANZG (2018) or ANZECC/ARMCANZ (2000) DGV, with an example shown in Figure 5-25. The full series of model results, including these box-whisker plots was provided to EPA as part of a package of information in December 2021.

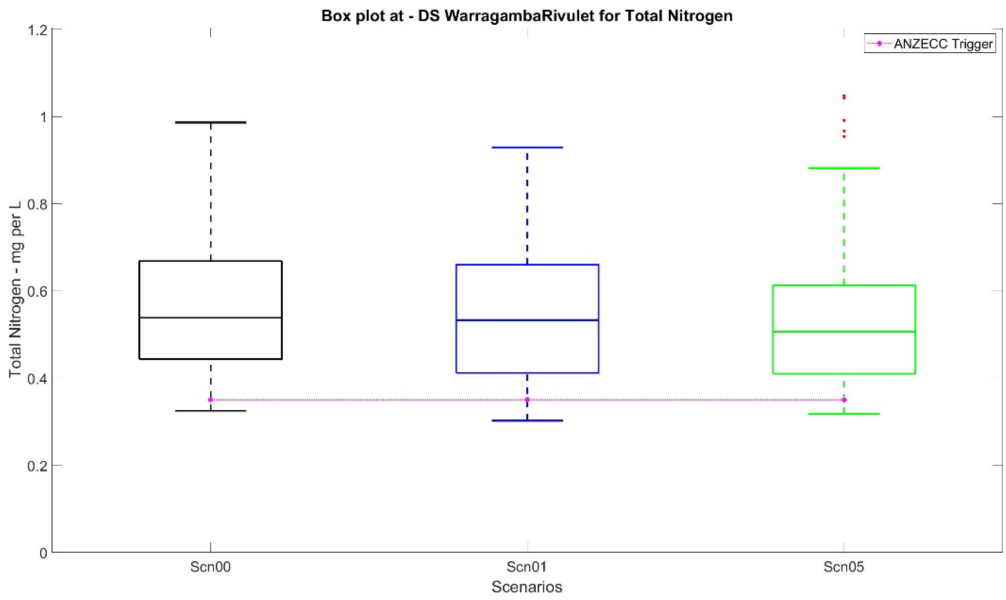


Figure 5-25 Example Box-Whisker plot of scenario results indicating trigger value, mean and variance between the background, baseline and impact scenario simulations.

In addition to the box-whisker plots, each scenario was plotted as a time-series at each analysis site and as a longitudinal profile of annual median concentrations. Again, this was done for all variables.

The combination of these assessment types allows for an extensive degree of analysis and interpretation, including understanding of:

- the broad changes caused by the scenario in the mean river condition (longitudinal profiles)
- how wet and dry periods and events in different years would differ (time-series)
- how the statistical nature of the variable is anticipated to change, including the likelihood of guideline exceedance with and without AWRC releases and any outliers (box-whisker plots).

Although the main body of the report only incorporated selected timeseries and longitudinal profile plots for brevity purposes, all these tools have been used together to draw the conclusions about the general nature of the AWRC release impacts in the context of other WWTP upgrades and land-use changes. Sydney Water considers that the application and interpretation of these presentation formats provide for detailed analysis of the model results. Other methods, such as percentage of time a guideline is exceeded or by flow percentile categories, were not considered to add value as the box-whisker and timeseries plots present greater detail regarding the temporal variations and the occurrence of any exceedances. It is also noted that most water quality objectives/default guideline values are primarily for comparison against median values (monitoring data or model results) and comparison against timeseries or box-whisker plots should be undertaken cautiously.

With respect to the capacity of the WQRMs to simulate the trends and variability of parameters such as chlorophyll *a* and nutrients, please refer to previous responses 5.10.11 and 5.10.12.

5.10.19 Hydrodynamics and water quality - nitrate concentrations in Nepean River

Issue description

The EPA notes the seasonal trends in nitrate concentrations shown in section 5.3.5.1 of the Hydrodynamic and Water Quality Impact Assessment (winter maxima; summer minima). The EPA notes that it is unclear whether these significant trends were faithfully replicated by the model, nor whether they were considered in the interpretation of modelling results. For example, nitrate concentrations in the river upstream of Wallacia Weir vary by up to four times between summer and winter which would have profound implications for the downstream flux of bio-available nitrogen and subsequent algal growth.

Response

The nutrient predictions are also discussed in section 5.10.12. Nitrate data was collated for the Nepean River based on Sydney Water and DPE monitoring. Figure 5-26 shows the nitrate predictions for a selected reach (Penrith Weir to Yarramundi, where consistent data was available) for the four simulated years. The model captures the pattern of nitrate reasonably well in all years, including the seasonal trends. As some of the reaches had relatively large spatial extents, the model results have been presented as a median line (calculated spatially across that zone at two-hourly time intervals), with surrounding percentiles also presented as shaded areas. This format allowed for comparison of the model median and variance against the collected field data. Statistical measures have also been reported on each zonal comparison plot.

Results for other reaches are presented graphically and also in the model performance summary tables in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report. Section 4.1.1 of the Calibration Report provides further information.

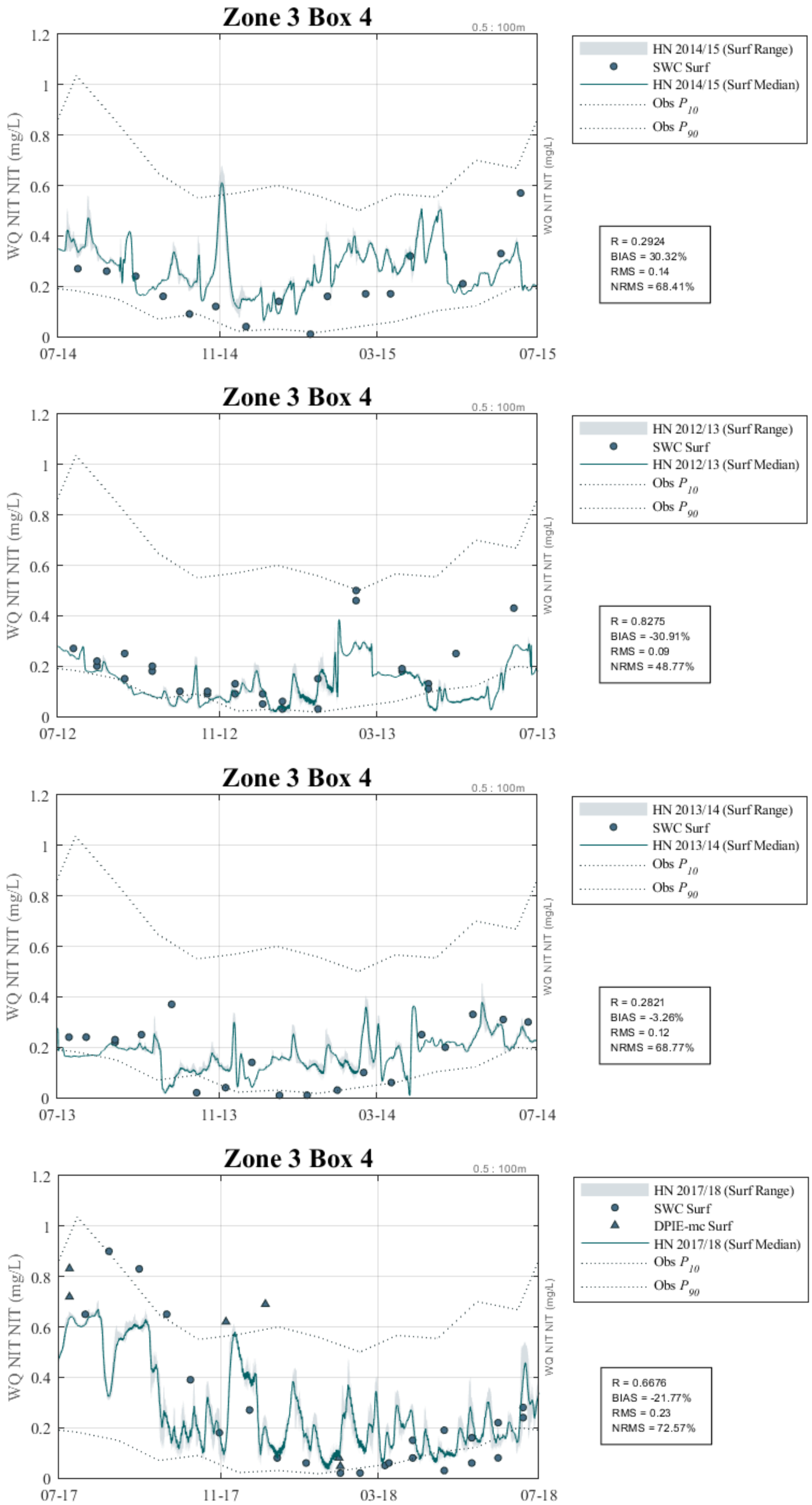


Figure 5-26 Nitrate concentrations for a selected reach in the Nepean River (Zone 3 Box 4) for four years

Notes to figure: The above plots are an example of a calibration/validation plot as included in the Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report (Sydney Water 2021a). The plot presents a comparison of the model results against monitoring data within a specific reach of the river. The solid green line represents the median concentrations predicted by the WQRM near the water surface. Around this line, there is also typically a grey shaded band that includes percentile bands of model predictions within the reach but this is not visible in this example. The monitoring data is shown as the individual dots as well as the dotted lines which represent upper and lower percentile bands of historical data ranges.

5.10.20 Hydrodynamics and water quality - wet weather discharges to South Creek

Issue description

The EPA notes that it is proposed that the AWRC will discharge to South Creek during moderate and severe wet weather conditions. The EPA states that the potential impacts of this occurrence are downplayed in the EIS based on the rationale that:

- there is a large background of pollutants from other diffuse and point sources
- water residence times are very short in South Creek during high flow conditions.

While the EPA recognises pollutants enter the creek from other sources and water residence time may be short, it is not a sufficient justification to contribute further to the creek's pollutant load. The EPA states that it is correct that the instream impacts will be negligible in South Creek itself due to short water residence times during wet weather flows, however the real impacts will be felt once this water reaches the freshwater tidal pool (Windsor to Wisemans Ferry reach) where residence times increase significantly. The EPA requests that analysis and discussion of this needs to be included in the Hydrodynamic and Water Quality Impact Assessment.

The EPA also notes that the actual contribution of the AWRC wet weather releases is not quantified (although this could easily be done) so it is not possible to properly assess this issue.

Response

Estimates of the contaminant loads from the AWRC releases to South Creek are provided graphically in section 6.1.1.2 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS. To assist interpretation, Table 5-29 presents estimated loads of total nitrogen and total phosphorus.

Table 5-29 Estimated nutrient load for AWRC releases and the cumulative South Creek catchment

Parameter	Total nitrogen (kg/year)		Total phosphorus (kg/year)	
Sources	AWRC	Cumulative South Creek catchment	AWRC	Cumulative South Creek catchment
2036 (dry year) (SC05)	4.6	336,724	<0.2	28,602
2036 (wet year) (SC05)	3,380	673,475	211	66,479

Parameter	Total nitrogen (kg/year)		Total phosphorus (kg/year)	
Sources	AWRC	Cumulative South Creek catchment	AWRC	Cumulative South Creek catchment
2056 (dry year) (SC06)	12.5	351,478	<0.2	30,125
2056 (wet year) (SC06)	6,712	703,167	287	69,864

From this analysis, the most significant contribution from AWRC releases to the overall catchment loads is below 1% during the representative wet year, and below 0.005% during the representative dry year.

As discussed further in the Hydrodynamic and Water Quality Impact Assessment, there are expected to be about six release events over 14 days during the representative wet year. Releases including primary treated water are predicted to be even more infrequent, provisionally expected to occur two to three times per year with annual frequencies varying between zero and six events.

It should be noted that the need for wet weather releases to South Creek only occurs as a result of stormwater ingress into the wastewater network. If, hypothetically, stormwater ingress to the wastewater network could be avoided (which is discussed in section 5.10.3), contributions (and impacts) from the AWRC on South Creek would effectively be zero, but the stormwater would still flow into waterways in the South Creek catchment. The flow and pollutant load from the stormwater would therefore be higher than the current analysis shows.

The potential risk of downstream impacts from the South Creek releases on the Hawkesbury River was identified early in the EIS modelling program. Consequently all the scenarios (impact, background and baseline) included an interface between the South Creek WQRM and the Hawkesbury Nepean WQRM. This interface was developed to allow changes in the flows and water quality originating from South Creek to be simulated in the downstream waters of the Hawkesbury Nepean River. The interface was located at the tidal limit of South Creek with results from the South Creek WQRM scenarios extracted at this location and then formatted as boundary conditions for the Hawkesbury Nepean WQRM. Further details about the interfacing are presented in section 4.5 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS.

The potential impacts from the South Creek releases were therefore modelled within the Hawkesbury Nepean WQRMs in addition to the releases to Wallacia Weir pool. Sydney Water has provided results for each scenario to EPA that show analysis of nutrient conditions throughout the Hawkesbury Nepean River. The results have been presented as longitudinal profiles as well as timeseries and box and whisker plots with analysis sites including Downstream of Cattai Creek and Downstream of Sackville Bend.

Table 5-30 provides commentary from an analysis of the timeseries results with respect to scenario HN00, HN02 and HN05, and the modelled annual median concentrations. The HN05 scenario is representative of the 2036 (50 ML/day) releases under low loading from other WWTP/WRP sources (refer section 4.6.3 of the Hydrodynamic and Water Quality Impact Scenario). This analysis has been limited to the wet year as the AWRC releases to South Creek are more significant during this period. The Executive Summary in Appendix F of the EIS also includes maps showing these trends.

Table 5-30 Summary of predicted changes to water quality downstream of Hawkesbury River and South Creek confluence (wet year)

Indicator	Summary of results	Modelled annual median concentrations (mg/L)		
Downstream of South Creek confluence		**Baseline (HN00)**	**Background (HN02)**	**Impact (HN05)**
Total nitrogen	Concentrations consistently below background conditions.	1.11	0.94	0.91
Ammonia	Concentrations generally similar in magnitude to, or lower than background conditions. Infrequent elevations in wet weather spikes.	0.033	0.035	0.034
Oxidised nitrogen	Concentrations generally similar in magnitude to, or lower than background conditions.	0.56	0.45	0.43
Total phosphorus	Concentrations consistently below background conditions	0.077	0.075	0.073
Filterable reactive phosphorus	Concentrations consistently below background conditions	0.032	0.03	0.029
Downstream of Cattai Creek confluence				
Total nitrogen	Concentrations generally similar to, or below background conditions.	1.19	1.03	1.00

Indicator	Summary of results	Modelled annual median concentrations (mg/L)		
Downstream of South Creek confluence		**Baseline (HN00)**	**Background (HN02)**	**Impact (HN05)**
Ammonia	Concentrations generally similar in magnitude to background conditions. Infrequent elevations in wet weather spikes.	0.030	0.032	0.031
Oxidised nitrogen	Concentrations generally similar to, or below background conditions	0.55	0.44	0.44
Total phosphorus	Concentrations generally similar to, or below background conditions	0.072	0.075	0.074
Filterable reactive phosphorus	Concentrations generally similar to, or below background conditions	0.030	0.030	0.028
Downstream of Sackville Bend				
Total nitrogen	Concentrations generally similar to background conditions.	0.85	0.80	0.80
Ammonia	Concentrations generally similar in magnitude to background conditions. Infrequent elevations in wet weather spikes.	0.014	0.016	0.017
Oxidised nitrogen	Concentrations generally similar to background conditions.	0.50	0.43	0.42

Indicator	Summary of results	Modelled annual median concentrations (mg/L)		
Downstream of South Creek confluence		Baseline (HN00)	Background (HN02)	Impact (HN05)
Total phosphorus	Concentrations generally similar to background conditions.	0.057	0.068	0.068
Filterable reactive phosphorus	Concentrations generally similar to background conditions.	0.025	0.031	0.032

Given the model interface set up that allows simulation of all AWRC release points, it is not possible to differentiate between the potential influences from the release to South Creek and/or Wallacia Weir. Impacts within the tidal pool of the Hawkesbury River may therefore be a product of one or both of the release points.

5.10.21 Hydrodynamics and water quality - comparison of baseline, background and impact scenarios

Issue description

The EPA notes that the Hydrodynamic and Water Quality Impact Assessment includes comparison of various modelled future scenarios of AWRC discharges with modelled 'background' scenarios (assuming no AWRC discharge). The EPA notes that timeseries figures provided in section 6 (Impact Assessment) that are used to justify these comparisons do not appear to include 'background' and simply compare the impacts of AWRC discharges with the current 'baseline' data. The EPA requests that the timeseries data provided in section 6 of the Hydrodynamic and Water Quality Impact Assessment should be amended to provide a clear comparison between projected water quality impacts from AWRC discharges and the projected water quality background impacts at 2036.

Response

Each figure presented in section 6.1 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS includes data for all three scenarios (ie impact, background and baseline). This applies to the longitudinal plots and the timeseries graphs and is notated in the graph legends.

On occasion, the results for the impact scenario (eg HN05 or SC05) may overlay the results for the associated background scenario (eg HN01 or SC02). Under these circumstances, it can be assumed there is negligible difference between the two scenarios and therefore negligible impact.

As noted in previous responses, a complete set of results for all the scenarios was provided to the EPA in December 2021. Sydney Water can provide further guidance on specific results if further clarification is required.

5.10.22 Hydrodynamics and water quality - Nepean River release location

Issue description

The EPA notes that dilution modelling in the Hydrodynamic and Water Quality Impact Assessment is restricted to a few key toxicants under extreme wet weather conditions and that the modelling results show that the discharge above Wallacia Weir into the Nepean River is not adequately mixed and diluted to meet ANZG guideline values for aluminium, copper, and zinc before it reaches the weir. The EPA note that mixing and dilution is hampered by the weir which is only 50 metres downstream of the release point. The EPA also noted that a moderate increase in water depth is anticipated in the Wallacia Weir pool (18 cm) as a result of the project. Given these issues, the EPA recommends an alternative discharge location and configuration to increase initial mixing for the Nepean River. Following additional modelling to consider a wider range of weather conditions (as recommended by the EPA), further amendments may have to be made to discharge locations and configurations.

Response

For clarity, this issue is only relevant in extreme wet weather conditions. This is expected to occur two to three times per year when there are also significant flows in Nepean River with low residence time of toxicants in the Wallacia weir pool. For most of the time, releases are predicted to meet ANZG guidelines.

Selection of release point

Section 3.4.2 of the EIS outlines the treated water pipeline release locations that were considered during the reference design process. Figure 3-3 in the EIS shows the locations that were considered for the treated water pipeline.

Sydney Water ruled out locations downstream of the Nepean/Warragamba River confluence as they would require a pipeline and release structure to be built in the World Heritage-listed Blue Mountains National Park or would be too far away from Warragamba Dam to effectively offset environmental flows released. Locations upstream of Wallacia Bridge were also ruled out as Wallacia Bridge marks the boundary of the Yarramundi 2 subzone as defined in the EPA's Hawkesbury Nepean nutrient framework (NSW EPA, 2019a). Releasing in this subzone is preferable as it is less stressed by nutrient loads than elsewhere along the river.

Table 3-5 of the EIS further outlines the reasoning other release locations were not selected, and why a release location around Wallacia Weir was preferable. This includes:

- The preferred location presented the lowest risk of increasing river bank erosion. A location further upstream of the weir would be at greater risk of bank erosion given the river bends and the erodible soils along river banks, especially during high flow conditions. This would likely require extensive scour protection downstream of the release location.
- The geotechnical profile of the area indicates that the rock strata dips steeply at the weir. A location further downstream of the weir would require deeper piling and foundations for the release structure at a greater cost and construction complexity.
- The preferred location is further from any publicly accessible recreational areas in Wallacia.

The Wallacia Weir pool offers a substantial body of water to assist initial dilution and near field mixing. Although the weir pool will commonly represent a lower energy environment relative to locations downstream of the weir, flows and velocities within the storage will increase during wet weather events.

Locations downstream of Wallacia Weir may represent higher energy conditions with riffles and faster flowing water but the lower volume of water, particularly during extended dry periods would offer limited levels of dilution with respect to the treated water releases.

Given these constraints for the Nepean River release location, Sydney Water considers that there is no feasible alternative location. On this basis, Sydney Water has focused on whether there are any opportunities to further improve mixing and dilution.

Near field modelling

The Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS included near field modelling of the reference design for the Nepean River release location, focused on toxicants where concentrations in the treated water are likely to exceed ANZG (2018) guidelines. The reference design includes a headwall outfall structure with energy dissipation consisting of baffle blocks. The invert level of the apron is 26.74 m AHD which is just above the level of the Wallacia Weir wall (26.6 m AHD), located about 50 m downstream.

The findings from the modelling concluded that initial mixing of the toxicants identified in the release stream was predicted to be relatively limited with predicted dilution factors ranging from two to ~6.5 within 50 m of the release point. As a result, respective mixing zone criteria for the toxicants were predicted to be unachievable within the reach between the release point and the weir.

Sydney Water maintains its position that the potential for toxicity and environmental harm arising from these releases is low because:

- Temporally, the events are very infrequent. On average the more severe three times ADWF events are predicted to occur two to three times per year.
- The release events are also typically short lived with durations ranging from less than one day to intermittently over three days.
- The releases correlate with conditions of significant flow within the river. Low residence times within the weir pool and the downstream reaches are therefore expected during these release events.
- Mixing zones are generally only considered in terms of management of continuous releases of treated wastewater, where releases may present a risk of harm to fish migration or harm to sedentary species. Consequently, mixing zone modelling is generally focused on periods of extended dry weather. For example, in the Queensland Government Technical Guideline, the minimum consecutive seven day average flow with a 10-year recurrence interval is recommended as a guide to minimum dilution conditions in non-tidal streams.
- Application of ANZG (2018) toxicant DGVs in the near field impact assessments could be considered very conservative as the DGVs are applicable to chronic exposure situations. Therefore, these DGVs are deemed more relevant to exposure durations of greater than three days. No applicable shorter-term toxicity based guidance values are available under the ANZG (2018) and ANZECC/ARMCANZ (2000) guidelines.

However, to address the EPA’s comment, Sydney Water has undertaken additional near field modelling for an alternative release structure design to investigate if further mixing and dilution is theoretically possible in this location.

The preliminary model results in Figure 5-27 represent the dilution profiles that are predicted to be achievable using (as an example) a three-port diffuser mounted on the bed of the weir pool, in the immediate vicinity of the treated water release location shown in the EIS. The predicted dilution profiles presented in Figure 5-27 correspond to the same six release events simulated in section 6.2.2 of the Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS).

The results indicate that significant improvements in dilution could be achieved through the installation of a submerged multi-port diffuser at the same location as previously proposed. The dilutions achieved immediately downstream of the diffuser ports are in excess of, and comply with, the dilution requirements previously specified for aluminium, copper, manganese and zinc.

Analysing these preliminary results shows there is a relatively well-defined region of near field mixing predicted within the first five metres of the diffuser, followed by ambient buoyant mixing processes. As would be expected, the magnitude of mixing ultimately achieved under each scenario modelled appears to be heavily influenced by the volume of flow within the weir pool, which becomes the limiting factor in the dilution process.

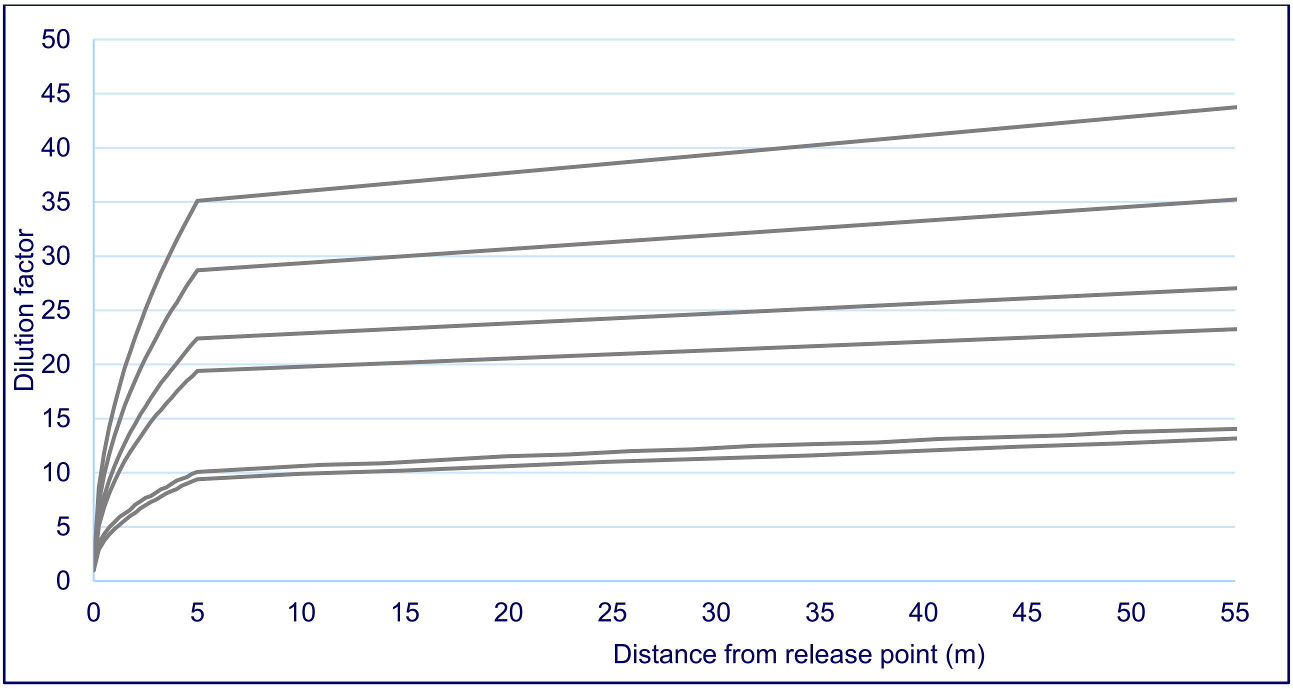


Figure 5-27 Predicted dilution profiles for the Nepean River (multi-port diffuser, 2036 releases)

Note to figure: Each profile corresponds to a severe wet weather release event. Refer to section 6.2.2 of the Hydrodynamic and Water Quality Impact Assessment for further details on the scenario conditions.

Provisionally, the above modelling has assumed a 10 m length of diffuser, located on the river bed in the middle of the weir pool, with three ports (each with 650 mm diameter) directed downstream as presented in Figure 5-27.

Although this modelling indicates additional dilution is theoretically possible, there are substantial challenges to achieving this in practice. Although diffuser structures are used in ocean and estuarine environments, they are not common in inland waterways and Sydney Water does not use this type of structure for its other inland water recycling plants.

There would be significant constraints and impacts associated with constructing and operating a diffuser release structure in Nepean River. This includes:

- significantly increased construction disturbance to Nepean River, including constructability challenges of creating a dry work environment to build the structure and using heavy construction equipment in the waterway
- operational risks associated with siltation, damage from snagging, geomorphic risks of higher velocity releases, potential structure exposure during low flows, limited access for inspection and maintenance.

On balance, Sydney Water considers that given the low risk of toxicity impacts outlined above there is no justification for the risks and impacts of building and operating an in-stream structure of this nature.

However, Sydney Water is currently in the procurement phase of a design and construct contract for the treated water pipeline and associated release structure. Further progression of release structure design will be part of that contract which is expected to be awarded after project determination. Management measure WW20 in Table 15-3 of the EIS commits to investigating opportunities during detailed design to improve mixing and dilution of releases and Sydney Water remains committed to doing this to see if there are any feasible opportunities to improve dilution of wet weather releases.

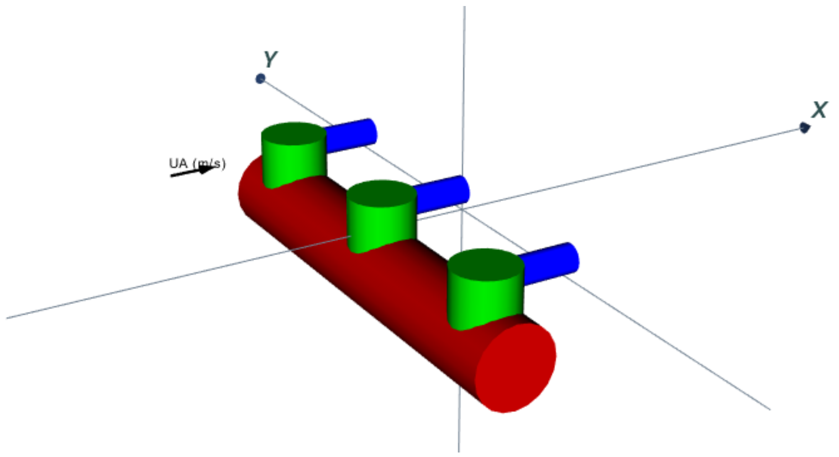


Figure 5-28 Conceptual design of multiport diffuser applied in preliminary modelling

5.10.23 Hydrodynamics and water quality - South Creek release location

Issue description

The EPA requests that in the event that Sydney Water provides sufficient justification for the general need for South Creek discharges from the AWRC, an assessment should be made of an alternative discharge location and configuration to increase initial mixing for South Creek for toxicants. This would be to address the insufficient dilution of chlorine and ammonia in the currently proposed discharge location.

Response

Section 3.3 of the EIS outlines how Sydney Water chose the location of the AWRC, and the reasoning for release to South Creek. To comply with the EPA's Hawkesbury Nepean Nutrient Framework, the project needs to use an advanced treatment process. Operationally, it is most efficient to release treated water to the closest waterway. For the AWRC, this would be either Kemps Creek or South Creek. However, given the ephemeral nature of these waterways and the NSW Government's proposed flow objectives for the South Creek catchment, these waterways are unsuitable to take consistent flows of this treated water.

Options for release locations to South Creek on the AWRC site are substantially constrained by hydraulics and site grades. The natural surface slope of the site is very shallow, with grades generally ranging from 0.5 to 1%. Elevation across the site is also minimal, with about three to four metres of natural elevation between the high point on site and the 1% AEP flood level. The natural ground conditions and low elevation mean that the site requires significant earthworks to adequately drain stormwater runoff. Alternative locations along South Creek near the AWRC are unlikely to increase mixing and dilution due to the limited inputs from other tributaries. The following principles have also been adopted in locating the release point from the AWRC to South Creek:

- Locate the release point on the AWRC site and minimise infrastructure length to waterway for more efficient operation and maintenance.
- Follow natural water flow paths on site where possible to minimise the extent of earthworks required.
- Avoid remnant patches of Swamp Oak Forest along South Creek.
- Avoid significant disturbance to existing oxbow of South Creek.
- Locate the release point away from waterway bends where possible to minimise erosion risk

Given the constraints of the servicing catchment, and the justification outlined in section 5.10.2 regarding the requirement for wet weather releases, Sydney Water considers that there is no feasible alternative location for wet weather releases that would improve dilution and mixing. On this basis, Sydney Water has focused on whether there are any opportunities to further improve mixing and dilution.

The Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS included near field modelling of the reference design for the South Creek release location, focused on toxicants where concentrations in the treated water are likely to exceed ANZG (2018) guidelines. The reference design consists of an open shallow (~1 m deep) channel with a 2.5 m wide base and 1:5 gradient sides. The channel meets the creek at an angle of ~30 degrees.

At the release location, South Creek can generally be described as ephemeral with minimal or no flow during extended dry weather periods. However, during the release events, flows within the creek are predicted to be significantly elevated due to rainfall and runoff in the upstream sub-catchments.

The findings from the modelling concluded that initial mixing of toxicants was predicted to be relatively limited with predicted dilutions ranging from two to six within 60 m of the release point. As a result, respective mixing zone criteria for the toxicants were predicted to be unachievable within the reach immediately downstream of the release point.

Sydney Water maintains its position that the potential for toxicity and environmental harm arising from these releases is low as detailed below:

- Temporally, the events are very infrequent. On average the more severe 3 x ADWF events are predicted to occur two to three times per year but frequencies may vary between zero and six events per year.
- The release events are also typically short lived with durations ranging from less than one day to intermittently over three days.
- The releases correlate with conditions of significant flow within the creek and corresponding low residence times.
- Mixing zones are generally only considered in terms of management of continuous releases of treated wastewater, where releases may present a risk of harm to fish migration or harm to sedentary species. Consequently, mixing zone modelling is generally focused on periods of extended dry weather. For example, in the Queensland Government Technical Guideline, the minimum consecutive seven day average flow with a 10-year recurrence interval is recommended as a guide to minimum dilution conditions in non-tidal streams.
- Application of ANZG (2018) toxicant DGVs in the near field impact assessments could be considered as very conservative as the DGVs are applicable to chronic exposure situations. Therefore, these guideline values are deemed more relevant to exposure durations of greater than three days. No applicable shorter-term toxicity-based guidance values are available under the ANZG (2018) and ANZECC/ARMCANZ (2000) guidelines.

Sydney Water has undertaken additional near field modelling for an alternative release infrastructure design.

The following preliminary model results (Figure 5-29) represent the dilution profiles that are predicted to be achievable using (as an example) a single port outfall mounted on the bed of the creek, in the immediate vicinity of the release point assumed in the EIS. The predicted dilution profiles presented in Figure 5-29 correspond to the same conditions simulated in section 6.2.1 of the Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS).

The results indicate that significant improvements in dilution could be achieved through the installation of a single-port release structure at the same location as previously proposed. The dilutions achieved within 60 m of the release port comply with the dilution requirements previously specified for ammonia and chlorine, particularly if the guideline value derived by Batley et al. (2021) for chlorine is adopted (as outlined in section 6.2.1.3.1 of the Hydrodynamic and Water Quality Impact Assessment). It should further be noted that the presence of any free chlorine in the discharge is very unlikely. Chlorine dosed for disinfection is expected to combine with ammonia and be present only in the form of chloramine. Modelling of chlorine levels and associated impacts should therefore be considered conservative.

From analysis of these preliminary results, regions of intensive near field mixing are predicted by a factor of 8.5 to 13 and extend downstream from ~20 m to ~55 m, depending on the release and ambient flow conditions. This is then followed by additional dilution from ambient buoyant mixing processes.

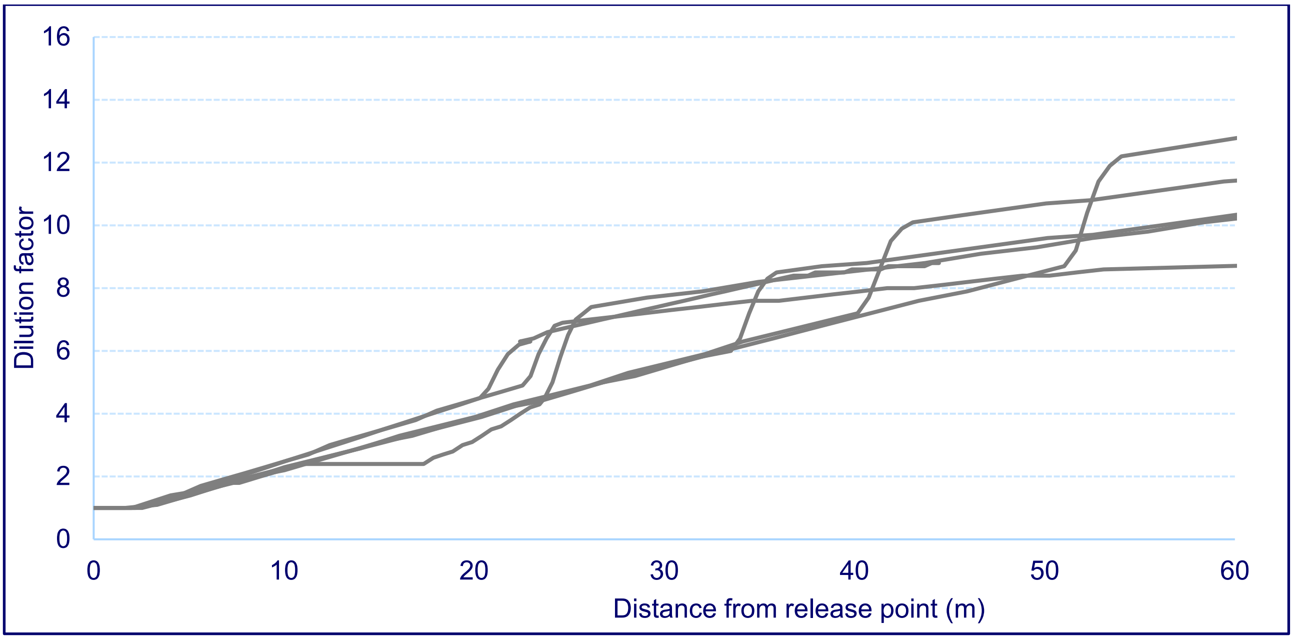


Figure 5-29 Predicted dilution profile for the South Creek (single-port structure, 2036 releases)

Note to figure: Each profile corresponds to a severe wet weather release event. Refer to section 6.2.2 of the Hydrodynamic and Water Quality Impact Assessment for further details on the scenario conditions.

Provisionally, the above modelling has assumed an 800 mm diameter release port, located on the creek bed in the middle of the creek channel, with the port directed downstream to avoid the potential for bank erosion and plume attachment.

Although this modelling indicates additional dilution is theoretically possible, there are substantial challenges to achieving this in practice. Although diffuser structures are used in ocean and estuarine environments, they are not common in inland waterways and Sydney Water does not use this type of structure for its other inland water recycling plants.

As outlined in section 5.10.22, there are significant constraints of constructing and operating a diffuser release structure in South Creek, including substantially more construction disturbance to waterway and constructability challenges, risk of siltation, damage from snagging, geomorphic risks of higher velocity releases and potential structure exposure during low flows.

On balance, Sydney Water considers that given the low risk of toxicity impacts outlined above there is no justification for the risks and impacts of building and operating an in-stream structure of this nature.

However, Sydney Water is currently in the procurement phase of a design and construct contract for the AWRC and associated release structure. Further progression of release structure design will be part of that contract which is expected to be awarded after project determination. Management measure WW20 in Table 15-3 of the EIS commits to investigating opportunities during detailed design to improve mixing and dilution of releases and Sydney Water remains committed to doing this to see if there are any feasible opportunities to improve dilution of wet weather releases.

5.10.24 Hydrodynamics and water quality, surface water - support of DPE EES submission

Issue description

The EPA notes that DPE EES has also provided extensive comments regarding AWRC effluent impacts on water quality to the Wianamatta-South Creek catchment as part of its submission dated 1 December 2021. The EPA concurs with these comment and recommends the proponent give consideration to their applicability to the proposed AWRC discharges to the Nepean River and Warragamba River.

The EPA has reviewed the Surface Water Impact Assessment in Appendix K and understands that a range of mitigation measures are proposed to manage impacts to surface water during the construction and operational phases of the project.

As with effluent impacts on water quality, it is noted DPE EES has previously provided extensive comments regarding surface water impacts from the AWRC to the Wianamatta-South Creek catchment in its submission dated 1 December 2021. These comments noted that revised stormwater assessment modelling is required to determine if the project will meet DPE EES water quality objectives.

Response

Waterways

Sydney Water notes EPA's support of DPE EES comments regarding water quality impacts to the Wianamatta-South Creek catchment. The comments have been considered for Nepean and Warragamba river releases where relevant. Sydney Water's response to DPE BCD (EES) comments is provided in section 5.4.

Surface Water

Sydney Water has revised the stormwater assessment to include updated MUSIC modelling. Sydney Water notes that the revised modelling predicts that the project still achieves DPE EES waterway health (quality and flow) objectives. Sydney Water's response to DPE EES comments on the surface water impact assessment can be found in sections 5.4.17 to 5.4.19 of this report.

Surface water management measures SW01-SW07 will effectively manage impacts during construction and operation and are detailed in Table 15-3 of the EIS.

5.10.25 Project description - salinity in advanced treated effluent

Issue description

The EPA notes that the project does not appear to include any mitigation measures to manage the low levels of salinity in advanced treated effluent (0.03 mg/L). The EPA advises that Sydney Water should provide additional information on any mitigation measures to manage low salinity in advanced treatment discharges (such as re-mineralisation).

Response

Section 4.5.2 of the EIS noted that the advanced treated water will be treated to remineralise the water and adjust the pH. This prevents concrete corrosion in the treated water and environmental flows pipelines and returns salinity and pH to levels similar to receiving waterways.

The reference design includes dosing of lime water and addition of carbon dioxide gas to adjust the pH and reduce the likelihood of concrete corrosion. Investigations were also completed to confirm whether reintroducing ionic salts would be needed to reduce toxicity of the advanced treated water to aquatic ecology in receiving waters.

A simple mass balance was conducted to determine the resulting median geochemical signature of the release when combined with the Nepean River at the release location. The final ionic composition was compared against the ANZECC/ARMCANZ (2000) conductivity guideline value, and upstream reference sites at Nepean Dam (N86) and Maldon Weir (N92). The median conductivity of the Warragamba and Nepean catchments were also calculated from WaterNSW monitoring data for comparison. Sydney Water found that after the necessary alkalinity, pH and corrosivity adjustments, the releases would have a median conductivity of 59.40 µS/cm, which is below the median Nepean catchment conductivity of 130 µS/cm. However, at the release point in Nepean River, there are currently elevated levels of salinity. Mass balance modelling predicted that once mixed in-stream, the treated water releases will help return the Nepean to source salinity whilst remaining in line with the ANZECC/ARMCANZ (2000) guideline value. Accordingly, further re-mineralisation is not expected to be required.

However, Sydney Water has added management measure WW21B to Appendix B requiring detailed design to confirm whether re-mineralisation is needed.

5.10.26 Operation activities – project review

Issue

The EPA notes support for an adaptive approach for the future development of the project and recommends a similar approach should also be delivered through conditions of approval. The submission notes that in particular with a discharge based on a worst-case scenario (that includes impacts to the waterway) a review should be required every five years to assess the performance of the scheme and to validate any predictions. This would also provide an opportunity to re-evaluate any limits placed on the discharges including caps on flow, review programs and works in relation to take up of recycled water and better understand flows from development including the Western Sydney Airport. Such an approach may also help drive recycled water outcomes if there is a risk that flow limits could be restricted.

Response

Sydney Water appreciates the EPA's support for an adaptive approach to future project development. Sydney Water considers that the issue raised is primarily a consideration for DPE, as the submission suggests an approach for conditions of approval. However, the response below outlines how Sydney Water plans to review and validate project performance and monitor development flows and recycled water uptake in Western Sydney.

Sydney Water will review and validate environmental performance of the project through a range of measures including:

- waterways monitoring and reporting as outlined in Table 15-4 of the EIS, for water quality, aquatic ecology and geomorphology in key waterways including South Creek, Nepean River and Warragamba River
- monitoring and reporting AWRC performance (including quality of effluent and water released) in accordance with the project's Environment Protection Licence as outlined in Table 15-4 of the EIS.

In addition, management measure SC01 in Table 15-3 of the EIS commits to ongoing conversations across government to understand the progress of development to allow Sydney Water to be adaptive in sizing and staging the project.

Sydney Water recognises the importance of the urban water balance to achieve the desired waterway outcomes in Nepean River and the South Creek catchment. Releases from the AWRC will be influenced by wastewater inflows, recycled water demands and stormwater harvesting.

Sydney Water will monitor and report on the uptake of recycled water and the realisation of expected benefits associated with the use of recycled water. This overall assessment of the benefit of recycled water schemes will capture any benefits associated with reduction in discharges to waterways.

The AWRC includes provision for recycled water of two qualities:

- Advanced treated water (reverse osmosis treated)
- Tertiary treated water suitable for third pipe use.

Depending on the type of businesses that establish in the area, the advanced treated water may offer new pathways to augment recycled water. Due to the complex nature of recycled water systems, Sydney Water is actively engaging with developers and businesses to understand their potential recycled water applications and how these can be serviced through optimisation of plant and networks. This includes consideration of the desire to provide recycled water for top-up of stormwater reuse systems.

Alongside recycled water is the potential to reduce dam water consumption through provision of replacement environmental flows, as outlined in the EIS. Further, there is an opportunity to augment water supply at the North Richmond Water Filtration Plant (WFP) through transfer of water to the Nepean River. Accommodating the 'maximum transfer' needs to the Nepean River, maximises the opportunity to realise these opportunities which are currently in the planning phase.

The value of recycled water needs to be considered over time against alternate opportunities that require use of the treated water pipeline.

5.10.27 Compliance with legislation, regulations and guidelines (hydrodynamics and water quality, Hawkesbury Nepean Nutrient Framework)

Issue description

The EPA notes that the proposal indicates compliance with load limits under the EPA's regulatory framework to manage nutrients with the Hawkesbury Nepean catchment (the Hawkesbury Nepean Nutrient Framework). The EPA confirms that an EPL issued for the AWRC would include conditions requiring compliance with agreed nutrient load limits for combined Sydney Water treatment plants in the Yarramundi Subzone 2 and Sackville Subzone 2 from 2024 onwards, as well as individual load limits on the AWRC.

The EPA requests that further information is provided with respect to AWRC effluent concentrations and compliance with the Hawkesbury Nepean Nutrient Framework.

Nepean River

The EPA notes that the tertiary treated effluent from the AWRC is expected to contain a median concentration of 1 mg/L for total phosphorus. Under the Hawkesbury Nepean Nutrient Framework, new wastewater treatment plants are expected to be able to achieve 'best practice' median effluent concentrations of 0.05 mg/L for discharge to the main stem of the river.

The EPA notes the following comments on the modelled impacts of the release into the Nepean for the most likely scenario (SC05):

- at times total phosphorus concentration in the river is increased during a dry year as a result of the release and at other times there is no discernible effect.
- In a wet year, the impacts of the discharge on the concentrations of pollutants in the Nepean are obvious not only for total phosphorus but also total nitrogen, ammonia, oxidised nitrogen and filterable reactive phosphorus. Of those pollutants it appears that increased total phosphorus concentrations attributable to the discharge are discernible for

> the greatest distance downstream from the discharge point. As such, the modelling results do not provide justification for adopting the higher total phosphorus concentration of 1 mg/L in the tertiary effluent. While it is noted that this ‘best practice’ concentration level would be the median of all discharges from the AWRC (rather than just tertiary effluent), limited information has been provided regarding the projected median effluent concentrations of total phosphorus from the AWRC.

The EPA requires additional modelling be provided around the median concentrations of effluent discharged from the AWRC, and whether it will comply with ‘best practice’ total phosphorus concentrations outlined in the Hawkesbury-Nepean Nutrient Framework.

South Creek

The EPA notes that the Hawkesbury Nepean Nutrient Framework sets an indicative ‘best practice’ concentration of 3 mg/L for total nitrogen and 0.05 mg/L for total phosphorus above ADWFs into South Creek.

The EPA notes that the proposed effluent quality for discharges to South Creek from the AWRC would result in exceedances of these concentrations for primary treated flows, and that impacts in exceedance of the South Creek Water Quality Objectives would occur, notwithstanding inputs from other sources. Furthermore, the Hydrodynamic and Water Quality Impact Assessment indicates that adequate dilution cannot be achieved for ammonia and chlorine from wet weather discharges to South Creek.

Response

Sydney Water accepts EPA’s statement that an EPL issued for the AWRC would include conditions requiring compliance with agreed nutrient load limits for combined Sydney Water treatment plants in the Yarramundi Subzone 2 and Sackville Subzone 2 from 2024 onwards, as well as individual load limits on the AWRC. Further information about compliance with the Hawkesbury Nepean Nutrient Framework is provided below.

Nepean River

The Upper South Creek AWRC primarily produces advanced treated water, with tertiary treated water released for only for short periods of time. Sydney Water therefore considers that the median values for a typical tertiary treatment plant are not applicable and that median phosphorus concentrations should meet the lower 0.025 mg/L. The project has been designed to meet this requirement, as outlined below.

Tertiary treatment at the Upper South Creek AWRC is proposed in a combined secondary/tertiary process where filtration is combined with solids separation in a Membrane Bioreactor (MBR). Although the nitrogen removal is equivalent to a standard tertiary system, the phosphorus removal has been designed to meet the requirements of feeding it to the advanced reverse osmosis process to achieve the median total phosphorus requirement. Obtaining lower phosphorus concentrations from the tertiary process is not an efficient use of chemicals, MBR volume and membranes, given median objectives are achieved by the reverse osmosis treatment. However, Sydney Water understands that the intent of the Hawkesbury-Nepean Nutrient Framework is to specify what concentration can be achieved in releases, rather than what can be achieved from the outputs of a particular treatment train of the AWRC.

Table 5-31 summarises modelled median concentrations of phosphorus in advanced treated water, tertiary treated water and the stream when both types of water are shandied for release (noted as 'Combined Nepean River releases') in the table. This shandy of advanced and tertiary (MBR treated) water would be released to Nepean River for about 40 days/year in a modelled wet year (and less frequently in average and dry years). At other times, advanced water is released, unless flows are three times ADWF then tertiary only flows are released at Nepean River with all advanced treated (reverse osmosis) flows to South Creek along with wet weather flows (primary treatment with disinfection). If an additional unit process was added to further reduce phosphorus from the tertiary process, this would only have benefits for a maximum of 40 days/year and provide a negligible shift in the median phosphorus concentration.

Table 5-31 Modelled performance of AWRC advanced, tertiary and combined flows – median concentration (50%iles)

	Advanced treated flows	Tertiary (MBR) treated flows	Combined Nepean River releases – median	Best Practice (Tertiary treatment)	Best Practice (Advanced treatment)
Total nitrogen (mg/L)	0.35	2.5	0.37	3	0.35
Total phosphorus (mg/L)	0.009	1	0.009	0.05	0.025

South Creek

Releases to South Creek will be intermittent and only during high flow wet weather conditions (when average dry weather flows are greater than 1.7xADWF) and may occur for varying periods in any one day. In addition, releases to South Creek will be a combination of advanced treated flows and wet weather treated (primary treatment and wet weather disinfection) flows, with the proportions depending on the incoming wastewater flow to the AWRC.

Sydney Water considers that best practice total nitrogen and total phosphorus concentrations of 3 mg/L and 0.05 mg/L apply to tertiary treatment in a conventional sense with continuous releases. For the project, releases to South Creek from the AWRC will either be advanced treated water or a shandy of advanced treated water and primary treated water. Releases to South Creek have been modelled as occurring only up to 14 days/year, and not all day. Accordingly, the combined outcome (primary treated and advanced treated water) is not considered a median in the conventional sense, as the releases are intermittent over the year and the day. Based on a normal median calculation, the true annual median of both total nitrogen and total phosphorus is just over zero, given there are many days with no releases to South Creek.

Table 5-32 shows the overall outcome based on applying 'median' of wet weather flows and advanced treated flows, as well as the combined primary treated and advanced treated flows at three times ADWF. However, as indicated above, this should not be considered a true median, and should not be compared to a conventional tertiary plant design.

Table 5-32 Comparison of treated water quality (median concentrations) to South Creek water quality objectives

Indicator	South Creek water quality objective	Advanced treated water	Primary treated water	Combined South Creek releases
Total Nitrogen (mg/L)	1.72	0.35	18	0.4
Ammonia (mg/L)	0.08	0.03	15	0.06
Oxidised Nitrogen (mg/L)	0.66	0.12	0	0.28
Total phosphorus	0.14	0.009	1	0.01
Total Suspended Solids (mg/L)	37	0	35	0
Conductivity (µS/cm)	1103	150	1500	34
pH	6.2 - 7.60	7	7	7
Dissolved Oxygen (DO, mg/L)	8	9.2	0	9.2

The issue raised about dilution of ammonia and chlorine in wet weather releases to South Creek is addressed separately in section 5.10.23.

5.10.28 Compliance with legislation, regulations and guidelines - impact on Malabar wastewater system

Issue description

The EPA notes that the brine wastewater stream from the advanced treatment process will be transferred by pipeline to the existing wastewater network at Lansdowne and transported to the Malabar WWTP for discharge to the ocean. The EPA notes that there is limited assessment in the Hydrodynamic and Water Quality Assessment of whether the Malabar system has capacity to accept such a new load of wastewater and whether there are any potential risks for its environmental performance to be compromised (including the requirements stipulated Sydney Water's environment protection licence for Malabar Sewage Treatment System).

Response

An assessment of the capacity of the Malabar wastewater system and impacts on the Malabar EPL was included in the EIS. Sydney Water notes that the EPA submission did not reference these EIS sections as having been reviewed in preparing its submission.

Section 4.6.2 of the EIS includes a description of how the brine from the AWRC will be managed. Brine will first be stored in tanks before release into the North Georges River Submain (NGRS) via the brine pipeline. These tanks will have a storage volume of about 30 ML. This equates to a storage duration of about six days in 2026 and three days when the AWRC is operating at 50 ML/day. This will ensure that the brine does not displace wastewater in the NGRS and the supporting Malabar wastewater network when this system experiences capacity issues, typically during wet weather. Once the system has capacity, the brine that is stored in the brine tanks can be released into the NGRS via the brine pipeline.

During wet weather events, the advanced treatment process will be switched off if the brine storage tanks reach capacity and are unable to release brine into the NGRS via the brine pipeline Modelling of the wastewater system suggests this is likely to be happen about six times in 10 years in 2026, and up to 15 times in 10 years when the AWRC is operating at 50 ML/day. Sydney Water expects that by 2036, upgrades to the Malabar wastewater system will increase its capacity so brine storage at the AWRC is unlikely to be required.

Section 8.7.1 of the EIS includes an assessment of the impacts of the brine on the Malabar EPL. The analysis showed that compliance with load limits is predicted until at least 2056.

Table 5-33 summarises the forecast loads at Malabar WWTP for 2036 and 2056, compared to current EPL load limits. Oil and grease is not expected in the brine, so has not been included in the table.

Table 5-33 Forecast loads at Malabar WWTP compared to EPL limits

Pollutant	Load Limit[1] (kg/yr)	2036		2056	
		Malabar load (kg/yr)	Malabar load including brine (kg/yr)	Malabar load (kg/yr)	Malabar load including brine (kg/yr)
Total nitrogen	**13,231,250**	10,457,673	10,508,955	11,592,081	11,694,646
Total phosphorus	**2,646,250**	1,454,433	1,472,501	1,638,148	1,674,283
Total suspended solids	**47,632,500**	31,463,141	31,481,391	34,341,646	34,378,146
Cadmium	**301**	67	73	74	85
Chromium	**10,804**	1,697	1,841	1,863	2,150

Pollutant	Load Limit[1] (kg/yr)	2036 Malabar load (kg/yr)	2036 Malabar load including brine (kg/yr)	2056 Malabar load (kg/yr)	2056 Malabar load including brine (kg/yr)
Copper	**43,610**	20,408	22,136	22,405	25,859
Lead	**5,615**	861	946	934	1,091
Mercury	**103**	8	8	8	10
Selenium	**3,969**	136	147	149	172
Zinc	**59,761**	24,042	26,077	26,394	30,464

1. Taken from EPL 372, June 2021.

Similarly, there is no risk to Malabar concentration limits with the addition of the brine. There is no hydrogen sulfide and biological oxygen demand expected in the brine.

Table 5-34 provides a comparison of predicted concentrations of total suspended solids and aluminium in the brine and Malabar influent concentration. Concentrations in the brine are lower, so will effectively dilute other inflows to Malabar WWTP.

Table 5-34 Comparison of pollutant concentration of brine and Malabar influent

Indicator	Unit	Brine concentration	Malabar Influent concentration (median 2020/21)
Aluminium	ug/L	425.0	1245.5
Total suspended solids	mg/L	8.3	355

5.10.29 Surface water - release of stormwater during construction

Issue description

The EPA notes that the Surface Water Impact Assessment indicates that sediment basins will be incorporated into the construction phase to manage site run-off. However, it is unclear what proposed discharges will occur from these basins, and whether any such discharges would include contaminated water from excavations or stockpiles. The EPA notes that the Surface Water Impact Assessment states that in the event that contaminated water from AWRC construction activities is to be discharged into waterways, a discharge impact assessment would be required to demonstrate the discharge will not have significant deleterious impacts to the receiving water body. The EPA notes that any construction stage stormwater discharges from the AWRC should require a discharge impact assessment on receiving waterways as a condition of approval.

Response

Details of construction sediment basins (such as location, design, and releases) have not yet been determined and will be developed by the construction contractor(s) during detailed design and construction planning. However, as outlined below, Sydney Water has committed to a range of measures to minimise construction impacts on surface water.

Construction runoff will be effectively managed by erosion and sediment control measures including management measure SW05 in Table 15-3 of the EIS. SW05 has been updated in Appendix B to consider construction phase targets in the draft Phase 2 Western Sydney Aerotropolis Development Control Plan (Phase 2 DCP) in response to comments from DPE Water in section 5.5.13 of this report. Meeting these targets will mean that during construction the NSW Government's water quality and flow related waterway objectives will be achieved and discharges to waterways during construction will be managed.

In addition, management measure G06 in Table 15-3 within the EIS commits to the development of construction site layout plans as part of the project's Construction Environmental Management Plan (CEMP). These layout plans will ensure the placement of waste storage and stockpiles within construction sites are located away from drainage pathways reducing potential for contaminated runoff to enter sedimentation basins, stormwater or receiving waterways. Management measures SW06 and SW07 in Table 15-3 of the EIS commit to store chemicals, fuels and oils in bunded areas and the development of spill response procedures which will reduce potential for these contaminants to enter surface runoff.

To manage contaminated discharges, management measure GW08 in Table 15-3 of the EIS commits to the development and implementation of a dewatering procedure for disposal of contaminated water which will include requirements for storage, testing, transport and appropriate discharge options.

Sydney Water has revised management measure GW08 in Appendix B to refer to contaminated runoff and any conditions of the project's EPL.

5.10.30 Waterways - trenching of Kemps and South creeks

Issue description

The EPA requests further justification for choosing to trench across Kemps Creek and South Creek for the construction of the treated water and brine pipelines. The EPA notes that streams of order 1 or 2 are not included in the assessment for crossing impacts, and justification for this is not provided. The EPA notes that Kemps Creek and South Creek are being trenched (rather than directionally drilled under) for the treated water discharge main and the brine discharge main, respectively. There is no indication of the depth and width of these waterways at the crossing point, although it is noted in the EIS that the South Creek crossing location does not pond in the dry season like the other waterways so normal drainage will be temporarily obstructed.

Response

The EIS assessed impacts for all waterway crossings, including streams of Strahler order 1 and 2. These streams were identified in Tables 8-15, 8-23 and 8-25 in the EIS and assessed in sections 8.6 and 9.1.5.

Sydney Water proposes to change the construction methodology and alignment of the brine pipeline at Kemps Creek. This change is assessed in the project's Amendment Report (Sydney Water, 2022). The pipeline will be installed in a concrete encasing that Sydney Water has recently installed for a separate project, which removes the need to trench across Kemps Creek.

As shown in Figure 4-17f of the EIS, Sydney Water proposes to trench the treated water pipeline across South Creek. The justification for trenching South Creek includes the waterway being narrow at the crossing location with minimal flows. Sydney Water considers the impact during construction associated with open trenching can be effectively managed through the implementation of the management measures in Table 15-3 of the EIS. These include:

- WW01 commits to designing and implementing construction methodologies in waterways that reduce geomorphic impacts.
- WW02 commits to minimising the duration of instream works and conducting the work during low flow conditions where practical.
- WW17 commits to avoiding Australian Bass migration season where possible.
- G05 commits to developing and implementing a Rehabilitation Management Plan to restore construction sites as soon as possible to pre-existing conditions.

5.10.31 Groundwater

Issue description

The EPA notes that the project may result in potential impacts to groundwater systems including mobilisation and migration of contaminated groundwater, disruption of surface water / groundwater connectivity and altered groundwater water quality and flow regimes. Consequently, the EPA notes that the Groundwater Impact Assessment (Appendix M) has recommended the implementation of continued groundwater level and groundwater quality monitoring during the construction and operations phases of the project through a Groundwater Monitoring Program. This will allow for comparison between collected groundwater data and the existing baseline dataset to identify impacts during all phases of the project.

The EPA notes that the proposed project will involve the extraction of groundwater and wastewater from dewatering activities during the construction of the treatment facility and pipelines, as well as the release of alkaline concrete washwater. The EPA notes that the agreed approach to manage this material has not yet been developed but may include discharge to a receiving surface water body or stormwater collection system. Should the proponent wish to discharge groundwater, wastewater or concrete washwater material to stormwater or a receiving waterbody, the EPA advises that the discharge may require regulation under an EPL and meet relevant requirements under water quality guidelines.

Response

Sydney Water notes the EPA's comments on potential impacts to groundwater. Management measures GW01 – GW14 in Table 15-3 of the EIS have been informed by the recommendations in Appendix M and will effectively manage impacts to groundwater during construction.

Sydney Water also notes the EPA's comments on regulation of discharges to stormwater or a receiving waterbody. As noted in Table 5-12 of the EIS, the project will require a scheduled development licence under section 43(a) of the POEO Act and Sydney Water expects this would regulate any releases to waterways if required during construction. Management measure GW08 in Table 15-3 of the EIS commits to developing an approach to manage extracted groundwater which will be confirmed as detailed design progresses. Sydney Water has revised GW08 in Appendix B to clarify that disposal of extracted groundwater and any contaminated runoff will also comply with the requirements of the project's EPL.

5.10.32 Noise and vibration - managing impacts

Issue description

The EPA notes that the project is likely to have a significant impact during the construction stage on communities adjacent to the works. The Noise and Vibration Impact Assessment indicates the potential for airborne and ground-borne noise impacts, as well as vibration impacts, during both daytime and night-time hours for some construction activities, for an extended period of approximately 36 months.

The EPA notes that the key to effectively managing these will be strong and proactive engagement and consultation with these communities about the predicted impacts, and what mitigation and management measures will be implemented to address them. The EPA notes that Sydney Water must ensure that all feasible and reasonable mitigation and management measures, including those outlined in section 7.6 of the Noise and Vibration Impact Assessment, are implemented prior to the commencement of construction activities. These measures should extend beyond community notification of upcoming works and consider community views in works programming and management.

Response

Sydney Water notes EPA's comment on potential significant noise and vibration impacts during construction. Although the entire construction program for the project is 36 months, as outlined in section 11.3 of the EIS, construction will be carried out progressively along pipeline alignments. This means that for most receivers, noise and vibration impacts will be experienced for up to several weeks, not 36 months. There are some locations such as the AWRC site where construction in one location will take longer and receivers will therefore experience noise and vibration impacts over longer periods.

Sydney Water notes the importance of strong and proactive engagement and consultation with the impacted communities. Chapter 6 of the EIS outlines the extensive community engagement and consultation undertaken to date, and the approach for future consultation as the project progresses. Management measure G08 in Table 15-3 of the EIS commits to developing and implementing a Community and Stakeholder Engagement Plan (CSEP) that will include consulting with impacted landowners and the community. Management measure NV06 commits to consulting with residents and landowners that will be most impacted by out of hours work (OOHW) and developing management measures to minimise noise and vibration impacts.

5.10.33 Noise and vibration - cumulative impacts

Issue description

The EPA notes that the Noise and Vibration Impact Assessment has not included consideration of any cumulative impacts from the construction of other projects as discussed in section 7.3 and acknowledges that this may result in increased impacts on receivers. The EPA notes that careful management of any concurrent construction activities with other projects in a given vicinity will be necessary to provide adequate respite and minimise the potential for noise and vibration impacts, and construction fatigue.

Response

Section 11.2.8 of the EIS outlines and acknowledges the potential cumulative noise and vibration impacts of the project. These are difficult to quantify at this stage given uncertainties in construction timing for other projects. Management measure G10 in Table 15-3 of the EIS commits to ongoing consultation and coordination with other major projects and utility providers where cumulative impacts may occur.

5.10.34 Noise and vibration - background noise monitoring

Issue description

The EPA notes that in addition to utilising background noise monitoring data for existing sensitive receiver locations, the Noise and Vibration Impact Assessment has in some instances provided estimated background noise levels for areas of future sensitive development, such as new residential areas, as might occur under the Western Sydney Aerotropolis Plan (NSW Government, 2020). The EPA notes that this approach is not acceptable, and requests that background noise monitoring data be used to derive noise criteria and influence noise mitigation measures.

Response

The AWRC will start operating in 2025, at which point the background noise environment will likely be significantly different to the current existing environment as a result of the M12 Motorway, Western Sydney International Airport and potentially other developments in the area. Accordingly, the future background noise levels cannot currently be quantified. A conservative approach has been adopted to predict likely background noise levels once the AWRC is operational.

Existing background and estimated future background noise have been used to derive criteria for assessing operational impacts of the AWRC. The existing background noise at the AWRC site was derived from noise logger L06 shown in Figure 11-5 of the EIS.

Predicted operational noise levels from the M12 Motorway EIS indicate it is expected to increase ambient noise levels by at least 5 dB. Operational impacts of the AWRC have been assessed based on this increase to the background acoustic environment. Although the Western Sydney International Airport is likely to increase average noise levels, the background noise level is unlikely to be affected due to the intermittent nature of aircraft movements. As a result, the potential operational noise impact from Stage 1 of the AWRC has been assessed assuming existing sensitive receivers remain and that the M12 Motorway is operational.

An updated comparison has been completed of two different operational noise scenarios at the AWRC. The first is shown in Table 5-35 which includes the background noise from the operation of the M12 Motorway in an Urban noise category and operational noise from the AWRC without any mitigation. As described in section 11.2.6 in the EIS, this assessment shows noise exceedances at one receiver under enhanced meteorological conditions.

Although unlikely to be representative of actual conditions during operation, Table 5-36 shows a scenario that assumes no changes to the background noise levels (ie no M12 Motorway), once the AWRC is operational and a Rural noise category, (ie the noise category remains unchanged from the current environment). In this scenario, noise level exceedances occur at four receiver locations (R3, R4, R5 and R6) under standard and enhanced meteorological conditions. Exceedances range from one to 6 dB. These exceedances are unmitigated and include the 2 dB engineering margin.

Management measure NV10 in Table 15-3 of the EIS commits to investigating opportunities to reduce the operational noise from the AWRC which will potentially reduce exceedances to only enhanced meteorological conditions.

Table 5-35 Predicted operational noise levels as per Scenario 1 in the EIS

Receiver	Standard meteorological conditions						Enhanced meteorological conditions					
	Day/Evening			Night			Day/Evening			Night		
	Predicted level	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance
R1	33	45	Yes	32	41	Yes	33	45	Yes	32	41	Yes
R2	29	45	Yes	29	41	Yes	34	45	Yes	34	41	Yes
R3	33	45	Yes	32	41	Yes	37	45	Yes	37	41	Yes
R4	36	45	Yes	35	41	Yes	40	45	Yes	40	41	Yes
R5	37	45	Yes	37	41	Yes	42	45	Yes	42	41	No
R6	37	45	Yes	36	41	Yes	41	45	Yes	40	41	Yes

Table 5-36 Updated predicted operational noise levels from the AWRC with Rural noise category

Receiver	Standard meteorological conditions						Enhanced meteorological conditions					
	Day/Evening			Night			Day/Evening			Night		
	Predicted level	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance	Predicted level (dB)	Criteria (dB)	Compliance
R1	33	40	Yes	32	36	Yes	33	40	Yes	32	36	Yes
R2	29	40	Yes	29	36	Yes	34	40	Yes	34	36	Yes
R3	33	40	Yes	32	36	Yes	37	40	Yes	37	36	No
R4	36	40	Yes	35	36	Yes	40	40	Yes	40	36	No
R5	37	40	Yes	37	36	No	42	40	No	42	36	No
R6	37	40	Yes	36	36	Yes	41	40	No	40	36	No

5.10.35 Noise and vibration – methodology clarifications

Issue description

The EPA requests several clarifications about noise assessment methodology. Table 5-37 includes responses to each of these.

Response

Table 5-37 Response to EPA comments on noise assessment methodology

Issue raised	Response
Section 6.2.5 of the Noise and Vibration Impact Assessment states that a +2 dB 'engineering margin' has been applied to all predicted operational noise levels. Further explanation is required to explain this, together with how it has been accounted for in the design of any mitigation measures. Predicted noise levels should be provided inclusive of any such margin.	The 2 dB engineering margin means that 2 dB has been added to the predicted levels for contingency. The predicted levels include this 2 dB engineering margin. This is due to the noise impact assessment being completed based on a reference design with final equipment only being determined during detailed design. This allows for a degree of flexibility and variation in the final equipment that is selected.
Explain the methodology for determining which receivers are subject to a 5 dB penalty for excess low frequency noise (as identified in section 6.2.5 of the Noise and Vibration Impact Assessment), with reference to Fact Sheet C of the Noise Policy for Industry (NPfI) (EPA, 2017).	Section 6.1.1.4 of Appendix S of the EIS explains the methodology for determining which receivers are subject to a 5dB penalty. This has been adopted from Table C1 of Fact Sheet C: Corrections for annoying noise characteristics in the Noise Policy for Industry. Table 11-16 of the EIS and Table 18 of Appendix S state that sensitive receiver R1 includes a 5 dB modifying factor due to the site contribution dB(C) exceeding dB(A) by more than 15 dB. This is in accordance with Fact Sheet C: Corrections for annoying noise characteristics in the Noise Policy for Industry.
Quantify and assess the expected noise levels associated with valve operation during surge events (as mentioned in Section 6.5).	Quantifying noise from air valves during a surge event is not possible. This will only occur if the valves malfunction, and is not part of their design or standard operation. As outlined in section 11.2.6 of the EIS, surge events are anticipated to occur about twice a year and last for about five seconds. Due to the frequency and duration of surge events, as well as the valves being located below ground, noise generation during surge events is expected to be minimal.

Issue raised	Response
Table 29 in section 7.1 identifies the potential use of a tunnel boring machine during Phase 2c/2d. Clarify whether a tunnel boring machine is proposed to be used on this project.	A Tunnel Boring Machine (TBM) may be required for the construction of the environmental flows pipeline between Bents Basin Road and Warragamba River. This is due to the depth and distance of the tunnel. This would be confirmed during detailed design when a construction contractor has been engaged.

5.10.36 Noise and vibration - construction traffic

Issue description

The EPA notes that section 7.5 of the Noise and Vibration Impact Assessment identifies that there is greater potential for noise impacts from construction traffic on a number of local roads, especially during the night-time period. All feasible and reasonable measures should be implemented to minimise these impacts.

Response

Section 4.10.4 of the EIS outlines the proposed construction hours for the project. However, OOHW will be required to facilitate construction and reduce impacts on the traffic network during peak hour times.

Sydney Water notes the potential noise impacts from construction traffic during OOHW. Management measure NV02 acknowledges the preference for work to be completed during standard construction hours. OOHW will be identified, developed and programmed in consultation with the community as outlined in management measure NV06 in Table 15-3 of the EIS.

5.10.37 Air quality – justification of air emission rates

Issue description

The EPA notes that the results of the dispersion modelling are presented as contour maps. Figure 10 in the Air Quality Impact Assessment (AQIA) shows the predicted incremental odour concentrations (99th percentile) for the 50 ML (Stage 1) scenario. The contours indicate compliance with the EPA's impact assessment criterion (IAC) of 2 odour units (OU) (for urban areas) at nearby sensitive receptors (both existing and future). Figure D2 in the AQIA presents the results for the 100 ML modelling scenario. Only marginal compliance with the EPA's 2OU criterion is predicted at future likely sensitive receptors with impacts between 1 and 2 OUs being predicted.

Whilst the modelling presents marginal compliance with the EPA's IAC, there is some uncertainty regarding the adopted emission rates used in the modelling. The Sydney Water odour emissions database has been used to develop estimates of maximum emissions from the proposed AWRC. Emission test data from other treatment plants has been relied upon to develop the emissions inventory. However, it has not been adequately demonstrated that the adopted emissions are appropriate for the proposed plant design and scale of the operations. Furthermore, it has not been shown that the adopted emission rates represent reasonable worst case. The biosolids loadout building has been modelled as a volume source, using a flow rate of 10 m^3/s. The method used to calculate this emission rate has not been detailed. Furthermore, biosolids loadout emissions have only been modelled for the hours between 7 am and 3 pm. There is no justification for why this time period is appropriate, and how odours will be controlled outside of this period.

The EPA recommends the AQIA be updated to include robust justification for the emission rates adopted in the dispersion modelling assessment

Response

The Sydney Water odour emissions database represents an extensive collection of over 10 years of odour sampling data from wastewater treatment plants in the Sydney Water network. The emission rates in this database were selected with the aim to provide a robust estimate of emissions from individual processes and potential odour impacts, where site-specific data are not available, such as in the case of a proposed plant.

Two key factors that made the Sydney Water odour emissions database an appropriate reference for this assessment were:

- The AWRC will be built as part of the same operational Sydney Water network as the plants on which the database is based, so climate effects on wastewater are similar and the wastewater quality is broadly similar (as opposed to comparing wastewater from different parts of the country).
- Sydney Water will set the operational specifications for the AWRC. This means that the AWRC will be operated in a similar manner to other plants on which the odour database is based.

Table 5-38 identifies the source of emission rates for each of the odorous sources. This information shows that the selected emission rates were either based on actual measurement data from similar processes or based on conservative estimates.

Table 5-38 Source of estimated odour emission rates and other modelled parameters

Project element	Assumed value for assessment	Source documentation
Odour Control Unit (OCU)	500 OU (concentration)	• Concentration: 500 OU is upper value for other sites that have an OCU with carbon polishing, or feature carbon as the main treatment stage. Examples include: – PARPS Re-lift Station (Adelaide): Biotrickling Filter (BTF) with Activated Carbon (AC) polishing: Based on four samples taken 9 January 2019. Sample results ranged between 76 and 106 OU with an average of 85 OU.

Project element	Assumed value for assessment	Source documentation
		– Merrimac STP – BTF with AC polishing: Based on 42 samples taken in 2008. Sample results ranged between 17 and 163 OU with an average of 68 OU. – Picton WRP: BTF with AC polishing. Based on 18 samples taken between 11 August 2005 and 8 August 2006. Sample results ranged between 22 and 506 OU with an average of 229 OU. • Temp: 293K = 20C. This is approximately ambient temperature. In winter, the air will be warmer than ambient, as the wastewater arrives at the plant slightly above ambient and the air will be warmer under odour control covers. Modelling source air at ambient, instead of warmer than ambient, in times of potentially highest odour impacts (i.e. winter) is a conservative approach. • Air flow: Air flow is based on the ventilation needs of covered processes and as per the design. • Velocity: 15 m/s is a standard design velocity. The value is intended to be high enough to achieve good dispersion without unwanted phenomena (eg noise / whistling from stack, backpressure on fan, etc).
Bioreactor 1, 2, 3 and 4	0.5 OU.m^3/m^2/s (specific odour emission rate)	Specific odour emission rate (SOER): 0.5 is a default value for this source from Sydney Water Odour Emissions Database (short sludge age plant). Concentration is back-calculated from the SOER based on a flux hood with 5 L/min air sample rate. Assumed value of 0.5 is conservative as the AWRC would be a long sludge age plant.
Membrane Tanks 1, 2, 3 and 4	0.5 OU.m^3/m^2/s (specific odour emission rate)	SOER: 0.5 is default value for this source from Sydney Water Odour Emissions Database (short sludge age plant). Concentration is back-calculated from the SOER based on a flux hood with 5 L/min air sample rate. Assumed value of 0.5 is conservative as the AWRC would be a long sludge age plant.
Biosolids Loadout Building	1,680 OU (concentration)	• Concentration: 1,680 OU based on measurement data from the Malabar WWTP. • Air flow: Based on nominal wind velocity and assumed openings in the building.

Project element	Assumed value for assessment	Source documentation
Cogeneration Engine	1,589 OU (concentration)	• Concentration: 1589 OU: from North Head WWTP and as sampled in 2013. • Temperature: From cogeneration unit at North Head WWTP. • Air flow: From cogeneration unit at North Head WWTP. Based on a temperature of 699 K. • Velocity: From cogeneration unit at North Head WWTP. Calculated from discharge air flow and stack diameter.

Plant scale is not typically a factor in the selection of odour emission rates as rates are related to the nature of a source rather than the size of a source. It is also useful to note that, at 50 ML/d, Stage 1 of the AWRC is not the largest of Sydney Water's treatment plants.

Increasing the AWRC to treat up to 100 ML/d also does not introduce scale issues for emission rates, as the second stage is simply a duplication of the first stage and process units will not be built at unconventional sizes. The odour modelling was configured to represent the proposed sizes of all sources.

It should be noted that the references to 'worst-case' in the AQIA related to the way in which the biosolids loadout operation and odour control unit operation had been modelled which, in turn, would lead to results that represent potential worst-case impacts.

The air flow rate for the biosolids loadout building was estimated from data published by the Chartered Institution of Building Services Engineers (CIBSE) relating to natural ventilation of warehouses. This reference was appropriate since the biosolids loadout building will be similar in size and design to a warehouse. The average and peak air flow rates from the CIBSE data were 6.8 m^3/s and 10.4 m^3/s respectively. An air flow rate at the upper end of this range, 10 m^3/s, was selected for the biosolids loadout building as this was a conservative approach that led to higher emissions in the modelling, as opposed to using the average flow rate.

Loadout emissions were modelled to occur in the time frame from 7 am to 3 pm, as this is the standard time that loadout may occur on any of Sydney Water's sites. Doors will be closed outside of these hours with the building ventilated through the odour control unit.

5.10.38 Air quality - odour control measures

Issue description

The EPA notes that section 4.2 of the EIS Executive Summary states that the AWRC will include a range of design measures to minimise odour impacts. However, these have not been adequately detailed in the AQIA. The AQIA does not include any plans, process flow diagrams or descriptions that clearly identify and explain all pollution control equipment and odour mitigation techniques proposed for all processes on the premises. No design specifications of the odour control unit (OCU) were provided. Whilst it is noted that the design of the plant will aim to achieve an odour emission performance of 500 OU, details about the control system design, configuration and operational variability should be provided.

The AQIA identifies the biosolids loadout building as the most significant source of odour associated with the AWRC. However, there is no discussion about the design and operation of the building. Odours from biosolids are recognised as a major odour source associated with wastewater treatment facilities. The EPA considers best practice odour control measures should be included in the final design of the plant. This may include full enclosure of the biosolids loadout building with capture and treat technologies applied that include capture and control of odorous air from odorous processes associated with a wastewater treatment plant.

The Technical framework: Assessment and management of odour from stationary sources in NSW (DEC, 2006) identifies that additional feasible odour mitigation measures that could be implemented should be considered at the assessment / planning stages of a proposal. The assessment does not identify or discuss additional feasible measures that could be adopted in the event that odour impacts occur once the proposed facility is operational.

It is the proponent’s responsibility to comply with section 129 of the POEO Act. Should odour impacts be experienced once a facility is operational the proponent will need to address these and, if necessary, modify the facility based on actual operational outcomes. Addressing odour impacts retrospectively is likely to be more difficult and costly than incorporating such measures in the initial proposal.

The EPA recommends the proponent update the AQIA to:

- include plans, process flow diagrams and descriptions that clearly identify and explain all pollution control equipment and odour mitigation techniques for the proposed facility
- identify and nominate additional feasible odour control measures and/or contingency measures for mitigating odour impacts, in the event they do occur.

Response

Process flow diagrams and detailed technical information about the exact equipment to be used are not available given the project has not yet progressed to detailed design. However, given its responsibility to comply with section 129 of the POEO Act, Sydney Water has taken a conservative approach to the assessment of potential air quality impacts and the EIS commits to meeting the modelled assessment outcomes. Some further information is included below about odour control, contingency and mitigation measures focused on the project components most relevant to air quality management:

- Odour covers and Centralised Odour Control Facility (OCF).
- Cogeneration engines and waste gas burners.

Sydney Water is designing the AWRC with best practice odour control available during the design phase.

Odour covers and Centralised OCF

The OCF will likely consist of bio-trickling filters (BTFs) and activated carbon filters prior to discharge of the treated air via a stack about 15 m high. The specific details of the OCF are still subject to detailed design. The discharge velocity from the stack will be about 15 m/s. The fans on the OCF will operate in a duty/standby arrangement.

The OCF will be sized with a capacity of 95,000 m^3/h which will take effect during biosolids out-loading. When the biosolids loadout building is not in use, the ventilation rate will drop back to a lower rate, with the OCF operating at a total ventilation rate of 85,000 m^3/h.

The following processes will be connected to the OCF:

- Inlet Works including:
  - flow receival chambers
  - inlet works channels
  - grit tanks, screens, screenings and grit handling equipment,
  - flow distribution chambers and drop chambers
  - drainage pump station.
- Primary sedimentation tanks including:
  - inlet and distribution channels
  - tanks, outlet weirs, and outlet channels.
  - scum wet wells
  - discharge drop chambers.
- Membrane fine screens including:
  - inlet, outlet, and distribution channels
  - screens, and screenings handling equipment
  - bioreactor feed distribution structures.
- Sludge treatment and handling facilities including:
  - Waste Activated Sludge (WAS) thickening and recuperative thickening rotary drum thickeners (RDTs)

- digester feed blending tank
- anaerobic digester overflow boxes
- fill and spill pumping station wet wells
- dewatering feed averaging tank (FAT)
- dewatering Centrifuges
- biosolids conveyors and storage hoppers
- biosolids loadout building
- recycle return pump station.

Covers will be fitted to plant and equipment like tanks so that odours can be contained and captured.

Cogeneration and waste gas burners (WGBs)

Biogas produced by the digesters will be combusted in the cogeneration engines to produce electricity and provide heating of the digesters using the waste heat. Gas produced in excess of the cogeneration engine and heating utilisation capacity will be destroyed by combustion using the waste gas burners (WGBs).

The cogeneration engines will be run solely on biogas. While a natural gas pipeline was considered to supplement digester heating, the pipeline is not required as the biogas will be preferentially used for digester heating as opposed to cogeneration.

Two WGBs will be installed to operate in a duty/standby arrangement to flare excess biogas. Each WGB has the capacity to flare all biogas produced at the peak biogas production rate.

Table 5-39 provides further detail of biogas generation, storage, and processing equipment (ie cogeneration engines and WGBs).

Table 5-39 Design details for biogas generation and utilisation equipment

Aspect	Parameter	Units	Value	Notes
Biogas quantity	Average (as biogas)	Cubic metres per day	7,800	Nominal biogas generated at 50ML/d, average loads
	Peak month (as biogas)	Cubic metres per day	10,100	Nominal biogas generated at 50ML/d, peak loads
	Maximum generation	Cubic metres per day	14,200 to 16,500	Nominal biogas generated at 12.5ML/d, average and peak loads

Aspect	Parameter	Units	Value	Notes
Biogas quality	Methane Carbon dioxide Nitrogen Other gases	Percent by weight (%w/w)	55-65% 30-40% 3-5% 1-2%	Sydney Water Anaerobic Digester Design Manual. Exact composition TBC.
Gas Holders	Quantity	Number	4	
	Type	-	Membrane	
Cogeneration Engine	CHP size	Kilowatts (kW) Kilowatts equivalent (kWe)	3,000 total 1,200	2 units, each at 600kWe. Provision for installation of third unit.
	Max biogas consumption	Cubic metres per day (m3/d)	11,150	
	Conversion to electricity	Percent (%)	35-40	Jenbacher engines in range of 40% efficiency
	Conversion to heat	Percent (%)	40-55	
Digester Heating	Number of hot water heaters	Number	2	Duty/standby
	Number of heat exchangers	Number	4	1 duty per digester
Gas Flaring	Number of waste gas burners	Number	2	Duty/standby

Additional feasible odour control measures and/or contingency measures for mitigating odour impacts

Table 8 of Appendix R of the EIS presented the odour inventory for the AWRC operating at up to 50 ML/d. This inventory indicated that the major odour sources on site will be the biosolids outloading building and OCF, followed by the cogeneration engine and bioreactors. These emissions, with the proposed emission controls, were shown by modelling to demonstrate compliance with the EPA odour criteria.

Additional odour control or contingency measures once the project is operational will depend on the potentially problematic odour source. Measures that could be considered for key odour sources are discussed below. Given odour modelling indicates these further measures are unlikely to be required, these are not part of core project scope and will only be considered if unforeseen odour impacts occur once the project is operational.

- Biosolids loadout building and bioreactors: The biosolids loadout building and bioreactors are proposed to be enclosed or covered. These measures are expected to be effective in controlling odour emissions, as odours are restricted from leaving these facilities. The connection of these facilities to the OCF also means that the extracted air flow can be augmented later if required. For example, if it was found that more odour control was required for the bioreactors, the ventilation of other processes could be reduced to increase the ventilation of the bioreactors, provided that it resulted in a net improvement in odour control. It may also be possible to use the 10,000 m^3/h of capacity of the OCF allocated for biosolids out-loading for ventilating other processes when out-loading is not occurring.
- Biosolids out-loading: If biosolids out-loading required additional control measures, one consideration is the planning of out-loading according to meteorological conditions. For example, the out-loading could be planned for days when high winds are forecast (for better dispersion), or when winds are not expected to blow towards sensitive receptor locations.
- OCF: A moderate intervention to reduce odour impacts from the OCF is to fit the stack with a narrower nose cone to increase exhaust velocity and improve odour dispersion.
- Cogeneration engines: The cogeneration engines are not expected to be problematic, as biogas is combusted, thus changing its chemical and odour properties, and the hot exhaust gas is buoyant and released from a tall stack, thus enhancing its dispersion. If problematic odours were attributed to this source, mitigation options could include:
  - Adjusting the time of operation of the engines to avoid impacts at sensitive locations.
  - Increasing the height of the stack.
  - Adding a narrower nose cone to the stack in increase discharge velocity.
  - Undertake a study into altering the operation of the digesters to change the biogas quality.

5.10.39 Air quality - cogeneration plant

Issue description

The EPA notes that the proposal includes energy recovery via the combustion of biogas in a cogeneration engine. No details about the engine design or operation have been included. It has not been discussed if the engine will operate on biofuel alone, or if supplementary fuel will be required.

It has been assumed in the AQIA, that the cogeneration unit will achieve compliance with the standards of concentration prescribed in the Protection of the Environment Operations (Clean Air) Regulation 2021, however, no evidence has been provided to demonstrate the expected emission performance of the unit.

The EPA recommends the AQIA be updated to include plans, process flow diagrams and descriptions that clearly identify and explain how the cogeneration plant will be fuelled, configured, and operated. Manufacturer design specifications (or similar) should also be provided to confirm the expected emission performance of the plant, and to demonstrate that the cogeneration unit will achieve compliance, with prescribed concentrations contained in the Clean Air Regulation

Response

Section 5.10.38 provides additional information about the operation of the cogeneration engine. The specific model of cogeneration engine has not been selected, so specific manufacturer specifications are not yet available. However the engine will be required to comply with the relevant emission limits from the Protection of the Environment Operations (Clean Air) Regulation 2010 (Clean Air Regulation). It should be noted that biogas is a clean burning fuel and emissions generally do not approach the Clean Air Regulation limit for solid particles (50 mg/m^3). Nitrogen dioxide concentrations from cogeneration engines produced by Jenbacher, as an example, are also less than the relevant limit (450 mg/Nm^3) with low-NO_x models producing less than 250 mg/Nm^3. Compliance with the Clean Air Regulation limits will be confirmed once the manufacturer has been selected and design specifications are available. Sydney Water is committed to ensuring that final equipment selection is within the modelled specification.

5.10.40 Soils and contamination - general comment on contamination study

The EPA notes that Appendix N is a preliminary site investigation and that 16 areas of environmental concern have been identified, with the main contaminant of concern being asbestos found in localised areas at a number of locations. EPA also notes that the greatest potential for impact is through disturbance of these contaminated soils during construction. Other sources include landfills and service stations.

The EPA acknowledges that the proponent has committed to further investigate Areas of Environmental Concern (AECs) as design progresses, develop plans to appropriately manage any contamination found (including asbestos) and implement standard soil and erosion management measures.

Response

Sydney Water notes the EPA’s comments on Appendix N. Sydney Water also notes that Appendix N is informed by a Detailed Site Investigation (DSI) (Aurecon Arup, 2020) prepared for the project’s reference design. The EPA’s issues about contamination and the DSI are addressed in the following sections.

5.10.41 Soils and contamination - notified sites near project footprint

Issue

The EPA notes that the soils and contaminated land impact assessment identified a number of notified sites within 200 metres of the project footprint including three service station sites that are within 10 metres of the proposed brine pipeline. Presence of contamination in these notified sites should be considered in the management measures to mitigate risks due to contamination finds within the project footprint

Response

Notified sites within 200 metres of the project construction footprint are included in the areas of environmental concern described in Appendix N and section 9.5 of the EIS. Management measure CLS01 in Table 15-3 of the EIS commits to additional sampling to ensure potentially contaminated soils disturbed during construction will be managed effectively as detailed design progresses.

Management measures CLS03 and CLS04 in Table 15-3 of the EIS commit to the development of remedial action plans to manage contaminated soils disturbed during construction within areas of environmental concern and an unexpected finds protocol to manage contaminated soils disturbed during construction that are not located within areas of environmental concern.

Sydney Water has updated management measure CLS01 in Appendix B to ensure sampling of excavated soils disturbed during construction includes areas of environmental concern and therefore also includes notified sites.

5.10.42 Soils and contamination - PFAS investigation sites near project

Issue

The EPA raises several points on potential per- and polyfluoroalkyl substances (PFAS) contamination in the project's desktop assessment area:

- The EPA notes that two PFAS investigation sites were identified within a 5 km radius of the desktop assessment area. One is from Kemps Creek NSW Rural Fire Service at 245 Devonshire Rd, Kemps Creek and the other site is from Bankstown Airport at 3 Avro St, Bankstown.
- The EPA notes a detailed site investigation was completed for 245 Devonshire Rd, Kemps Creek in April 2018 which verified the presence of PFAS at and around the AWRC in soil, sediment, surface water and groundwater and that the soils and contaminated land impact assessment contamination assessment mentioned that the NSW Rural Fire Services is currently developing a Site Management Plan to inform management actions for the site.

- The EPA notes the soil contamination assessment also considered PFAS from Bankstown Airport (3 Avro St, Bankstown). The airport is located 2.6 km from the brine pipeline and the overall PFAS groundwater contamination risk is considered low due to both distance and the shallow depths of proposed construction works.

Response

Sydney Water notes the EPA's comments on potential PFAS contamination within the desktop assessment area.

Appendix N concluded the overall PFAS groundwater contamination risk associated with Bankstown Airport (3 Arvo Street, Bankstown) is considered low due to the distance to the brine pipeline and shallow depths of proposed construction works.

Appendix N and Table 9-51 in section 9.5 of the EIS identified a low risk of PFAS impacting the project from AEC 3 (NSW Rural Fire Service site at 245 Devonshire Road (RFS training site), and 1662 Elizabeth Drive (RFS site), Kemps Creek). 245 Devonshire Road is located about 3.5-4.5 km to the south west of the AWRC and brine pipeline construction footprint. The risk of PFAS impacting the project is low due to the distance of the site from the brine pipeline.1665 Elizabeth Drive is located about 500 m away from the brine pipeline construction footprint. The risk of PFAS impacting the project is low because soil sampling undertaken as part of the project's detailed site investigation (Aurecon Arup, 2020) did not report PFAS in any soil samples within 1 km of the site along the brine pipeline alignment, which included two boreholes and one test pit nearby.

In March 2021, the Site Management Plan was completed for the RFS site on Elizabeth Drive. Site improvement works were undertaken including the removal of PFAS impacted soils and replacement with clean soils (https://www.rfs.nsw.gov.au/news-and-media/pfas-environmental-investigation/kemps-creek-rfs, accessed January 2022). This further reduces the risk associated with PFAS contamination from this site impacting the project and pipeline alignments. For the RFS training site on Devonshire Road, implementation of the site options improvement plan is underway (https://www.rfs.nsw.gov.au/news-and-media/pfas-environmental-investigation/kemps-creek-training-facility, accessed January 2022).

5.10.43 Soils and contamination - detailed site investigation

Issue

The EPA considers that the EIS and the supporting contamination reports have partially addressed the Secretary's Environmental Assessment Requirements (SEARs) for the project. However, DSIs are required to be carried out by appropriately qualified contaminated land consultants, covering the areas likely to be disturbed as part of the development. The investigations should assess all relevant media to be affected by the project. The EPA requests that the DSI/s be submitted as part of the Response to Submissions.

Response

Sydney Water (Aurecon Arup, 2020) prepared three preliminary site investigations (PSI) for the AWRC and pipeline alignments (AAJV) and a DSI (Aurecon Arup 2020) for the project's reference design. The DSI included taking soil samples across the AWRC site and from representative areas along the brine and treated water pipeline alignments to assess for Contaminants of Potential Concern (COPC), salinity, sodicity and acid sulfate soils (ASS). Appendix N of the EIS shows the sample locations and results for COPC that exceed the project land use commercial and industrial investigation levels (ASC NEPM 2013).

The impact assessment and identification of areas of environmental concern described in Appendix N and section 9.5 of the EIS were informed by the PSI and DSI. The PSI and DSI are lengthy and detailed technical reports so were not included in the EIS. Sydney Water considers that Appendix N and section 9.5 of the EIS capture relevant content from these reports to fully address SEARs 26 c) and g) requiring the assessment of potential contamination, identification of remediation requirements and identification of risk posed by any contamination found. However, the DSI was provided separately to the EPA in February 2022.

Management measure CLS01 commits to additional sampling for areas of environmental concern in accordance with ASC NEPM 2013 and relevant EPA guidelines.

5.10.44 Soils and contamination - Sampling and Analysis Quality Plan

Issue

The EPA recommends the proponent submit a Sampling and Analysis Quality Plan (SAQP) as part of the response to submissions to ensure that field investigations and analyses will be undertaken in a way that enables the collection and reporting of reliable data to meet project objectives, including (where applicable) the relevant site characterisation requirements of the detailed or targeted site investigations.

Response

Management measure CLS01 in Table 15-3 of the EIS commits to undertaking any additional soil sampling investigations in accordance with the NSW EPA sampling design guidelines (NSW EPA, 1995). As engineering design progresses, the construction contractor(s) will prepare a SAQP to ensure soil sampling investigations meet the requirements of these guidelines prior to further detailed site investigations work being undertaken. Sydney Water considers this is most appropriately done by the construction contractor(s) to align with their detailed design which means the SAQP is not available for inclusion in this response to submissions.

Sydney Water has revised management measure CLS01 in Appendix B to ensure a SAQP is prepared prior to any further sampling work being undertaken.

Sydney Water notes that consultation for new draft sampling design guidelines (Sampling Design Part 1 and Part 2, NSW EPA, 2020) was completed in November 2020 and once finalised will replace the current sampling guidelines (NSW EPA, 1995).

5.10.45 Soils and contamination - NSW EPA accredited site auditor

Issue

The EPA makes the following recommendations regarding engagement of a NSW EPA site auditor:

- The EPA recommends a NSW EPA accredited site auditor is engaged for the entire project footprint and throughout the duration of works given the presence of areas of concern across the project site, to ensure that any work required in relation to contamination is appropriately managed, including any unexpected contamination finds.
- It is also recommended that as part of RtS, the proponent submit interim audit advice from a NSW accredited site auditor commenting on the nature and extent of the contamination and what further works are required.

Response

The project's Soils and Contaminated Land Impact Assessment (Appendix N of the EIS) did not identify any major contamination risks within the construction footprint. The impact assessment in Appendix N and section 9.5 of the EIS identified 16 areas of environmental concern based on preliminary and detailed site investigations and identified moderate risks associated with disturbance of soils within four of these areas. These risks can be managed appropriately by measures CLS01 - CLS04 in Table 15-3 of the EIS which will be undertaken by the construction contractor as part of their detailed design.

The project's soils and contaminated land impact assessment (Appendix N of the EIS) was prepared by a contaminated lands practitioner certified under the Certified Environmental Practitioners Scheme – Site Contamination (CEnvP- SC). Sydney Water does not consider an EPA accredited site auditor is required to manage contaminated soils disturbed during construction or to prepare interim audit advice, because the contamination risk remains localised and identified as low risk in 12 of the 16 areas of environmental concern and is based on detailed site investigations. Work required to manage the disturbance of contaminated soils will be appropriately managed by the construction contractor in accordance with management measures CLS01-CLS04.

5.11 NSW Health

5.11.1 Hydrodynamics and water quality – algal blooms

Issue description

NSW Health notes that controls should ensure outflow is of sufficient quality that it does not add to eutrophication or risk of increasing algal blooms during at risk times of the year.

Response

The release of treated water high in nutrients can result in eutrophication and increase the risk of algal blooms. Excessive algae growth has the capacity to impact aquatic fauna and flora in the receiving waters. Potential effects can include depletion of dissolved oxygen levels as well as blocking of sunlight to the lower water column. High levels of cyanobacteria (blue-green algae) can also be toxic to humans and livestock.

The advanced treatment process at the Advanced Water Recycling Centre (AWRC) will treat water to a high level of nutrient removal. The AWRC will have a control system that provides continuous monitoring of various quality parameters throughout the plant to ensure the treatment process produces effluent that meets the required quality. The control system includes alarms to alert staff if the water quality parameters diverge from setpoints so that action can be taken to restore performance. Additionally, sampling will also be undertaken to confirm the treated water quality being discharged remains within the limits set in the environment protection licence that will be required for the AWRC.

As part of water quality modelling of treated water releases, Sydney Water modelled two key indicators, chlorophyll *a* and a cyanobacteria risk index, to assess the risk of eutrophication and algal blooms. Chlorophyll *a* is an indicator of phytoplankton abundance and biomass. The cyanobacteria risk index was derived from conditions that are considered conducive to cyanobacteria growth, including temperature, salinity, oxidised nitrogen, ammonia, filterable reactive phosphorus, depth and velocity.

The Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) compared the change in predicted cyanobacteria risk and chlorophyll *a* concentrations between the impact, background and baseline scenarios. The results for the impact scenario are summarised below:

- South Creek releases:
  - No change predicted to chlorophyll *a* in South Creek as a result of the AWRC releases.
  - No overall increase in cyanobacteria risk index in South Creek predicted.
- Nepean River:
  - Reduction in annual medians of chlorophyll *a* predicted between the Wallacia release point and just downstream of the confluence with Warragamba River. Concentrations are modified downstream but are predicted to be of similar magnitude to conditions without the releases.
  - No overall increase in cyanobacteria risk index predicted.
- Nepean River and Warragamba River releases (when releasing to both rivers):
  - Increase in annual medians predicted in Warragamba River downstream of the release point to the confluence with Nepean River.
  - Potential for increase in cyanobacteria risk within Warragamba River.

In summary, there is no increased risk of eutrophication and algal blooms predicted in the downstream waterways for the scenarios that include releases of AWRC treated water to South Creek and Nepean River.

If releases to Warragamba River are introduced, the modelling results predict a small increase in the risk of eutrophication and algal blooms within the downstream reaches of the Warragamba River. However, these impacts are limited with respect to magnitude and spatial extent with the effects predicted to not extend beyond the confluence of the Warragamba and Nepean rivers. The risk is also predicted to be limited to the summer months when nutrient availability, climatic and flow conditions are optimal and as modelling of dissolved oxygen shows, the periods of low dissolved oxygen are short lived. The increased risk of algal growth is not expected to alter the trophic state of the river, meaning any potential impacts would be minor.

5.11.2 Human health and hazards - quality and quantity of floodwater

Issue description

NSW Health notes that it should be modelled that releases during significant wet weather events do not result in increased risk of contaminated water that may as floodwater present a risk to residents of the Nepean Hawkesbury floodplain. It also notes that modelling should ensure that released volumes are assessed against the risk mitigation strategy to align with the Nepean Hawkesbury hydrological characteristics.

Response

The overall treatment and release strategy proposed for the AWRC mitigates water quality risks by releasing suitably treated water that is considered appropriate to the conditions expected in the receiving waterways. Hydrological risks are minimised by transferring dry weather flows to Nepean River and limiting releases to South Creek to wet weather only.

During larger wet weather events, when flows to the AWRC are greater than 3 x average dry weather flow (ADWF), Sydney Water will release tertiary treated water to the Nepean River and a combination of advanced and primary treated water to South Creek. Advanced and tertiary treated water are treated to remove pathogens. Wet weather treated flows are disinfected prior to release.

The waterway objectives developed for the project included indicators relating to contamination that may impact on health, including enterococci, *E. Coli, c*yanobacteria risk index and toxicants. Table 5-40 summarises the water quality modelling results during wet weather events only. Results are divided into impacts to Nepean River and South Creek. Warragamba River has been excluded given that releases to Warragamba River will not occur during wet weather.

Table 5-40 Summary of water quality impacts during significant wet weather events

Indicator	Predicted impacts on water quality
Enterococci	• Nepean River – no change as enterococci densities in tertiary treated water are estimated to be nil, due to treatment process. • South Creek – short term spikes in some wet weather events

Indicator	Predicted impacts on water quality
E.Coli	• Nepean River – no change as *E. Coli* densities in tertiary treated water are estimated to be nil, due to treatment process. • South Creek – short term spikes in some wet weather events
Cyanobacteria risk index	• Nepean River – no overall increase predicted • South Creek – no overall increase predicted
Toxicants	• Nepean River (aluminium, copper, zinc, manganese) and South Creek (ammonia and total chlorine) – conservative mixing zone criteria not met, however the potential for toxicity and environmental harm is considered low due to infrequency of events and short-term nature.

The modelling results show that there will be short term spikes in enterococci and *E.Coli* in South Creek during more severe weather events. Near field modelling also highlights the potential for mixing zone criteria to be exceeded in both waterways for the toxicants noted in Table 5-40 above. However, it is important to note that the modelling undertaken was for representative dry and wet years and that these years did not include the significant flood events to which NSW Health is referring. As explained below, the AWRC releases represent a very small contribution to flows during flood events and are therefore unlikely to result in more than a negligible increase in the risk of contamination.

The Hawkesbury-Nepean Valley Flood Risk Management Strategy (NSW Government, 2017) aims to reduce and manage the social and economic impacts of flooding in the region. The Hawkesbury Nepean Valley Regional Flood Study was completed in 2019 (WMA Water, 2019) aims to identify flood affected areas in the region and allows the ongoing assessment of flood mitigation options that inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy (NSW Government, 2017).

Section 9.3 and Appendix L of the EIS detail the approach taken to assess the impact of releases on flooding in Nepean River and South Creek. The impact assessment uses data from the Hawkesbury Nepean Valley Regional Flood Study (WMA Water, 2019) and the Nepean River Flood Study (WorleyParsons, 2015b) to define existing flood flows and levels during a significant flood event such as the 1% Annual Exceedance Probability (AEP) event. During a significant flood (where water spills over banks and enters the floodplain), AWRC releases will represent a very small proportion of the existing flood flow expected in the Nepean River (for example 0.04% of the 1% AEP event) and South Creek (for example 0.5% of the 1% AEP event). During significant flood events the releases from the AWRC represent an increase in flood levels of up to five millimetres which is a negligible change in risk to residents within the floodplain.

Because impacts from release volumes on existing flood hydrology (including flood levels) have been identified as negligible, no further assessment against the flood mitigation options identified in the Hawkesbury Nepean Valley Flood Risk Management Strategy (NSW Government, 2017) is considered necessary.

5.12 NSW Rural Fire Service

5.12.1 Compliance with legislation, regulations and guidelines

Issue description

NSW Rural Fire Service (RFS) makes the following comments and recommendations:

- A minimum 10-metre Asset Protection Zone (APZ) is to be provided for structures and associated buildings/infrastructure (including the ground solar panels) according to section 8.3.5 of Planning for Bush Fire Protection 2019.
- The Advanced Water Recycling Centre (AWRC) operational area (except for the onsite detention basins) is to be managed in perpetuity to the standards of an inner protection area (IPA) as outlined in Appendix 4 of Planning for Bush Fire Protection 2019.
- Operational access roads, including the provision for a perimeter access road for the ground solar panels, should comply with the standards for property access as outlined in Table 7.4a of Planning for Bush Fire Protection 2019.
- The provision of water, electricity, and gas should comply with Table 7.4a of Planning for Bush Fire Protection 2019.

Response

Sydney Water completed a bushfire risk assessment for the AWRC site during development of the reference design. This assessment identified the bushfire risk of the AWRC site as being between medium and high, and recommended several design measures to comply with Planning for Bush Fire Protection 2019. The current reference design has included the following:

- 10 metre wide APZ which includes a four metre wide fire trail located outside of the AWRC security fencing allowing access to the perimeter of the AWRC site at all times.
- Internal roads allowing for firefighting truck access (23T) by having four metre minimum vertical clearance and six metre minimum curve inner radius.
- Vegetative screening will be outside of the APZ and not be of a depth or area to increase the overall bushfire impact risk.
- Stage 1 solar panel array will allow combustible vegetation (grasses) to grow between panels with elevated water sprayers to be installed in this area.
- Water supply requirements detailed in Chapter 7; Table 7.4a of Planning for Bush Fire Protection 2019 are to be satisfied with a reticulated underground ring type water main capable of providing fire fighting water via fire hydrants.

As outlined in section 4.14.4 of the EIS, the provision of access and utilities, including water, electricity, and gas to the AWRC site are outside the scope of this project and will be delivered under separate planning approvals. Where water, electricity, and gas utilities are required within the AWRC site, their design will comply with the Planning for Bush Fire Protection 2019.

Sydney Water has added a new management measure G14 in Appendix B to ensure the requirements of the Planning for Bush Fire Protection 2019 are incorporated into the detailed design of the AWRC.

5.13 Regional NSW

5.13.1 Stakeholder and community engagement - exploration licence holders

Issue description

Regional NSW notes that the treated water pipeline transects two exploration licences for structural/brick clay. Regional NSW requests that Sydney Water contacts these licence holders for their information and awareness and to determine their level of interest in the project.

Response

Sydney Water has contacted both exploration licence holders identified in the submission. Figure 5-30 shows the location of these licences in relation to the project.

The licence holder for EL8327 did not have any concerns about interactions with the project. Sydney Water is continuing to consult with licence holder for EL8429 to better understand any potential interactions between their licence and the treated water pipeline alignment.

5.13.2 Stakeholder and community engagement - establishing biodiversity stewardship sites

Issue description

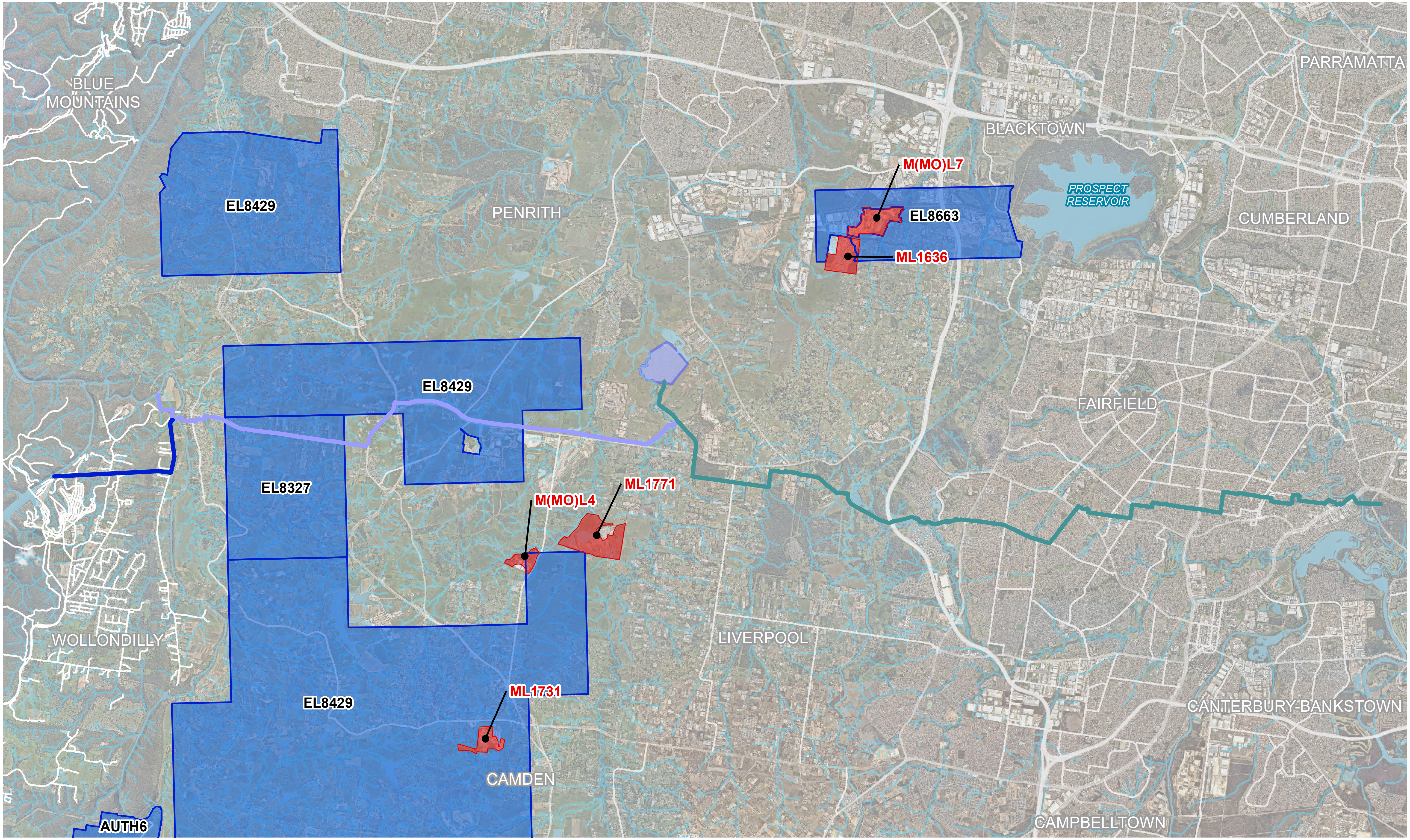
Regional NSW requests to be consulted about the establishment of any biodiversity stewardship sites for the project, to ensure there is no sterilisation of mineral or extractive resources as a result.

Response

As outlined in section 9.1.10 of the EIS, Sydney Water is committed to the implementation of a Biodiversity Offset Strategy (BOS) for the project. The EIS described the three main avenues for securing biodiversity offsets for the project as being:

- payment to the Biodiversity Conservation Fund managed by the Biodiversity Conservation Trust
- purchasing (transfer) and retiring credits from existing credit holders
- establishing a Biodiversity Stewardship Site to generate credits required by the project.

In the event that Sydney Water proposes to establish Biodiversity Stewardship Site(s) for the project, Sydney Water will consult with Regional NSW about potential for sterilisation of mineral or extractive resources. This has been added as management measure TB11 in Appendix B.



Environmental flows pipeline
Treated water pipeline
Brine pipeline
Underbore
Advanced Water Recycling Centre

Licence
Exploring
Mining

1:130,000
0 1.5 3km

Figure 5-30 Exploration licences near the project

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI
Projection: GDA2020 MGA Zone 56

5.14 Transport for NSW

5.14.1 Traffic and transport

Issue description

Transport for NSW (TfNSW) raises concerns about the increase in traffic delays and queue distance at Elizabeth Drive and Clifton Avenue. TfNSW states that the queue out of the existing right turn bay on Elizabeth Drive into the through lane (westbound traffic) is not acceptable. TfNSW is concerned about the impacts on the State road network and request mitigation measures be considered, including increasing the right turn bay from Elizabeth Drive into Clifton Avenue.

Response

Sydney Water notes TfNSW concerns about project impacts on traffic around the Elizabeth Drive and Clifton Avenue intersection. Section 11.4.5 of the EIS shows west bound traffic on Elizabeth Drive will be impacted with a Level of Service (LoS) of F and Degree of Saturation (DoS) of >1 during peak construction of the Advanced Water Recycling Centre (AWRC) without any mitigation. The impacts are a result of construction vehicles turning right into Clifton Avenue off Elizabeth Drive, leading to the turning bay reaching capacity and blocking westbound traffic on Elizabeth Drive.

Site specific management measures relating to construction traffic impacts will be detailed in the Site Specific Construction Traffic Management Plans (SSCTMPs) as outlined in management measure TT01 in Table 15-3 of the EIS. These plans will be developed prior to construction and in consultation with relevant local councils, impacted residents and businesses and TfNSW. Potential options that will be investigated during the development of the SSCTMPs to reduce construction traffic impacts on Elizabeth Drive may include:

- scheduling some heavy construction vehicle movements outside of peak times
- spreading the program of construction vehicle peaks across more days, reducing the peak volume of construction vehicles or workers
- scheduling some vehicles to be restricted to 'left-in' only into Clifton Avenue as this movement will cause less delays than the 'right-in' turn off Elizabeth Drive.
- scheduling some vehicles to be restricted to 'left-out' only from Clifton Avenue onto Elizabeth Drive as this movement will result in less queuing on Clifton Avenue
- increasing the length of the right hand turn bay from Elizabeth Drive onto Clifton Avenue.

Sydney Water acknowledges that a collaborative approach to cumulative construction traffic impacts is required between major projects in the area around Elizabeth Drive. Management measure G10 in Table 15-3 of the EIS commits to continue to consult and coordinate with other major projects and utility providers that may be impacted during construction, or where cumulative impacts may occur.

5.14.2 Stakeholder and community engagement

Issue description

TfNSW notes its support for ongoing collaboration during the detailed design and construction process regarding impacts to existing and future TfNSW assets, including M12, Sydney Metro Western Sydney Aerotropolis and East West Rail Line. TfNSW requests that this includes consultation with the M12 team within TfNSW about construction staging of the AWRC and treated water pipeline.

TfNSW also makes the following requests regarding consultation and provision of documents for review:

- SIDRA files.
- Concept plans for proposed upgrade of Elizabeth Drive and Clifton Avenue, including design and checking vehicle turn paths for the intersection.
- Draft Construction Traffic Management Plan, including identified mitigation measures.

Response

The proposed upgrade of the Elizabeth Drive and Clifton Avenue intersection is outside the scope of this project and will be delivered under a separate planning approval. Sydney Water has ongoing consultation with TfNSW regarding these works, with a meeting held in March 2021 regarding the scope and timing of the access road works and Clifton Avenue and Elizabeth Drive intersection upgrade works. Sydney Water will continue to consult with TfNSW and provide any required information regarding these works including SIDRA files and concept plans.

Management measure TT01 in Table 15-3 of the EIS commits to preparing SSCTMPs and the Framework Construction Traffic Management Plan in consultation with TfNSW. These documents will include site specific mitigation measures for minimising impacts from construction on the traffic network, including roads managed by TfNSW.

As the intersection upgrade works are not part of the scope of the project, the provision of the SIDRA files and concept plans has not been incorporated as a management measure for this project. Sydney Water will continue to consult with TfNSW for that project, and will provide the required documentation when it is available.

5.14.3 Issues beyond the scope of the project

Issue description

TfNSW notes that Sydney Water will deliver sections of the project under different planning pathways. TfNSW notes that works delivered under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) will be required to comply with Division 5.31 of the EP&A Act with respect to concurrence and notification requirements for activities within infrastructure corridors.

Response

The proposed upgrade of the Elizabeth Drive and Clifton Avenue intersection, and the access road to the AWRC off Clifton Avenue, are outside the scope of this project and will be delivered under a separate planning approval. Sydney Water's consultation with TfNSW, Penrith City Council and Liverpool City Council regarding these works is ongoing. Consultation, and any required concurrence and approvals under the EP&A Act, will be obtained prior to construction.

5.15 WaterNSW

5.15.1 Support for project

Issue description

WaterNSW's submission notes that it supports a range of project elements, including:

- no dry weather releases to South Creek
- avoiding negative impacts on Sydney's drinking water catchment
- stormwater management measure SW02
- baseline and post commissioning monitoring of water quality, aquatic ecology and geomorphology
- ongoing consultation with WaterNSW about relevant WaterNSW land and infrastructure.

Response

Sydney Water notes WaterNSW's support for these elements of the project and considers that no further response is required.

5.15.2 Operation activities and project timing - environmental flows

Issue description

WaterNSW raises several issues in relation to environmental flows:

- It requests further detail about how the environmental flow regime will be assessed by the Department of Planning and Environment (DPE) and the timing for release of the refined plan. This includes seeking clarification that Warragamba environmental flows are fixed until 2025.
- It requests further detail on when the final decision to building the environmental flows pipeline will be made.
- It supports the summary on environmental flow replacement in section 8.7.5 of the EIS but requests clarification that the option for environmental flow replacement/supplement is in combination with the existing environmental flows program and not total replacement.

- Environmental flow releases will require coordination with WaterNSW to ensure a balance between recycled water and environmental flow drivers. WaterNSW needs to understand what this coordination entails to determine the impact to operations. It is critical that WaterNSW is involved in monitoring and release considerations of the treated water pipeline at Wallacia weir and the e-flow pipeline. It is unclear in the EIS if the proposal will change any requirements on WaterNSW to deliver environmental flows and how Sydney Water will involve WaterNSW in data sharing and consultation. WaterNSW requests a corresponding management measure to address this concern.

Response

Assessment of environmental flows regime

Sydney Water is collaborating with DPE, WaterNSW and other members of NSW Government environmental flows working group to provide information about available flows from the project over time, and how these might be considered as a portion of total environmental flows in Nepean River. These discussions are also considering assessment of environmental flows benefits versus alternate uses of the water.

It is not for Sydney Water to respond on behalf of DPE about their variable environmental flow plan or whether Warragamba environmental flows are fixed until 2025. However, Sydney Water understands that although DPE may require a certain volume of environmental flow releases as part of the revised Water Sharing Plan, it is unlikely to specify a requirement that part of this must come from the Upper South Creek Advanced Water Recycling Centre (AWRC).

In addition, the project will not be operational until mid-2025 and will therefore not influence WaterNSW dam releases prior to that.

Decision on building environmental flows pipeline

Sydney Water is currently in the process of procuring contractors to build the AWRC, treated water pipeline and brine pipeline. At this stage, Sydney Water is not procuring a contractor to build the environmental flows pipeline. A decision on whether to build the environmental flows pipeline will depend on population growth, implementation of recycled water schemes, and agreements in the NSW Government’s environmental flows working group about the conditions under which treated water from the project can be counted as a replacement for some environmental flows (and whether this can be achieved from the treated water pipeline alone). There is currently no certainty on timing of these elements, and a decision date can therefore not be fixed.

Project supplementing environmental flows

Sydney Water confirms that the project could supplement but not entirely replace WaterNSW releases from Warragamba Dam. The project’s water quality and hydrological modelling was based on the current Warragamba Dam release regime. A variable release environmental flow regime was not used in the modelling, given that it is yet to be finalised by DPE. However, the benefits of replacing a portion of the variable environmental flows were captured in the project’s strategic business case to Infrastructure NSW and Sydney Water is continuing to pursue this opportunity with DPE.

The peak discharge under the proposed environmental flows release regime is 3,000 ML/d, with all Warragamba catchment inflows up to the 90%ile (currently 82 ML/d) released, and an additional 10% of flows released above the 90%ile, scaled with dam storage levels. Given the very high flow release requirements to achieve the environmental objectives of the environmental flows, even operating at ultimate capacity of 100ML/day, the Upper South Creek AWRC would only contribute to replacement of the baseline dry weather releases under the new regime. Accordingly, under the variable release regime, Sydney Water expects the project could only contribute flows in the lower range of the total flows, and WaterNSW will be required to provide the peak flows from Warragamba Dam.

Coordination with WaterNSW

Sydney Water agrees that the practical implementation and operational arrangements for environmental flows requires coordination between Sydney Water and WaterNSW. This includes further development of automated and manual communications before a new environmental flows regime can be implemented. As noted above, the project will not change WaterNSW requirements for environmental flows prior to mid-2025. In addition, any future changes to WaterNSW's environmental flow regime depend on a range of further decisions by the NSW Government environmental flows working groups including the conditions for treated water releases from the project to count as environmental flows.

Sydney Water has made the following changes to the project's management measures to address this issue:

- Amended management measure SC02 in Appendix B, to consult with the NSW Government environmental flows working group about environmental flows rather than DPE Water. DPE Water, WaterNSW and Sydney Water are members of this working group. The management measure now states 'Consult with NSW Government environmental flows working group on the details of the optimal treated water release location and approach and how this can be incorporated into the Greater Sydney Water Strategy and water sharing plans. This will inform Sydney Water's decision about whether to build the environmental flows pipeline.'
- Added new management measure U06 in Appendix B, to require collaboration with WaterNSW prior to the implementation of an environmental flows regime. This management measure states 'Collaborate with WaterNSW to develop and agree operational protocols for releasing environmental flows to the Nepean River associated with coordinating the project's treated water releases and WaterNSW dam releases.'

5.15.3 Design requirements - pipeline route alignment

Issue description

WaterNSW requests to see a more refined route alignment for the pipelines, as it is difficult to interpret the crossing locations from the high-level map.

Response

Sydney Water has not yet developed a more refined route alignment for the pipelines. Figure 4-17 in the EIS provides the most detailed alignment of the project pipelines currently available. A more refined route alignment will be completed during the project's detailed design. Sydney Water has added a new management measure U05 in Appendix B 'Consult with WaterNSW during detailed design of infrastructure on WaterNSW land or that will directly affect WaterNSW infrastructure.'

5.15.4 Construction activities - traffic routes

Issue description

WaterNSW requests further detail on construction traffic routes for building the environmental flows pipeline, especially near Warragamba Dam.

Response

Sydney Water will require construction access to the proposed environmental flows release structure at Warragamba River, downstream of Warragamba Dam. Access will be required via WaterNSW land. Section 13.2.3 of the EIS outlines the proposed access via Core Park Road, Production Avenue and Valve House Road. As outlined in section 11.4.5 of the EIS, construction access will be required for:

- Work crews undertaking construction along the pipeline alignments.
- Light vehicles accessing site compounds and work sites.
- Heavy vehicles accessing site compounds for delivery and removal of raw materials and equipment.

Section 11.4.7 of the EIS and management measure TT01 commit to the development of Site-specific Construction Traffic Management Plans (SSCTMP) prior to construction. The detailed construction traffic routes for building the environmental flows pipeline will be outlined in the SSCTMP.

5.15.5 Human health and hazards

Issue description

WaterNSW questions whether it is acceptable to have a school in the evacuation zone of the methanol tanker (850 m).

Response

Methanol has been identified in the reference design as the preferred source of carbon dosing required for operations of the AWRC.

Appendix W of the EIS includes a copy of the Preliminary Hazard Analysis (PHA) completed for the EIS. As part of this assessment the potential transportation route of methanol to the AWRC was assessed.

The PHA identified a potential risk for a loss of containment (LoS) of methanol to occur during transporting methanol to the AWRC. This includes the event occurring outside of a school on Elizabeth Drive. The PHA identified this as a very low risk that would only eventuate if multiple failures occur simultaneously, including:

- The accident occurs near the school or other sensitive receptor.
- The accident is extreme enough to cause a failure of the tank.
- The pool of methanol vaporises and does not ignite.
- The wind is strong enough and in the right direction to disperse the cloud towards sensitive receptors.
- There are sensitive receptors outside and close enough to the short-term exposure limit (STEL) contour to be affected.

At the time of writing the EIS and completion of the PHA, the route evaluation of methanol transport had not yet been completed. Management measure HIA01 commits to completing a detailed route evaluation for methanol transport to the AWRC in accordance with HIPAP 11 – Route Selection. This will include further analysis and management of potential impacts resulting from methanol transport to the AWRC.

5.15.6 Groundwater

Issue description

WaterNSW requests confirmation that (with exception of excess flows down South Creek), changes to groundwater from the project will not impact on WaterNSW assets.

Response

The main potential impacts on groundwater near WaterNSW assets is where pipelines will be tunnelled beneath these assets. The environmental flows pipelines will be tunnelled beneath the Warragamba pipeline and the brine pipeline will be tunnelled beneath the Upper Canal.

Section 9.4 and Appendix M assess impacts from tunnelled construction including localised drawdowns and groundwater seepage. The environmental flows pipeline will be tunnelled beneath the Warragamba pipeline close to the environmental flows release location (Figure 13-2 in the EIS). At this location the environmental flows pipeline will be about 35 m below the Warragamba pipeline. Appendix M notes that water supply bore data suggests there is no significant aquifer present at the pipeline depth so impacts to the Warragamba pipeline from drawdown and seepage are not expected.

In the project's reference design the brine pipeline is proposed about six metres below the WaterNSW Upper Canal. Section 9.4 and Appendix M indicates that at this depth, groundwater will likely be encountered however drawdown and groundwater seepage impacts will remain localised which means impacts to the Upper Canal are unlikely.

Management measure GW11 in Table 15-3 of the EIS will effectively manage potential impacts resulting from tunnelling under WaterNSW assets and waterways by committing to geotechnical investigations to confirm groundwater conditions during detailed design. Sydney Water has amended management measure GW11 in Appendix B to ensure geotechnical investigations are also completed around the Upper Canal.

5.15.7 Management measures – refinement of existing measures

Issue description

WaterNSW notes it supports the management measures in the EIS and recommends changes to some to strengthen the protection outcome. These management measures relate to erosion and sediment controls, design and construction around the Upper Canal, non-Aboriginal heritage, vibration and protection of WaterNSW assets. The response in Table 5-41 lists all requested changes and Sydney Water's response to them.

Response

Table 5-41 Management measure changes requested by WaterNSW

Management measure changes requested	Sydney Water response
G06 – Construction Environmental Management Plan (CEMP) Site Plans. WaterNSW recommends erosion and sediment controls be included as a requirement on these plans.	Management measure SW01 commits to preparing and implementing a Soil and Water Management Plan as part of the project's CEMP. This plan will include erosion and sediment controls.
G07 – Risk of brine pipeline failure. WaterNSW recommends additional controls be included to ensure no air vents, inspection points or release points are located in WaterNSW's Upper Canal corridor.	The reference design does not include any scours, valves, release points or air vents in WaterNSW's Upper Canal corridor.
GW11 – tunnelling controls beneath Warragamba pipeline. WaterNSW requests that the Upper Canal be included in this management measure.	Sydney Water has amended management measure GW11 in Appendix B to ensure geotechnical investigations are also completed around the Upper Canal.

Management measure changes requested	Sydney Water response
NAH07 – Non-Aboriginal heritage. WaterNSW requests a separate management measure for an unexpected finds protocol for non-Aboriginal heritage.	Management measure AH02 in Table 15-3 of the EIS includes an unexpected finds protocol for non-Aboriginal heritage as part of the Heritage Management Plan. This has been done to minimise duplication in management measures. Sydney Water considers managing unexpected finds is adequately addressed and no changes are proposed.
NV07 – Vibration impacts to structures. WaterNSW requests this measure be strengthened, identifying where the results of the investigation will be included and how they will be implemented.	Sydney Water has changed management measure NV07 to include where the results of investigations to reduce vibration could be implemented. This includes for tunnelling under the WaterNSW Upper Canal.
U04 – Impacts to WaterNSW assets during construction. WaterNSW recommends that all management measures that reduce impacts to WaterNSW assets are listed here by item number.	The following management measures from Table 15-3 of the EIS, and the updated management measures in Appendix B, will reduce impacts to WaterNSW assets: • G13 • NV07 • U05 • U06 • U07

5.15.8 Additional conditions

Issue description

WaterNSW requests a range of additional conditions be applied to the project relating to noise and vibration, surface water, flooding, protection of WaterNSW infrastructure, unexpected heritage finds, access and security, erosion and sediment control, consultation and incident notification. Table 5-42 lists all requested conditions and Sydney Water's response to each.

Response

Table 5-42 Additional conditions requested by WaterNSW

Additional conditions requested	Sydney Water response
Noise and vibration	
During construction and operation, specific mitigation measures must be implemented around WaterNSW infrastructure to achieve agreed vibration limits, determined in accordance with German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures (for structural damage).	Management measure NV08 in Table 15-3 of the EIS states that where the monitoring identifies exceedances in the relevant criteria, or where impacts are identified, additional management measures will be identified and implemented to appropriately manage impacts. Any additional management measures would be documented in the Construction Noise and Vibration Management Plan (CNVMP) as per management measure NV01 in Table 15-3 of the EIS. No further response or change is required.
Prior to construction and on completion of construction, a dilapidation and/or condition survey must be completed on infrastructure and structures at risk from being damaged by vibration during construction, including heritage items.	Management measure NAH02 in in Table 15-3 of the EIS states that a dilapidation survey will be completed on the WaterNSW Upper Canal and Warragamba Pipelines prior to any construction work commencing.
Flooding, hydrology and water quality	
Final levels and design of the proposal must not result in an increase in overland flow water into the Pipeline corridor of either quantity, quality or velocity. The development must be designed, operated and maintained to ensure post-development flows do not exceed pre-development flows into and through the Pipelines Corridor, for each storm event up to and including 1% Annual Exceedance Probability (AEP) event.	The current reference design is above Penrith City Council's 1% AEP Flood Planning Level. Management measure SW02 in Table 15-3 states 'Design, install and maintain stormwater management measures on the AWRC site (including a range of Water Sensitive Urban Design measures) to ensure post development peak flows do not exceed pre-development peak flows for the 50%, and 1% storm events'. No further response or change required.
Utility protection measures – Protection of WaterNSW infrastructure (general)	
Consultation with WaterNSW is to occur during detailed design and construction activities within and adjacent to WaterNSW lands.	To address this, Sydney Water has added a new management measure U05 in Appendix B 'Consult with WaterNSW during detailed design of infrastructure on WaterNSW land or that will directly affect WaterNSW infrastructure.'

Additional conditions requested	Sydney Water response
Construction planning and approaches to minimise risks of damage to critical water supply infrastructure must be developed in consultation with WaterNSW, and in accordance with the Guideline for Development Adajacent to the Upper Canal and Warragamba Pipelines (WaterNSW, 2021)	Management measure NAH02 in Table 15-3 of the EIS states that construction activities in proximity to the Upper Canal and Warragamba Pipelines will be undertaken in accordance with WaterNSW 'Guideline for Development Adjacent to the Upper Canal and Warragamba Pipelines'. Sydney Water has also added a new management measure U05 in Appendix B 'Consult with WaterNSW during detailed design of infrastructure on WaterNSW land or that will directly affect WaterNSW infrastructure.'
Prior to construction, a dilapidation report identifying the condition of all infrastructure within the construction footprint must occur.	Management measure U03 in Table 15-3 of the EIS states that utilities at risk of impact from construction of the project will be assessed via a dilapidation survey prior to construction. Management measure NAH02 in Table 15-3 of the EIS states that a dilapidation survey will be completed on the WaterNSW Upper Canal prior to any construction work commencing. No further response or change is required.
WaterNSW must be consulted on the final CEMPs, to allow for assessment of design and related works procedures and revisions as required.	Sydney Water has added management measure G13 in Appendix B requiring consultation with WaterNSW during preparation of relevant sections of the CEMP.
Utility protection measures – drilling under the Upper Canal for brine pipeline	
To mitigate any impact to the Upper Canal, WaterNSW requires that any underbore (drilling) be, at minimum, five (5) metres under the invert level of the canal.	The current reference design for the project has the brine pipeline about six metres below the WaterNSW Upper Canal. No further response or change is required.
Entry and exit points of the underbore, must be outside the WaterNSW corridor.	The current reference design for the tunnelling beneath the Upper Canal has the construction entry and exit pits outside of WaterNSW land. No further response or change is required.

Additional conditions requested	Sydney Water response
No service, maintenance or inspection pits are allowed within WaterNSW land.	The current reference design for the project does not include any service, maintenance or inspection pits, such as scours/ valves within WaterNSW land associated with the WaterNSW Upper Canal. No further response or change is required.
Heritage	
Advise WaterNSW of any unexpected heritage items found on WaterNSW land.	Sydney Water has added management measure NAH08 in Appendix B to notify WaterNSW of any unexpected heritage items found on its land.
WaterNSW access and security	
24-hour all-weather access to WaterNSW owned and managed lands shall be retained or provided for WaterNSW staff and contractors.	Sydney Water will ensure 24-hour all-weather access to WaterNSW owned and managed lands is maintained throughout construction. Management measure TT01 in Table 15-3 of the EIS relates to preparing a SSCTMP prior to construction which will outline how access will be maintained. No further response or change is required.
Access to the WaterNSW Pipelines corridor, Upper Canal or Warragamba sites is prohibited unless written consent has been obtained from WaterNSW.	Sydney Water will consult and coordinate with WaterNSW regarding any access to WaterNSW land. Sydney Water proposes to consult in accordance with the 'Sydney Water and WaterNSW Access Protocol', which is a framework developed by Sydney Water and WaterNSW regarding access to or activities which may impact each other's land and/or assets. Sydney Water has added a new management measure U07 in Appendix B 'Sydney Water will follow the 'Sydney Water and WaterNSW Access Protocol' regarding any required access to WaterNSW land, including the WaterNSW Pipelines corridor, Upper Canal or Warragamba sites.'

Additional conditions requested	Sydney Water response
Any damage to the Controlled Area and or associated infrastructure caused at any stage by the development shall be repaired by the proponent, or shall pay all reasonable costs associated with repairing the damaged water supply infrastructure, in a timely manner and to the satisfaction of WaterNSW.	Management measure U03 Table 15-3 of the EIS states that Sydney Water will repair any utilities that have been directly impacted by construction activities. No further response or change is required.
Appropriate and secure boundary identification (such as temporary construction fencing), must be installed prior to works commencing and must be maintained throughout the construction period.	Management measure G06 in Table 15-3 of the EIS states that construction site layout plans will be developed prior to construction. These plans will include the location of site boundaries and the requirement for any temporary construction fencing. No further response or change is required.
Any existing security fencing that is damaged during the development process shall be repaired or replaced by the proponent at the proponent's expense, in a timely manner and to the satisfaction of WaterNSW.	Management measure U03 in Table 15-3 of the EIS states that Sydney Water will repair any utilities that have been directly impacted by construction activities. No further response or change is required.
Any changes to existing fencing must be reinstated on completion of the construction component.	Management measure U03 in Table 15-3 of the EIS states that Sydney Water will repair any utilities that have been directly impacted by construction activities. No further response or change is required.
Erosion and sediment control	
Appropriate and adequate dust suppression measures must be undertaken to prevent dust leaving the project site.	Management measure AQ02 in Table 15-3 of the EIS states that the project's CEMP will include measures to manage construction dust. These include a measure to water exposed areas using a non-drinking water source, where possible. No further response or change is required
Erosion and sediment controls are to be designed, installed and maintained in accordance with the 'Blue Book', Landcom (2004) Managing Urban Stormwater; Soils and Construction.	Management measure SW05 in Table 15-3 of the EIS states that Sydney Water will implement and maintain sediment and erosion control measures and install sedimentation basins in appropriate locations considering the guidance in Managing Urban Stormwater, Soils and Construction Volume 1, 4th Edition (Landcom, 2004).

Additional conditions requested	Sydney Water response
	No further response or change is required
Effective erosion and sediment controls must be installed prior to construction and be regularly maintained and retained until works have been completed and the ground surface stabilised or groundcover re-established.	Management measure SW05 in Table 15-3 of the EIS states 'Implement and maintain sediment and erosion control measures and install sedimentation basins in appropriate locations considering the guidance in Managing Urban Stormwater, Soils and Construction Volume 1, 4th Edition (Landcom, 2004)'. Management measure SW03 in Table 15-3 of the EIS states that Sydney Water will progressively construct operational stormwater management measures for potential use and contributions to stormwater management during construction, if practical. No further response or change is required
Consultation	
WaterNSW requests to be involved in the detailed design for all aspects of the development that directly interact with WaterNSW lands, assets and infrastructure.	To address this, Sydney Water has added a new management measure U05 in Appendix B 'Consult with WaterNSW during detailed design of infrastructure on WaterNSW land or that will directly affect WaterNSW infrastructure.'
Consultation with WaterNSW (re: monitoring, access, vibration controls, e-flow discharge) is included in the project communication strategy.	Given WaterNSW is a relevant landowner and government agency, ongoing consultation is captured as part of management measure G08 in Table 15-3 of the EIS which involves developing a Community and Stakeholder Engagement Plan.
If the proposal significantly changes or changes to directly impact on WaterNSW lands, assets or infrastructure, that WaterNSW be notified and given the opportunity to comment on these changes.	Sydney Water considers that this request is covered by management measure G10 in Table 15-3 of the EIS in which Sydney Water commits to ongoing consultation with utility providers that may be impacted during construction.

Additional conditions requested	Sydney Water response
Notification of incidents	
All incidents that affect or could affect the WaterNSW lands, assets and infrastructure shall be reported to WaterNSW on the 24-hour Incident Notification Number 1800 061 069 as a matter of urgency.	Management measure G01 in Table 15-3 of the EIS states that a CEMP will be developed and implemented in accordance with the Environmental Management Plan Guideline – Guideline for Infrastructure Projects. The CEMP will include incident management, as well as a list of emergency contacts depending on the incident. No further response or change is required.

5.15.9 Issues beyond scope of project

Issue description

WaterNSW is extremely concerned with increased risk potential created at Warragamba Pipelines caused by increased development in catchment. It notes that the EIS assessment says the project is not increasing geomorphic risks to WaterNSW infrastructure and that water sensitive urban design will minimise the project's impacts. Cumulative impacts and potential cost implications created must be addressed across the catchment especially as it relates to impacts on downstream critical infrastructure.

Response

A risk assessment included in the Ecohydrology and Geomorphology Impact Assessment (Appendix G of the EIS) included an assessment of the geomorphic risks to WaterNSW infrastructure, including the Warragamba Pipelines downstream of the AWRC release to South Creek.

The risk assessment considers the risks in relation to flood flows leading to structural damage and non-flood impacts associated with erosion or deposition. The risk was rated as medium under current conditions and with AWRC releases, so the risk rating is unchanged as a result of the project. The risk to other WaterNSW infrastructure (including Warragamba Weir, Wallacia Weir, Penrith Weir and the Warragamba Pipelines crossing at Nepean River) was rated as low.

The key justifications for the risk ratings assigned to the Warragamba Pipeline at South Creek are outlined below:

- Flood flows break the banks of South Creek for events with an AEP of 10-50%, with more than 900 m of pipeline and roadway potentially inundated.
- High velocities through the South Creek channel section during flood events have the potential to scour the channel bed and banks, destabilising or undermining the piers of each structure.

- Flood flows are not changed by the addition of the AWRC flows and therefore there is no change in expected flooding and general scour of the channel during flood events. The contribution of the wet weather flows to South Creek during wet weather events is expected to be less than 1% of the baseline or usual flood flow rates.
- The channel bed and bank materials are susceptible to erosion and changes to the channel thalweg and form at the crossing have been observed.
- The failure of a weir structure upstream of the crossing has destabilised the channel and this may propagate downstream towards the structures.
- Enhanced long term channel degradation is unlikely to occur as a direct result of the wet weather flow releases from the AWRC.

Appendix G also notes that urbanisation of the catchment is likely contributing to long term hydrological change. This increases the likelihood of erosion in and around the pier structures.

The cumulative impacts associated with catchment development are outside the scope of the project. Sydney Water is happy to contribute to discussions relating to cumulative impacts and management measures.

5.16 Western Parkland City Authority

5.16.1 Support for the project

Issue description

Western Parkland City Authority notes it does not have any comments on the project. It notes it is very supportive of the facility in unlocking and servicing development across the Western Parkland City.

Response

Sydney Water notes Western Parkland City Authority's support for the project and considers that no further response is required.

5.17 Western Sydney Airport (WSA)

5.17.1 Support for the project

Issue description

WSA recognises that this facility is critical to the delivery of water supply to the Western Parkland City.

Response

Sydney Water notes WSA's support for the project and considers that no further response on this issue is required.

5.17.2 Project timing

Issue description

WSA notes that in section 13.1.2 of the EIS an assumption has been made that construction of the project will be complete before Western Sydney International Airport (WSI) is operational. With operations identified as being complete in mid-2025 (section 4.1 of the EIS), there needs to be contingencies planned in case the project construction period is still underway when the airport becomes operational. With WSI projected to be complete in 2026, and testing occurring as soon as 2025, there is a risk that some overlap could occur between the construction of the Sydney Water and WSI. WSA recommends that contingencies are in place, including any further assessment required, in the instance that project delays mean that construction activities are occurring in a concurrent manner with operations at WSI.

Response

It is difficult to determine at this stage what construction activities may be occurring if project construction is still underway once WSI starts testing or operating. However, the main potential for interaction with airport operations in this scenario is cranes for the construction of Advanced Water Recycling Centre (AWRC) structures. The EIS notes these are likely to be about 50 metres high which is below the maximum Obstacle Limitation Surface (OLS) height of 75 metres.

Sydney Water will maintain ongoing consultation with WSA during construction in accordance with management measure G10 in Table 15-3 of the EIS which will identify any matters that require further assessment or management to avoid impact on airport testing or operations.

5.17.3 Stakeholder and community engagement – project changes

Issue description

WSA requests that it be consulted if the scope of the project changes throughout the assessment process.

Response

As outlined in management measure G08 in Table 15-3 of the EIS, Sydney Water will develop a Community and Stakeholder Engagement Plan that will outline ongoing consultation with government agencies, including WSA. Sydney Water will consult with WSA regarding any project changes relevant to the operation of WSI.

5.17.4 Stakeholder and community engagement and compliance with legislation, regulations and guidelines

Issue description

WSA notes that CASA and Airservices have been contacted by Sydney Water prior to lodgement of this application and that this application has been forwarded to these two organisations as well as the Commonwealth Department of Infrastructure, Transport, Regional Development and Communication. WSA recommends that any changes to the components of the development which pertain to CASA / Airservices comments (eg vertical flaring) be forwarded to the respective agencies, as well as WSA, for re-assessment.

WSA also notes that comments do not incorporate those from Bankstown or Camden Airports, and that comments from these organisations should be sought separately.

Response

Management measure AO03 in Table 15-3 of the EIS commits to assessing the consistency of any changes to the location and size of structures, or plume estimations at the AWRC against the Western Sydney International Airport OLS and CASA plume rise assessments outlined in the EIS.

Sydney Water will consult with Bankstown and Camden Airports during detailed design but it is unlikely the project will require activities that impact operation of these airports. These airports will be identified as relevant stakeholders in the project's Community and Stakeholder Engagement Plan outlined in management measure G08 in Table 15-3 of the EIS.

5.17.5 Stakeholder and community engagement - review of CEMPs

Issue description

WSA requests an opportunity to review the Construction Environmental Management Plans (CEMPs) as they are developed, following any future development consent issue.

Response

Management measure G01 in Table 15-3 of the EIS commits to developing a CEMP consistent with *Environmental Management Plan Guideline – Guideline for Infrastructure Projects*. Sydney Water will consult with WSA in accordance with management measures G08 and G10 in Table 15-3 of the EIS.

5.17.6 Stakeholder and community engagement - future stages

Issue description

WSA notes it has not provided specific comments in relation to the concept component of the development. WSA notes that when construction of that stage is underway WSI will be an operational airport which will affect the manner in which construction activities can be undertaken. This will be a relevant consideration at this future point in time. WSA requests that they are notified of any changes to the identified staging of the project.

Response

Sydney Water will need to prepare an EIS for future stages of the project and Western Sydney International Airport would be a relevant stakeholder consulted at that time.

5.17.7 Compliance with legislation, regulations and guidelines

Issue description

WSA notes that the exhibition of the Aerotropolis Planning Package (October 2021), which includes additional relevant aviation safeguarding provisions, may affect some of the legislative context of the proposed development. WSA recommends that further assessment of the recently exhibited documentation be considered as part of this application. WSA requests that any future documentation by the Western Sydney Planning Partnership / Department of Planning and Environment (DPE) that is exhibited or finalised in the coming months also be considered. WSA notes that DPE plans to finalise the majority of documents by the end of 2021.

Response

Sydney Water has reviewed the Aerotropolis Planning Package which was on exhibition from 8 October 2021 until 5 November 2021, which included the following documents:

- Explanation of Intended Effect - Amendment to Environmental Planning Instruments in relation to the Western Sydney Aerotropolis
- Luddenham Village Discussion Paper
- Western Sydney Aerotropolis Development Control Plan – Phase 2 (Phase 2 DCP).

The Phase 2 DCP was not finalised at the time of writing this report but other elements of the planning package were finalised on 25 March 2022 with those most relevant to the project being:

- Amendments to State Environmental Planning Policy (Precincts – Western Parkland City) 2021
- Aerotropolis Precinct Plan
- Luddenham Village Interim Strategy.

State Environmental Planning Policy

The 'Explanation of Intended Effect - Amendment to Environmental Planning Instruments in relation to the Western Sydney Aerotropolis' for public exhibition includes proposed changes to State Environmental Planning Policy (Western Sydney Aerotropolis) 2020, which has since been incorporated into State Environmental Planning Policy (Precincts – Western Parkland City) 2021. It also includes proposed changes to the former State Environmental Planning Policy (Western Sydney Employment Area) 2009 and State Environmental Planning Policy (State and Regional Development) 2011 but these are not relevant to the project.

The changes to State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (SEPP) include:

- removing Environment and Recreation zoning from some land south of Elizabeth Drive

- reduction in land identified as open space
- retaining previously permissible land uses in some areas.

As outlined in the EIS, this SEPP does not apply to the project given the provisions of section 5.22 of the *Environmental Planning and Assessment Act 1979 (*EP&A Act). However, Table 5-4 of the EIS described how the project aligned with key provisions of the SEPP. Sydney Water considers that the project and its proposed amendments would continue to align with the key provisions of the SEPP and the changes have limited implications for the project.

Luddenham Village

The 'Luddenham Village Discussion Paper' outlines the research collected on Luddenham Village in response to community feedback during the public exhibition of the Western Sydney Aerotropolis Plan and Precinct Plans in late 2020. The treated water pipeline runs through the northern part of the village. The document aims to provide a framework for conversation with the community about the role of Luddenham Village in the future Aerotropolis and more specifically, the Agribusiness Precinct. The paper presents four scenarios for future development, ranging from no change from previous plants to significant growth.

The subsequent 'Luddenham Village Interim Strategy' was released on 25 March 2022 and describes what is possible now and the steps towards residential growth once noise impacts from Western Sydney Airport are better understood. Sydney Water will continue to monitor future development plans in the area as part of the water and wastewater planning process but considers the project does not constrain the future development of Luddenham Village.

Phase 2 DCP

The draft Phase 2 DCP would supersede the Phase 1 DCP. The DCP applies to development applications under Part 4 of the EP&A Act and therefore does not apply to the project, which is assessed under Part 5 of the EP&A Act.

The Phase 2 DCP includes more detailed and refined objectives than the Phase 1 DCP, although the general themes are consistent across both documents. Appendix B of the EIS considered project alignment with the general performance outcomes in the Phase 1 DCP and that assessment remains relevant to the draft Phase 2 DCP.

Additional themes in the Phase 2 DCP include a greater focus on the importance of recognising Country. A separate draft guideline 'Recognise Country – Draft Guidelines for development in the Aerotropolis' was released alongside the Phase 2 DCP. This document provides guidance on implementing statutory and non-statutory planning requirements relating to Aboriginal Cultural Design. Sydney Water will further consider this guideline during the detailed design phase, particularly for the AWRC site. This has been included in management measure UD01. The amended management measures are provided in Appendix B.

The draft 'Aviation Safeguarding Guidelines – Western Sydney and surrounding areas' was also released with the draft Phase 2 DCP. Sydney Water has reviewed these guidelines in line with the impact assessment provided in section 13.1 of the EIS. Sydney Water considers that the project aligns with these draft guidelines. Further consideration of these guidelines is provided in section 5.18.2 of this report.

Aerotropolis Precinct Plan

Appendix B of the EIS assessed project alignment with the precinct objectives in the draft Western Sydney Aerotropolis Precinct Plan. Although the final plan has been restructured and there have been some changes to objectives, Sydney Water considers these are not substantially different from those originally considered in the EIS and the project continues to align with the precinct plan.

5.17.8 Compliance with legislation, regulations and guidelines - prescribed airspace

Issue description

WSA notes that there is significant topographical change across the AWRC site, with the OLS height to ground level being approximately 75 m in the south-western corner of the site. Based on the information available, WSA notes that none of the proposed buildings appear to extend into the OLS, however also notes that the *Airports Act 1996* covers any intrusions into prescribed airspace, which could include:

- constructing permanent structures, such as buildings, into the protected airspace
- temporary structures such as cranes protruding into the protected airspace
- activities causing non-structural intrusions into the protected airspace such as air turbulence from stacks or vents, smoke, dust, steam or other gases or particulate matter.
- WSA notes that if it is likely that any of the above components would result in an impact on protected airspace, then approval will need to be obtained in accordance with the Airports Act 1996 and the Airports (Protection of Airspace) Regulations 1996.
- WSA recommends that a condition of any future consent include provisions to ensure that any intrusions into prescribed airspace are referred to WSA.

Response

The Airport Safeguarding assessment in Appendix AA of the EIS states that the assessment has been completed with reference to:

- relevant legislation, including the Airports Act and regulations, and the Civil Aviation Act 1988 and regulations
- National Airports Safeguarding Framework (NASF, 2018)
- Manual of Standards Part 139 – Aerodromes (CASA, 2019).

Sydney Water has relied on the details of the NASF Guideline F, the former State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 (now State Environmental Planning Policy (Precincts – Western Parkland City) 2021) and the Western Sydney Airport safeguarding tool. The tallest permanent structure at the AWRC is about 25 m high which is lower than the maximum height of 75 m specified on the OLS map. As such, no approval is required under *Airports Act 1996* and the Airports (Protection of Airspace) Regulations 1996.

5.17.9 Airport operations – general aviation safeguarding

Issue description

WSA notes that section 13.1.2 of the EIS identifies that the aviation assessment 'was limited to impacts from the AWRC … because pipeline infrastructure is primarily located below ground, with some very small footprint above-ground structures. Pipeline operations are therefore considered to present no risk to airport operations'.

WSA requests that Sydney Water clarify that the risk of the pipeline has been assessed, given the potential for matters to impact on aviation safeguarding such as protected airspace intrusions during construction (eg machinery use), wildlife attraction to exit points from the pipeline, and traffic impacts from construction, particularly the pipeline construction on Elizabeth Drive, where there will be other major infrastructure under construction such as the M12 and Sydney Metro Western Sydney Airport line.

WSA recommends that further information be provided to WSA to demonstrate that the pipeline system would not result in aviation safeguarding impacts.

Response

Section 13.1 of the EIS outlines the potential impacts of the project on operations of the Western Sydney International Airport. Construction of the project is proposed to be completed by mid-2025. The Western Sydney International Airport is proposed to being operation by early 2026. As the construction phase of the project does not overlap with the operation of the Western Sydney International Airport, this phase of the project has not been considered as part of the airport operations impact assessment in section 13.1 of the EIS. Sydney Water has responded in section 5.17.2 to the issue raised about contingencies if project construction is delayed.

Pipeline operation was not included in the impact assessment on the operations of the Western Sydney International Airport given no risks were identified. This is due to the pipelines being located below ground and complying with all NASF guidelines. Minor above ground structures are required, including pit covers and scour valves, however, these will be less than one metre high. The environmental flows and treated water pipeline release structures will also be above ground. These are located about 8.5 km west of the Western Sydney International Airport and will not impact on airport operations and are considered unlikely to attract wildlife.

5.17.10 Airport operations - management of wildlife risk

Issue description

WSA provides a range of comments about the risk of wildlife attraction, the risk assessment completed and the level of detail in management measures. Table 5-43 responds to each of these comments.

Response

Table 5-43 Response to WSA comments on management of wildlife risk

Issue raised	Response
WSA notes that wildlife attraction is described as a 'very high risk'. Given this risk, combined with a flexible proposed design approach, WSA requires additional assurance from Sydney Water and DPE to guarantee this risk has appropriate and sufficient management measures in place to adequately protect WSI from wildlife strike. Being directly under the north-east approach path of Runway 1, this will need to be ensured as a long-term outcome for WSI.	Sydney Water considers the 'very high risk' is reflected in the management measures proposed that commit to ongoing management of wildlife at the AWRC throughout the operational phase of the project. Management measure AO01 and AO02 in Table 15-3 of the EIS commit to investigating further design options for excluding wildlife, and developing a Wildlife Management Plan for managing wildlife at the AWRC site during operation. This includes how open bodies of water, such as detention basins will be managed and any exclusionary devices around the operational area of the site. Sydney Water is committed to effectively managing the wildlife attraction risk of the AWRC site which is why management measures in the EIS reflect the recommendations of aviation specialists. Sydney Water considers it is critical to be adaptable to managing this risk which is why the Wildlife Management Plan commits to ongoing hazard assessments and review of the effectiveness of measures.
WSA recommends that during the detailed design phase, the aviation safeguarding documentation, including the Wildlife Risk Assessment, be updated and the final design be reviewed to confirm any additional or changed mitigation measures. WSA requests that this information is provided to WSA for comment.	Management measures AO01 and AO02 in Table 15-3 of the EIS commit to investigating further design options for excluding wildlife and developing a Wildlife Management Plan for managing wildlife at the AWRC site during operation. Sydney Water has added management measure AO04 in Appendix B to assess the consistency of any proposed changes to the AWRC design with the Avisure Wildlife Hazard Assessment. Sydney Water has also added management measure G15 in Appendix B which commits to consulting with WSA regarding the final design of the AWRC and any potential changes to risks relating to wildlife strikes.

Issue raised	Response
WSA notes that management measure AO01 does not provide sufficient certainty that: • the detailed design of a 'very high risk' development, to ensure that wildlife risk does not present an adverse risk outcome to the future operations of WSI; and • the measures identified would actually be implemented in the final design.	The Avisure Wildlife Hazard Assessment states that the AWRC development is a 'very high risk' to wildlife hazards if mitigation measures are not applied. Sydney Water proposes numerous management measures to reduce the wildlife hazard risk of the AWRC, as outlined in management measures AO01 to AO04 in Table 15-3 of the EIS and Appendix B of this report. Management measure AO01 in Appendix B has been updated to provide reassurance that additional design measures will be implemented, where appropriate, to further manage potential wildlife populations at the AWRC site. Sydney Water has also added management measure AO04 in Appendix B to assess the consistency of any proposed changes to the AWRC design with the Avisure Wildlife Hazard Assessment.
WSA also recommends the following in relation to management measures: • Management measures identified in Volume 4 of the EIS be revised to provide specific additional certainty that adverse wildlife attraction outcomes would not impact WSI operations. • Wildlife risk design management measures be identified on a specific and final design (including design of the green space), so that an assessment can be undertaken by the wildlife risk consultants for the project. WSA requests that they have an opportunity to review the final risk assessment and design. • Management measure AO02, requiring the preparation and implementation of a Wildlife Management Plan, be prepared in consultation with WSA.	Management measures AO01 and AO02 in Table 15-3 of the EIS commit to investigating further design options for excluding wildlife, and developing a Wildlife Management Plan for managing wildlife at the AWRC site during operation. These management measures will begin in detailed design and continue through operation of the AWRC and will minimise the risk of the AWRC site contributing to negative impacts on WSI operations. The Avisure Wildlife Hazard Assessment undertaken as part of the EIS was based on the reference design of the AWRC. Sydney Water has added management measure AO04 in Appendix B to assess the consistency of any proposed changes to the AWRC design with the Avisure Wildlife Hazard Assessment. Management measure AO02 has been updated to include consulting with WSA during the preparation of the Wildlife Management Plan.

5.17.11 Airport operations - wildlife hazard assessment – general comments

Issue description

WSA provides a range of general comments and recommendations on wildlife hazard assessment. Table 5-44 includes a response to each of these.

Response

Table 5-44 Response to WSA comments on wildlife hazard assessment

Issue raised	Response
Recommends that the following specific measures included in section 5.2.1, are further reviewed in the context of the WSA submission and the specific wildlife hazard risk of detailed design of this site to WSI: • In relation to point 2, further detail is needed to mitigate the identified nesting risk. • In relation to point 3, further detail is needed in relation to the mitigation of risk from water storage facilities, including their form and function as well as how wildlife would be managed in each case. Covering of these water storage facilities is to be considered as part of any risk evaluation and is the preferred outcome. • In relation to point 4, specific landscaping and grassed area species selection is to be reflected in an updated wildlife hazard assessment.	The level of detail noted in this submission is not yet available and will form part of future detailed design and management plan development. Management measures AO01 and AO02 in Table 15-3 of the EIS commit to investigating further design options for excluding wildlife (including nesting), and developing a Wildlife Management Plan for managing wildlife at the AWRC site during operation. This includes how open bodies of water, such as detention basins will be managed and any exclusionary devices around the operational area of the site. Management measure UD01 in Table 15-3 of the EIS commits to preparing an Urban Design and Landscaping Plan for the AWRC that considers and addresses the constraints relating to airport safeguarding. This would include plant species selection for landscaping and has been amended in Appendix B to require input from a wildlife hazard expert. Sydney Water has also added management measure AO04 in Appendix B to assess the consistency of any proposed changes to the AWRC design with the Avisure Wildlife Hazard Assessment. If required, further risk assessments will be completed to reduce the wildlife hazard of the AWRC.

Issue raised	Response
As part of the wildlife risk assessment, consider the cumulative impact of the project alongside other wildlife attracting development within proximity of the site, which is likely to impact on the movement of high-risk species.	Sydney Water will manage the risk of wildlife attraction to the AWRC site as outlined in management measures AO01 and AO02 in Table 15-3 of the EIS and as amended in Appendix B. Sydney Water does not have control over the extent and nature of developments on land around the AWRC site, including the potential they may have for attracting wildlife. Sydney Water also considers that the landscape in the area is likely change over the next three to four years before the AWRC is operational and assessment of any cumulative impact now may not be reflective of actual risk.
Requests that management measures G05, UD02, WW11, WW18 and W01 be reviewed to confirm that wildlife attraction risk has been adequately assessed.	Management measure G05 in Table 15-3 of the EIS commits to the development of a Rehabilitation Management Plan. This relates to restoring areas impacted by pipeline construction to pre-existing conditions. Sydney Water has revised this measure in Appendix B to reference considering the risk of wildlife attraction. Management measure UD02 commits to consulting with DPE in preparing the Urban Design and Landscaping Plan. Management measure UD01 commits to the preparation of the Urban Design and Landscaping Plan which will address airport safeguarding constraints. Sydney Water has revised UD01 in Appendix B to note that inputs from a wildlife hazard expert would be incorporated into the Urban Design and Landscaping Plan. Management measure WW11 relates to the consideration of riparian planting and bank stabilisation following the construction impacts of the environment flows release structure at Warragamba River. Due to the significant distance from the Western Sydney International Airport, and substantial existing surrounding vegetation, the release structures and associated vegetation restoration are not expected to impact airport operations. Management measure WW18 has been updated in Appendix B to reflect that any

Issue raised	Response
	vegetated riparian zones on the AWRC site will consider airport safeguarding constraints. Management measure W01 commits to the development and implementation of a Waste Management Plan as part of the project’s CEMP. This plan will relate to the construction phase of the project which will be completed prior to the WSA being operational. The WSA submission refers to W01 as the Wildlife Management Plan, however, the reference for this safeguard is AO02. As stated in AO02, the Wildlife Management Plan will include adoption of wildlife deterrent technologies to reduce hazardous bird populations which will address the wildlife attraction risk of the AWRC site.
Recommends that the measures included in Table 4-4 of the Landscape Character and Visual Assessment be assessed in relation to aviation wildlife risk. Components such as revegetation, vegetative screening and living walls would likely increase the wildlife attraction risk assessment, especially on a cumulative basis with other development at the site. WSA also seek confirmation that the inclusion of wetlands be confirmed, given the high wildlife risk.	Measures included in Table 4-4 of the Landscape Character and Visual Impact Assessment are indicative measures considered as part of the impact assessment to align with the themes and principles described in Table 4-4 of the EIS. As detailed design progresses, Sydney Water will consider a range of measures that continue to align with these themes and principles as part of the Urban Design and Landscaping Plan for the AWRC site (management measure UD01 in Table 15-3 of the EIS). Management measure UD01 also specifies that airport safeguarding constraints will be addressed in developing this plan. The wetlands in the green space area on the AWRC site have a stormwater management function and these will be confirmed as detailed design progresses. Management measures AO01 and AO02 commit to investigating opportunities for additional design measures to effectively manage wildlife attraction risks associated with wetlands and open bodies of water.

5.17.12 Airport operations - glare from solar panels

Issue description

WSA notes that given the significant solar panel portion of the site, a review should be undertaken of the angle of these to ensure that aircraft overhead would not be adversely affected by glare from the panels. WSA supports the anti-glare treatment of solar panels. WSA recommends that the angle of solar panels be reviewed during detailed assessment, to confirm that they will not result in adverse glare outcomes to pilots.

Response

Section 4.5.3 of the EIS states that the solar panels will have an antiglare treatment to reduce the risk to aircrafts in accordance with the NASF Guidelines. Safeguard AO05 has been added which commits to investigating further design options for the solar panels at the AWRC so that overhead aircrafts would not be adversely affected by any glare.

5.17.13 Project outcomes – airport operations

Issue description

WSA notes that Table 15-5 of Volume 4 of the EIS identifies key project outcomes. WSA recommends that ‘Ensure that 24-hour operations of WSI and aviation safeguarding is ensured’ be included as a key project outcome.

Response

Section 13.1 of the EIS demonstrates how Sydney Water will contribute to this outcome for WSI. The project will not influence operating hours of the Western Sydney International Airport. Measures AO1-AO3 in Table 15-3 of the EIS demonstrate how Sydney Water will manage potential impacts on WSI, including measures to manage wildlife hazard.

Sydney Water has not included the proposed words as a key project outcome, because it can only commit to effectively managing risks of its own projects and activities, not achieving this overall outcome for WSI.

5.17.14 Traffic and transport - impacts to road upgrades along Elizabeth Drive

Issue description

WSA notes that a pipeline is proposed along Elizabeth Drive and recommends further discussions with Transport for NSW (TfNSW), Sydney Metro and WSA, with the intent of minimising cumulative construction impacts of the pipeline on road upgrades proposed along the corridor.

Response

Sydney Water has consulted with WSA, TfNSW (including Sydney Metro) throughout the development of the reference design and EIS. Management measure G10 in Table 15-3 of the EIS commits to ongoing consultation and coordination with other major projects and utility providers that may be impacted during construction, or where cumulative impacts may occur. This would include TfNSW, Sydney Metro and WSA. Management measure G08 commits to the development and implementation of a Community and Stakeholder Engagement Plan that will outline ongoing consultation with other government agencies.

5.17.15 Traffic and transport - intersection of Elizabeth Drive and Clifton Avenue

Issue description

WSA notes that the western approach to the intersection of Elizabeth Drive and Clifton Avenue is identified to be Loss of Service (LoS) F in 2023. A finding of the traffic assessment is 'To develop appropriate mitigation measures stakeholder engagement will also be required with the M12 project team and TfNSW'. WSA recommends that further information be provided in relation to the measures proposed to mitigate the impact of the proposal on Elizabeth Drive, which already operates at LoS F.

Response

Sydney Water notes the WSA's concerns about the impact the project will have on traffic along Elizabeth Drive. Table 11-38 in section 11.4.5 of the EIS shows that the western approach of Elizabeth Drive is unlikely to be impacted with a LoS of A and a Degree of Saturation (DoS) of 0.773. The eastern approach will be impacted with a LoS of F and DoS of >1. This is due to the potential queuing of construction traffic beyond the capacity of the turning bay turning right into Clifton Avenue off Elizabeth Drive.

Site specific management measures relating to construction traffic impacts will be detailed in the Site Specific Construction Traffic Management Plans (SSCTMPs) as outlined in management measure TT01 in Table 15-3 of the EIS. These plans will be developed prior to construction and in consultation with relevant local councils, impacted residents and businesses and TfNSW. Potential options that will be investigated during the development of the SSCTMPs to reduce construction traffic impacts on Elizabeth Drive may include:

- scheduling some heavy construction vehicle movements outside of peak times
- spreading the program of construction vehicle peaks across more days, reducing the peak volume of construction vehicles or workers
- scheduling some vehicles to be restricted to 'left-in' only into Clifton Avenue as this movement will cause less delays than the 'right-in' turn off Elizabeth Drive.
- scheduling some vehicles to be restricted to 'left-out' only from Clifton Avenue onto Elizabeth Drive as this movement will result in less queuing on Clifton Avenue

- increasing the length of the right hand turn bay from Elizabeth Drive onto Clifton Avenue.

Sydney Water acknowledges that a collaborative approach to cumulative construction traffic impacts is required between major projects in the area around Elizabeth Drive. Management measure G10 in Table 15-3 of the EIS commits to ongoing consultation and coordination with other major projects and utility providers that may be impacted during construction, or where cumulative impacts may occur.

5.17.16 Landscape character and visual amenity - lighting

Issue description

WSA notes that the landscape character report indicates that lighting at the AWRC will be considered at detailed design, however the impact assessment assumes that the following measures are implemented to reduce potential impacts:

- Use of downlighting to avoid light spill.
- Layout of lighting is not to replicate airport runway, given the proximity to WSA.

WSA recommends that consideration be given to the lighting provisions outlined in the draft Phase 2 DCP.

Response

Management measure LCV02 in Table 15-3 of the EIS commits to designing and implementing lighting of night-work construction and operations of the AWRC in accordance with NASF Guideline E – Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports. The lighting provisions outlined in the draft Phase 2 DCP are consistent with those in NASF Guideline E, that is, a limit of 450 candela (cd) for light intensity in Zone D. Accordingly, no changes to management measure LCV02 are required.

5.18 Western Sydney Planning Partnership

5.18.1 Strategic context – AWRC site

Issue description

Western Sydney Planning Partnership notes that the Advanced Water Recycling Centre (AWRC) site is located in the Kemps Creek Precinct of the Western Sydney Aerotropolis, which is a non-initial precinct which has not been the subject of detailed precinct planning investigations and rezoning. The site is identified as generally suitable for future employment uses in the Western Sydney Aerotropolis Plan (WSAP).

Western Sydney Planning Partnership notes that the underlying Penrith Local Environmental Plan (LEP) land use zonings continue to apply to the site. However, certain provisions of the State Environmental Planning Policy - Western Sydney Aerotropolis 2020 (Aerotropolis SEPP) do apply to the site. The Aerotropolis SEPP applies to the site for the purpose of aligning the strategic objectives and WSAP to the site along with airport safeguarding provisions.

Response

Sydney Water notes Western Sydney Planning Partnership's comments about the applicability of planning instruments and alignment with strategic objectives and these align with Sydney Water's position on these matters in the EIS.

As outlined in section 5.2.1 of the EIS, the AWRC site is on land zoned partly under Penrith Local Environmental Plan 2010 and partly under the former State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 (Aerotropolis SEPP) (now incorporated into State Environmental Planning Policy (Precincts – Western Parkland City) 2021). The project as proposed on the AWRC site is permissible without consent under these planning instruments.

Table 5-4 in the EIS demonstrates that the project aligns with the key provisions of the Aerotropolis SEPP, including airport safeguarding. These provisions are renumbered but have not substantially changed in the State Environmental Planning Policy (Precincts – Western Parkland City) 2021. Appendix B of the EIS also demonstrates project alignment with other key strategic planning documents for the Western Sydney Aerotropolis, including the WSAP, Precinct Plan and Phase 1 DCP.

5.18.2 Compliance with legislation, regulation and guidelines – Western Sydney International Airport

Issue description

Western Sydney Planning Partnership notes that a key planning objective for the Aerotropolis is to safeguard the 24-hour operations of Western Sydney International (Nancy-Bird Walton) Airport. The site is wholly within the 8 km wildlife buffer zone on the Wildlife Buffer Zone Map of the Aerotropolis SEPP and careful consideration must be given to any proposed vegetation or landscaping to minimise wildlife attraction as per Clause 21 of Part 3 of the Aerotropolis SEPP. Western Sydney Planning Partnership notes that in accordance with the issued Secretary's Environmental Assessment Requirements (SEARs) the proponent has prepared an Aviation Safeguarding assessment.

Western Sydney Planning Partnership notes that since the SEARs were issued additional guidance has been prepared in the form of the draft Aviation Safeguarding Guidelines - Western Sydney Aerotropolis and surrounding areas. As the assessment progresses, Western Sydney Planning Partnership recommends that specific consideration be given to these guidelines prior to the determination of the application.

Response

Sydney Water notes that the AWRC site is located within the 8 km wildlife buffer zone on the Wildlife Buffer Zone Map of the former Aerotropolis SEPP (now incorporated into State Environmental Planning Policy (Precincts – Western Parkland City) 2021). This is consistent with the impact assessment in section 13.1 of the EIS. Management measure AO01 commits to investigating opportunities for further design measures at the AWRC to manage and minimise wildlife attraction. Management measure AO02 in Table 15-3 commits to preparing and implementing a Wildlife Management Plan for the AWRC site as part of the operation of the site.

Sydney Water has reviewed the draft Aviation Safeguarding Guidelines - Western Sydney Aerotropolis and surrounding areas in line with the impact assessment provided in section 13.1 of the EIS. The draft Aviation Safeguarding Guidelines - Western Sydney Aerotropolis and surrounding areas have adopted all but one of the National Airports Safeguarding Framework (NASF) guidelines against which the project was assessed in the EIS. Guideline A in relation to the Australian Noise Exposure Concept (ANEC) contours has not been adopted, however this does not change the outcomes of Sydney Water's assessment in the EIS. Sydney Water considers that the project therefore aligns with these draft guidelines.

5.18.3 Strategic context – overall project

Issue description

Western Sydney Planning Partnership notes that the project is consistent with the vision, objectives and principles in the WSAP, in particular the key consideration to deliver water and wastewater infrastructure and to enable the Upper South Creek AWRC to be delivered by Sydney Water.

Response

Sydney Water notes Western Sydney Planning Partnership's advice that the project is consistent with the vision, objectives and principles in the WSAP and considers that no further response is required.

6 Response to local council submissions

This chapter provides Sydney Water's response to issues raised in submissions from local councils.

Five submissions were received from the councils for the five local government areas in which project infrastructure will be located. Each submission has been addressed separately and broken down into discrete issues, with Appendix A summarising the submissions received, categories of issues raised and the section in the submissions report where they are addressed. In some instances, the subsections below respond to more than one issue, where the issues are related or very similar.

Appendix B, being based on Tables 15-3 and 15-4 in the EIS, contains new or amended management measures resulting from a submission, with new measures shaded orange and changes to existing measures in red text.

6.1 Canterbury Bankstown City Council

6.1.1 Socio-economics and stakeholder and community engagement

Issue description

Canterbury-Bankstown City Council acknowledges that only a very small portion of the project is in its local government area but the area impacted has high environmental and amenity value to the community (Lansdowne Reserve). Council requests that the following be addressed:

- No impact on the "Biobank" in Lansdowne Reserve.
- Coordination with Council for the access and construction requirements (CTMP) of the project to mitigate low term effects on the area.
- Coordination with Council for remediation and maintenance requirements for the works within the reserve.
- Coordination with Council for specific works within Lansdowne Reserve to improve access routes through the reserve and enable suitable restoration on cessation of the occupation.

Council also notes that it has engaged continuously with Sydney Water's project team and these comments have already been discussed at length.

Response

As noted in the submission, Sydney Water has designed the project to minimise impacts on Lansdowne Reserve in consultation with Canterbury-Bankstown City Council. No impacts are proposed to the biodiversity stewardship site in Lansdowne Reserve. Sydney Water will consult with Council as design and construction progresses, including in relation to access, remediation and maintenance as part of our Community and Stakeholder Engagement Plan in management measure G08 in Table 15-3 of the EIS.

6.2 Fairfield City Council

6.2.1 Support for project

Issue description

Fairfield City Council notes that the construction of the project will support the Western Sydney Aerotropolis and South West Growth Areas whilst generating circular economy.

Response

Sydney Water notes Fairfield City Council's comment and considers that no further response is required.

6.2.2 Socio-economics - Cabravale Memorial Park

Issue description

Fairfield City Council states that Cabravale Memorial Park is not an approved or agreed site for Sydney Water infrastructure or the locating of a site compound. Council notes that the park is a local heritage item, and the major focal point for a range of community activities throughout the year including ceremonies and festivals.

Council acknowledges that Sydney Water has been working with relevant rail authorities to secure an alternative alignment under the passenger and freight line corridors directly to the east that would avoid potential impacts on Cabravale Park. Council welcomes this initiative and supports Sydney Water's efforts to realise an alternative alignment for the pipeline and location for a works compound in this part of Fairfield City.

Response

As noted in Fairfield City Council's submission, Sydney Water has been consulting with Council on this matter and understands its concerns about impacts on Cabravale Memorial Park. In response, Sydney Water proposes an amendment to the brine pipeline alignment and construction method in this location that relocates the brine pipeline and associated construction activities outside Cabravale Memorial Park. Sydney Water has consulted with Fairfield City Council on this alignment and it is generally supportive of the change. The project's Amendment Report (Sydney Water, 2022) describes the proposed realignment of the brine pipeline and construction activities in this area and assesses its impacts.

6.2.3 Terrestrial biodiversity

Issue description

Fairfield City Council notes that the biodiversity assessment adequately follows the Biodiversity Assessment Method and that impact on native vegetation is low but that street trees will need to be removed.

Council requests that an Arborist Impact Assessment be provided to Council prior to commencement of construction and once detailed design of the brine pipeline has been confirmed. Consideration should be given for offsets on a local scale if trees are to be removed, for example replant trees or fund a biodiversity action on a local level where vegetation identified on Council's Conservation Significance Values map is impacted.

Response

Due to the scale of the project it is not practical to provide arborist impact assessments prior to construction for all street trees that may potentially be impacted. As pipeline installation will be done in incremental segments, Sydney Water proposes to engage an arborist on an as needs basis as construction progresses as outlined in management measure TB05 in Table 15-3 of the EIS. Where practical to do so, construction contractors will be required to try and avoid or minimise impacts to street trees as outlined in management measures TB03 and TB04 in Table 15-3 of the EIS.

The project's Rehabilitation Management Plan (management measure G05 in Table 15-3 of the EIS) outlines Sydney Water's approach to restore sites to their pre-existing condition, including the replacement of street on a like for like basis or where this is not possible, considering other opportunities to reduce impacts to streetscape character and visual amenity.

6.2.4 Construction activities and design requirements - impact of brine pipeline

Issue description

Fairfield City Council makes the following requests regarding consultation during the detailed design phase and impacts associated with the brine pipeline:

- Further clarification is required during detailed design to understand the construction methodology and construction corridor width (including trench width) of the brine pipeline to determine the impact construction will have on the local road network, pedestrian areas and Council infrastructure.
- It requests trench widths are minimised in urban areas of Fairfield City and notes that measures will need to be investigated to minimise disruption to community and Council infrastructure projects.
- It strongly recommends that Sydney Water and Council work collaboratively on the detailed design of the brine pipeline to realise the best outcomes and minimise impacts on the community and infrastructure of Fairfield City.

Response

Section 4.9 of the EIS outlines the construction approach for pipelines. This includes potential construction corridor widths in section 4.9.2 and construction methodologies in section 4.9.3. Figure 4-17 of the EIS maps the project's impact area (construction corridor). Sydney Water has aimed to minimise impacts of the brine pipeline construction on the local road network, pedestrian areas and Council infrastructure by minimising construction footprints and aligning the pipeline away from large busy roads where possible.

Sydney Water notes Council's request for trench widths to be minimised in urban areas of Fairfield City. This request aligns with the approach Sydney Water generally takes for pipeline construction in urban areas. A narrower trench is preferable as it reduces potential impact on adjacent underground services, the traffic network, construction duration and extent of restoration of the impacted area.

Detailed design will include further clarity on the finer details of construction methodology and construction corridor widths in Fairfield City. Management measure G08 in Table 15-3 of the EIS commits Sydney Water to having ongoing consultation during detailed design and construction with local councils via the Community and Stakeholder Engagement Plan (CSEP).

6.2.5 Design requirements - minimum cover above pipeline

Issue description

Fairfield City Council notes that the proposed new wastewater pipeline servicing future development in the Aerotropolis runs through State Road, Regional Road, Collector Road, Local Road and Council's Road Reserve. During the detailed design of pipeline, Council requests that Sydney Water consult and liaise with Council to obtain an approval to maintain minimum cover from road surface to pipeline.

In addition, Council expects a similar process to maintain minimum lateral and vertical clearances between the pipeline when crossing to or near Council's storm water lines.

Response

Sydney Water has designed the project pipelines to comply with the Water Services Association of Australia (WSA) 03-2011 Water Supply Code of Australia Version 3.1 (WSAA, 2011). This includes the suggested minimum lateral and vertical clearances between the project pipelines and underground services.

Sydney Water will consult with Fairfield City Council as outlined in management measure G10 and U05 in Table 15-3 of the EIS.

6.2.6 Waterways and design requirements

Issue description

Fairfield City Council notes that tunnelling is proposed at Henty Creek, Green Valley Creek and Prospect Creek. Council requests several matters be reviewed by Council at the detailed design stage. Table 6-1 Response to Fairfield City Council comments about design and construction across waterways responds to each of these.

Response

Sydney Water notes that in the EIS, Henty Creek is referred to as Clear Paddock Creek.

Table 6-1 Response to Fairfield City Council comments about design and construction across waterways

Issue raised	Response
Geotechnical investigations to be undertaken to reduce the risk of creek erosion and groundwater interference.	Management measure GW11 requires that the geotechnical program investigate: • groundwater levels along tunnelled section of environmental flows pipeline. Identify any additional measures required to prevent groundwater seepage into the Warragamba Pipelines Corridor • potential surface water - groundwater linkages around watercourses. If needed, consider options to avoid disrupting the connectivity.
Regular monitoring of the creek profile should be conducted for creeks that are underbored as well as trenched.	Management measure WW27 in Appendix B has been modified to require monitoring at waterways where pipelines have been tunnelled.
Tunnelling of pipelines should meet surface outside the riparian corridor, with the width of the riparian corridor based on the Strahler naming convention as a minimum.	Clear Paddock and Green Valley creeks are first order streams and Prospect Creek is a fifth order. NRAR (2018) recommends riparian corridors of 20 m (plus channel width) for first order streams and 80 m (plus channel width) for fifth order streams. Construction at Clear Paddock and Green Valley creeks will be within the road reserve and will not impact riparian vegetation. The length of tunnelling beneath Prospect Creek is over 500m with entry and exit pits located outside of the riparian corridor.
Depth of tunnelling below creek beds must be detailed and justified to avoid incision, erosion and other detrimental impacts to Fairfield's creeks.	The detailed design phase will ensure that pipelines are at a sufficient depth to avoid incision and erosion. More detail has been added to management measure WW08 to address this.

Issue raised	Response
Location of site sheds and stockpiles should be shown on the detailed design and should be located outside the 1% Annual Exceedence Probality (AEP) flood extent.	Management measure G06 in Table 15-3 of the EIS states that during the development of the site plans for the Construction Environmental Management Plan (CEMP), Sydney Water will consider locating stockpiles and site buildings required for construction outside the 1% AEP where possible.
Relief valves and inspection pits should be shown on detailed design.	The design drawings and plans developed during detailed design will include all project components, including any relief valves and inspection pits.
Location of pumping stations should be shown on detailed design.	The design drawings and plans developed during detailed design will include all project components, including the requirement of any pumping stations. The current reference design includes two pumping stations located within the boundary of the Advanced Water Recycling Centre (AWRC) site.

6.2.7 Stakeholder and community engagement – traffic and transport

Issue description

Fairfield City Council requests that affected bus companies, Bicycle NSW, Western Sydney Cycling Network, Council and affected residents of Fairfield shall be notified, consulted and issues resolved as a result of temporary disruptions from the project.

Council also requests that pedestrians be provided alternate access to footpaths and properties.

During the consultation process, Council recommends that affected residents must be consulted and that Sydney Water resolve the customer issues prior to works commencing.

Response

Management measure TT01 in Table 15-3 of the EIS commits to developing and implementing Site Specific Construction Traffic Management Plans (SSCTMP). These will be developed in consultation with relevant local councils, impacted residents and businesses, TfNSW and in accordance with relevant guidelines and the project Framework Construction Traffic Management Plan (CTMP). Sydney Water has amended management measure TT01 to include consultation with bus companies, Bicycle NSW and Western Sydney Cycling Network.

The SSCTMPs will also outline safe alternative routes for pedestrians, cyclists and other active transport in accordance with relevant safety standards if temporary disruption is required during construction.

Management measure G08 in Table 15-3 of the EIS commits to developing and implementing a CSEP. This plan will outline the consultation process with any impacted landowners, stakeholders, local councils, businesses and other government agencies. Sydney Water will endeavour to consult and resolve any issues prior to works commencing, however, this may not always be feasible or practical depending on the issue.

6.2.8 Stakeholder and community engagement - impact on Council land

Issue description

Fairfield City Council requests that any further negotiation for the use or burdening of the Council land with Sydney Water infrastructure must be consulted and undertaken with its Property Division with compensatory requirements met.

Response

Management measure G08 in Table 15-3 of the EIS commits to development and implementing a CSEP. Sydney Water will continue to consult with Fairfield City Council regarding any proposed use of, and impact to, Council land during construction.

6.2.9 Construction environmental management plan – various environmental matters and review of document

Issue description

Fairfield City Council makes the following comments in relation to the CEMP:

- Request that the CEMP is submitted to the relevant consent authority for review. Following consideration and any required amendment to the submitted CEMP, appropriate conditions shall be imposed to ensure its effectiveness and enforcement.
- Request that a Construction Noise and Vibration Management Plan (CNVMP) be prepared for the development and submitted to the relevant consent authority for review. Following consideration and any required amendment, appropriate conditions shall be imposed to ensure its effectiveness and enforcement. Appropriate community consultation shall take place in preparation of the CNVMP in accordance with mitigation measures given in the Noise and Vibration Impact Assessment, prepared by Aurecon Arup, dated 28 April 2021.
- Prior to commencement of construction detailed review of the final equipment layout, plant selections and mitigation measures should be carried out by an acoustic consultant.
- Request that appropriate community consultation take place in preparation of the CEMP in accordance with commitments given in the Air Quality Impact Assessment, prepared by Jacobs, dated 15 June 2021.

- Request that a Groundwater Management Plan be prepared during the detailed design, construction and operational phases of the project and shall be submitted to the relevant consent authority for review. The plan is to include all the mitigation measures mentioned in the Ground Water Impact Assessment report, prepared by Aurecon Arup, dated 29 June 2021.

Response

CEMP review process

Management measure G01 in Table 15-3 of the EIS commits to preparing and implementing a CEMP consistent with *Environmental Management Plan Guideline – Guideline for Infrastructure Projects*. The CEMP will be developed and approved by the approval agency prior to the commencement of construction.

Construction Noise and Vibration Management Plan

Management measure NV01 in Table 15-3 of the EIS commits to preparing a Construction Noise and Vibration Management Plan (CNVMP) prior to and during construction. Sydney Water will consult with any impacted landowners, stakeholders, local councils, businesses and other government agencies in accordance with management measure G08 in Table 15-3 of the EIS.

Community consultation about air quality impacts

As part of the overall CEMP, consultation will be undertaken with the community regarding all aspects of construction and potential impacts, including air quality. Sydney Water will consult with any impacted landowners, stakeholders, local councils, businesses and other government agencies in accordance with management measure G08 in Table 15-3 of the EIS.

Groundwater Management Plan

Management measure SW01 in Table 15-3 of the EIS commits to preparing a Soil and Water Management Plan (SWMP) as part of the overall CEMP, prior to and during construction. The SWMP will include construction phase groundwater management measures (GW01 – GW13) from Table 15-3 which will effectively manage the project's potential impacts on the groundwater environment. These measures are consistent with the measures described in Appendix M of the EIS. Management measure G01 in Table 15-3 of the EIS commits to preparing and implementing a CEMP consistent with Environmental Management Plan Guideline – Guideline for Infrastructure Projects, which means the CEMP will be developed and approved by the relevant consent authority prior to the commencement of construction.

6.2.10 Construction activities - safety

Issue description

Fairfield City Council notes that Sydney Water or its nominated contractor must take responsibility of the maintenance regime to keep safe these proposed sites (work in Council and public land) during and after construction of the project until permanent restoration.

Response

Management measure G05 in Table 15-3 of the EIS commits to developing and implementing a Rehabilitation Management Plan to restore pipeline work sites to pre-existing condition or otherwise agreed with the relevant landowner or council. Pipeline construction sites will be restored in a progressive manner, with restoration being completed following construction work as soon as possible.

Management measure G01 in Table 15-3 of the EIS commits to preparing and implementing a CEMP) consistent with *Environmental Management Plan Guideline – Guideline for Infrastructure Projects*. The CEMP will outline roles and responsibilities in relation to construction site maintenance, security, safety and site restoration.

6.2.11 Construction activities – access to sportsfields and parks

Issue description

Fairfield City Council requests that access to sportsfields and parks along the route must be maintained during periods of hire or peak periods of use. Council must be provided with notice prior to any impact on any sportsfields or park assets.

Council requests that access to Bareena Park must be maintained at all times to ensure that its planned upgrade construction at this site will not be delayed (due to commence in 2022).

Response

Management measure TT01 in Table 15-3 of the EIS commits to developing and implementing SSCTMPs which will outline the staging and timing of construction for each area of the project. These plans will be developed in consultation with relevant local councils, impacted residents and businesses and TfNSW. If any changes to traffic conditions, including access to sportsfields and parks are required during construction, these will be communicated to impacted stakeholders and management measures will be implemented to minimise impacts.

Sydney Water notes Fairfield City Council's planned upgrade of Bareena Park located at 2 Bareena Street, Canley Vale. The brine pipeline will be located along Bareena Street between Fairview Road and Vale Street, and along Vale Street, which border Bareena Park. The timing and staging of these works is yet to be determined. Sydney Water will continue to consult with Council about the staging, timing and any proposed traffic changes at this location as outlined in management measures TT01 and G08 in Table 15-3 of the EIS.

6.2.12 Utilities - work in road reserve

Issue description

Fairfield City Council requests that all work is to remain in the road reserve. Negotiation with Council's Property Division is required prior to any resolution to burden public land with Sydney Water assets (including community or operational land owned by Council such as Cabravale Memorial Park or Cabravale Leisure Centre Car Park).

Response

As outlined in section 3.4.1 of the EIS, Sydney Water's preference is to follow existing road alignments for pipeline construction to minimise disturbance to the environment and community. Sydney Water can accommodate this approach for most of the brine pipeline, which is the only project infrastructure located in the Fairfield local government area. However, in some instances this is not possible, including where the brine pipeline crosses the T2, T3 and T5 railway line at Cabramatta. The proposed alignment of the brine pipeline is shown in Figure 4-17 of the EIS.

The project's Amendment Report (Sydney Water, 2022) assesses the impacts of a proposed change to the brine pipeline alignment through Cabramatta. This includes a realignment to avoid impacts to Cabravale Memorial Park by moving the tunnelling pit to the Cabravale Leisure Centre car park. This realignment is proposed as a result of consultation with Fairfield City Council and will reduce impacts to public open space during project construction.

Sydney Water will continue to investigate opportunities and refinements of the project pipelines to minimise potential impact to public land outside of road reserves.

6.2.13 Utilities and socio-economics - dilapidation surveys

Issue description

Fairfield City Council requests that a dilapidation survey of the Council's roads (construction sites and routes) be carried out before the commencement of construction. The dilapidation survey should include information in regard to each defect on the road pavement, kerb and gutter and other associated assets with photographic evidence and be prepared by a suitably qualified person. These dilapidation surveys will establish the extent of any existing damage and enable any deterioration during and after construction to be identified and remediated.

Council also requests a Dilapidation Report on its existing park trees adjacent to the development and notes that any damage to the park turf or plantings will need to be remediated as part of the completion of the development.

Council also notes that prior to any site compound establishment an Access over Community Land permit must be obtained with the lodgement of a Dilapidation Report relevant to the site.

Response

Management measure G05 in Table 15-3 of the EIS commits to developing and implementing a Rehabilitation Management Plan to restore pipeline work sites to pre-existing condition or otherwise agreed with the relevant landowner or council. Sydney Water typically completes dilapidation surveys for items or structures that are at risk of being unintentionally damaged by construction works. Completing detailed dilapidation surveys for every construction area, including documentation of each defect on the road pavement, kerb and gutter and other associated assets with photographic evidence may not be necessary if the risk of impact from construction activities is considered low. Management measure U02 in Table 15-3 of the EIS commits to identifying any existing utilities that may be at risk of impact from construction, and completing pre-construction dilapidation surveys to establish a pre-construction condition assessment

Sydney Water will consult and work with Fairfield City Council regarding the location of construction work sites, and note any particular areas of concern. If necessary, dilapidation surveys as per management measure U02 described above will be developed, otherwise post-construction rehabilitation will be completed in accordance with the Rehabilitation Management Plan outlined in management measure G05. Management measure U03 in Table 15-3 of the EIS commits to repairing any utilities directly impacted by project construction activities.

6.2.14 Utilities - stormwater assets

Issue description

Fairfield City Council notes that there are about 70 locations along the project where the proposed pipelines cross Council's stormwater networks. Council requests that pre and post CCTV footage of Council's pipes at each crossing point must be undertaken to determine any damage to Council's stormwater drainage networks. An independent (third party) consultant must certify that the proposed works at crossing points has not damaged Council's stormwater drainage networks.

Council requests that the Work-As-Executed drawings for this project be submitted to its Asset Management Division for the future maintenance of Council's assets at these locations.

Response

Sydney Water designs pipelines to avoid impacting adjacent utilities and services, including council stormwater assets. This is completed through Dial-Before-You-Dig (DBYD) searches, non-invasive surveys, potholing and requesting asset location information from council or the utility owner. Undertaking pre and post CCTV footage, including dilapidation surveys, of all assets in which pipelines cross is not standard practice and is usually limited to structures and assets in which standard offset distances cannot be achieved, or there is risk of damage from construction. Management measure U02, U03 and U04 commit to identifying existing utilities at risk of damage from construction, completing dilapidation surveys and repairing any utilities that have been impacts by construction.

Following the completion and commissioning of the project, the new assets are uploaded to Sydney Water's Geographic Information System with the assets then being identified through DBYD searches. Fairfield City Council would be able to identify any Sydney Water assets, including those related to this project, via these DBYD searches.

6.2.15 Compliance with legislation, regulations and guidelines - road openings

Issue description

Fairfield City Council requests that for every Road Opening (per House Number/Site) a Road Reserve Clearance Certificate Application (fees applicable) be lodged. A two-year warranty period will apply after the issue of the Road Reserve Clearance Certificate.

Response

Sydney Water will obtain any legally required approvals from Fairfield City Council prior to construction. Sydney Water will continue to consult with Fairfield City Council as outlined in management measure G08 in Table 15-3 of the EIS on the timing and requirement of any required approvals.

6.2.16 Compliance with legislation, regulation and guidelines – traffic and transport

Issue description

Road Occupancy Licences must be obtained from Transport for NSW (TfNSW) and/or Fairfield City Council. ‘Work Zones’ within Fairfield LGA will also require approval from Fairfield Traffic Committee.

Response

Management measure G11 in Table 15-3 of the project commits Sydney Water to obtaining all relevant approvals under legislation prior to construction. This includes any approvals required under the *Roads Act 1993*.

The Framework CTMP outlined in section 11.4.7 of the EIS will be finalised prior to construction in accordance with management measure TT02. This will include requirements to comply with all relevant legislation and approvals from relevant authorities, such as councils and TfNSW.

In addition, the SSCTMPs outlined in management measure TT01 in Table 15-3 of the EIS will be developed in consultation with relevant stakeholders, including local councils. These plans will outline for specific locations, the staging, location, changed traffic conditions and management measures to minimise impacts on the traffic network.

6.2.17 Compliance with legislation, regulation and guidelines - Tree Work Permit

Issue description

Fairfield City Council notes that the pipeline is following the road reserve. Council requires the lodgement of a Tree Work Permit for any work proposed to impact public/private trees (including street trees/trees in parks). Any trees likely to be impacted are to be inspected by a qualified arborist with reports provided to Council prior to the commencement of works with compensatory mechanisms applied to support additional plantings.

Response

The requirement for Tree Work Permits under section 3.2.1 of the Fairfield Development Control Plan 2013 (DCP 2013) is noted. As the project is critical State significant infrastructure, DCP 2013 does not apply to the project and therefore Tree Work permits are not required. Despite this, as outlined in section 6.2.3, Sydney Water will engage an arborist to assess potential impact to street trees in certain circumstances. Where the project results in the loss of a street tree Sydney Water will replace on a like for like basis or where this is not possible, consider other opportunities to reduce impacts to streetscape character and visual amenity.

6.3 Liverpool City Council

6.3.1 Support for the project and general comment on impacts

Issue description

Liverpool City Council strongly supports the progression of the project to ensure critical supporting infrastructure is delivered to support the existing and future population of Western Sydney.

Council supports the project from a strategic level, as it is instrumental in servicing Liverpool's growth areas for recycled water and wastewater. Council notes the example of the Austral precinct which has limited capacity for wastewater services and that existing infrastructure would not be able to cope with the demands of the wider precinct. This is especially important given the Austral and Leppington North precincts are developing at a rapid pace beyond what was originally envisioned.

The Advanced Water Recycling Centre (AWRC) is also integral in that it will capture waters from the existing release and Aerotropolis precincts to alleviate sewerage network stresses on the Liverpool treatment plant at Warwick Farm.

Liverpool Council also recommends a re-alignment of the brine pipeline to avoid impacts during the construction stage. These include impacts on biodiversity, flooding, water quality, erosion, and sedimentation.

Response

Sydney Water notes Liverpool City Council’s support for the project and considers that no further response is required. The sections below address specific comments on biodiversity, flooding, water quality and erosion and sedimentation.

6.3.2 Terrestrial biodiversity

Issue description

Liverpool City Council provides a range of recommendations in relation to biodiversity. Table 6-2 responds to each of these.

Response

Table 6-2 Response to Liverpool City Council's biodiversity recommendations

Issue raised	Response
Caution is exercised when considering impacts on individuals within the land that is not bio-certified, given the potential for mapping errors, encroachments and impacts to the local population: • In accordance with the assumption made in the Biodiversuty Development Assessment Report (BDAR), impacts should be avoided within land not biodiversity certified. Appropriate buffers and mitigation measures should be prescribed to ensure that no adverse impacts occur. • Potential impacts to these species at this location should also be specifically addressed within section 11.2 (Indirect Impacts) of the BDAR to ensure that potential impacts to their local population are appropriately considered Individuals within bio-certified land are avoided where possible to help protect the local population of these species.	Sydney Water understands Council's comment primarily relates to impacts around Western Road, Cross Street and Kemps Creek. Although no impacts are recorded to threatened species (specifically *Dillwynia tenuifolia, Pultenaea parviflora var. parviflora* and Cumberland Plain Land Snail), Sydney Water notes the close proximity of previous recordings of these species. Sydney Water considers that section 11.2 of the BDAR incorporated a complete assessment of indirect impacts that would apply to this location including inadvertent impact on adjacent habitat and trampling of threatened species. Table 15-3 of the EIS included a range of measures (TB01-TB10) to manage impacts on terrestrial biodiversity, that would also apply on land that is not bio-certified. These include implementing a Biodiversity Management Plan and designating no go zones (TB01) and requiring approval before removing vegetation (TB02). As part of the project's Amendment Report (Sydney Water, 2022), Sydney Water is also proposing to realign a section of the brine pipeline to the west of Kemps Creek, to relocate it in an area previously cleared for another Sydney Water project. This will further reduce impacts to threatened species and habitat in this area. For example, this has reduced impacts on on suitable habitat for *Dillwynia tenuifolia* and Cumberland Plain Land Snail in this location to zero.
All mitigation measures identified within Table 51 of the BDAR are included as management measures within the EIS, unless otherwise justified.	Sydney Water has incorporated relevant management measures from the BDAR into Table 15-3 of the EIS and Appendix B of this report.

Issue raised	Response
The legends for Figures 9-2h and 9-2i be revised to include threatened species, vegetation zones and bio-certification status as they currently do not include all pertinent map features.	Certain figures have been reproduced as part of the project's Amendment Report (Sydney Water, 2022) and in these cases legends have been updated. As the BDAR has been formally submitted to Department of Planning and Environment – Biodiversity and Conservation (DPE BCD) it is not considered appropriate to update additional figures in isolation at this time.
For the terrestrial biodiversity management measures (EIS Table 9-17), expand TB06 to include additional measures such as soft tree felling protocols, supervision by an ecologist during vegetation clearing, and measures to avoid fauna becoming trapped in trenches and pits.	Management measure TB06 in Appendix B has been updated to include soft felling of habitat trees and inspections for trapped fauna.
Pipe depth and designs are sufficient to allow for a fully structured vegetation community to become re-established.	Specific details regarding vegetation planting will be prepared in accordance with the Rehabilitation Management Plan outlined in management measure G05 in Table 15-3 of the EIS. This notes that areas of native vegetation removal will be rehabilitated to the highest ecological condition possible but that there are limitations to minimise potential damage to pipelines from tree roots.
Feasibility of realignment within identified fault line reduces biodiversity impacts (e.g., feasibility of moving the alignment north to a location near Elizabeth Drive).	As noted above, Sydney Water has proposed a realignment of the brine pipeline around Kemps Creek in the project's Amendment Report (Sydney Water, 2022). This would move part of the pipeline into areas previously cleared for another Sydney Water project. Sydney Water has proposed this alignment because the area is already cleared. Locating the pipeline adjacent to another Sydney Water pipeline minimises the number of properties on which easements will be required. Sydney Water considers this is the best option for realigning this section of the pipeline. Options for an east-west pipeline further south are constrained by Kemps Creek Nature Reserve. Options further north are constrained by the proposed M12 Motorway, limited space in the road verge along

Issue raised	Response
	Elizabeth Drive and numerous small lots with existing structures.

6.3.3 Air quality

Issue description

Liverpool Council notes that the Air Quality Impact Assessment concluded that dust mitigation during construction can be minimised to acceptable levels with appropriate environmental safeguards and that odour emissions are to be assessed using the dynamic olfactometry method.

However, the consultant discusses that 'the 4OU contour will not extend to any existing or potential private sensitive receptors or residential areas. There is potential for the western side of the AWRC site to be opened up as parkland for transient recreational users however the infrequent use, low numbers of people and short durations mean that impacts would be unlikely'.

No discussion was provided with regards to the impact of the 2OU contour when the 100 ML/d is processed. Figure D2 - Predicted odour levels at the 99th percentile due to the AWRC (100 ML/d) illustrates a greater 2OU area beyond the site boundary will be impacted when the system is operating at full capacity.

The submission recommends that further analysis regarding the impact to future sensitive receivers within the 2OU contour is provided.

Response

The modelling results have been assessed by referencing the EPA odour impact assessment criteria. As noted in Table 3 of Appendix R of the EIS, the EPA criteria are population based, that is, more stringent criteria are applied for higher population densities. The process for assessment of the modelling results was to determine the population predicted to detect over 2OU and to identify the appropriate EPA criterion relating to that population. From this process it was determined that the appropriate project specific criterion would be at least 4OU.

The EPA (2016) defines a sensitive receptor as a 'location where people are likely to work or reside'. The results of the modelling (Appendix C of Appendix R of the EIS) showed that the 4OU contour (the appropriate EPA assessment criterion) will not extend to any existing or potential private sensitive receptors or residential areas under either the 50 or 100 ML/d scenarios.

It should be noted that all modelled odour impacts are conservative estimates of actual impacts. For example, the biosolids out-loading was assumed to occur every day from 7 am to 3 pm. In reality this activity would only occur for a few hours at a frequency of typically once per week. Given the conservative nature of the modelling the extent of odour contours (including the 4OU) are likely to be overestimated.

6.3.4 Noise and vibration – assessment methodology

Issue description

Liverpool City Council raises concerns about noise and vibration impacts associated with the development and in particular, the methodology used to carry out the assessment. Council notes that assessment of impacts must be representative of the immediate context. This includes ensuring that residences are considered as a key affected body and that future development plans (which may or may not eventuate) do not wholly compromise assessment of the immediate context.

Response

The EIS assessed potential impacts to existing environment and community receivers that are directly and indirectly impacted by the construction and operation of the project. Where possible, such as near the AWRC and along Elizabeth Drive, the EIS has also considered impacts to potential future receivers that do not currently exist. This is due to the extended construction timeframe of 36 months, potential ongoing operational impacts from the project and acknowledging there is a potential for receivers to change over time given development of surrounding areas is likely to commence over the next several years. However, the main focus of the EIS is the impact the project will have on known existing sensitive receivers.

Section 11.2.2 of the EIS outlines the methodology and assumptions of the noise and vibration impact assessment. Figure 11-5 in the EIS shows the current and future receivers around the AWRC that were considered in the noise and vibration assessment. Sydney Water notes the importance of noise and vibration impacts on current receivers. Management measure NV01 in Table 15-3 of the EIS commits to preparing a Construction Noise and Vibration Management Plan which includes community engagement and suitable management measures for reducing impacts to the community.

6.3.5 Noise and vibration – Rated Background Levels

Issue description

Liverpool City Council notes that the Rated Background Levels (RBLs) within the area have been determined using noise logger data, located approximately 410 m from the AWRC site and in very close proximity to Elizabeth Drive which encounters large traffic volumes. In accordance with the Noise Policy for Industry (NPfI) section, the data logger should be sited at the most affected residence/s, and in a location that is truly representative of the noise environment at the residence (eg within the open field on, or in very close proximity to the development site and away from Elizabeth Drive).

Response

The noise logger (L06) used for the noise assessment to determine appropriate criteria for the operation of the AWRC is shown in Figure 11-5 of the EIS. This is located about 450 m east of the AWRC and 1.7 km north of Elizabeth Drive. This logger is located adjacent to the closest existing residents and sensitive receivers along Clifton Avenue, and is of sufficient distance away from Elizabeth Drive.

6.3.6 Noise and vibration - recommendations

Issue description

Liverpool City Council provides a range of noise and vibration recommendations. Table 6-3 responds to each of these.

Response

Table 6-3 Response to Liverpool City Council's noise recommendations

Noise recommendations	Response
Data loggers should be sited at the most affected residences and therefore should have been conducted within the open field on, or in very close proximity to the development site and away from Elizabeth Drive. Readings are reconducted within the open field on, or in very close proximity to the development site and away from Elizabeth Drive.	The noise logger (L06) used for the noise assessment to determine appropriate criteria for the operation of the AWRC is shown in Figure 11-5 of the EIS. This is located about 450 m east of the AWRC and 1.7 km north of Elizabeth Drive. This logger is located adjacent to the closest existing residents and sensitive receivers along Clifton Avenue, in an open field and is of sufficient distance from Elizabeth Drive. No changes are proposed.
An assessment of noise is conducted as it currently exists in consideration, being a rural zone without the additional 5 dB(A) to the rating background level (RBL) resulting from a development that has not yet occurred.	An updated comparison has been completed of two different predicted background noise levels once the AWRC is operational. The first is shown in Table 5-35 which includes the background noise from the operation of the M12 Motorway in an Urban noise category without any mitigation. The second is shown in Table 5-36 and assumes no changes to the background noise levels in a Rural noise category. Section 5.10.34 of this report provides more details on these assessments. In accordance with the NPfI, in order to derive criteria, the background noise levels should be measured and should be representative of typical activities (which in this case would include traffic noise from the M12 Motorway). Noting that the background noise levels are expected to increase, the Noise and Vibration Impact Assessment was prepared acknowledging that the existing situation

Noise recommendations	Response
	will change in the near future and that designing to the existing situation would be unduly stringent and not representative of the background noise environment.
A reassessment is undertaken on the operational impacts and whether the development meets the project specific noise trigger levels, due to the existing assessment being based on an inaccurate RBL.	Noise criteria applicable to the existing environment have been developed using existing background noise data from L06, as outlined in section 6.3.5, without correction and using the urban category for the amenity criteria applicable to residential receivers. Changing the receiver category from urban to rural, including removing the 5 dB from the operation of the M12 Motorway, results in noise level exceedances at four receiver locations (R3, R4, R5 and R6) under standard and enhanced meteorological conditions. Exceedances range from 1 to 6 dB. These exceedances are unmitigated and include the 2 dB engineering margin. Further information is provided in section 5.10.34. It should be noted that the predictions have assumed all noise sources operating at 100% capacity which is very conservative. Although there is potential for the AWRC to be operating one year before increased background noise levels from the M12 Motorway, it will not be operating at 100% capacity. The noise assessment is based on the AWRC operating at its full Stage 1 capacity which is not expected until about 2036. Accordingly, when it first starts operating, the AWRC is expected to emit lower noise levels than predicted. In addition, a 2 dB contingency is included in the predicted levels as outlined in section 5.10.35.
A variation of noise mitigation measures, due to the RBL concerns raised, are undertaken at detailed design phase	Management measure NV10 in Table 15-3 of the EIS commits to investigating opportunities to reduce operational noise from the project, particularly at the AWRC.

6.3.7 Flooding - brine pipeline alignment

Issue description

Liverpool City Council notes that the brine pipeline will potentially cross the flood detention Basin 3B at Cecil Hills in Liverpool Local Government Area (LGA). Liverpool City Council recommends a re-alignment of the proposed brine pipeline to avoid impacts on flooding, water quality, erosion, and sedimentation. Alternatively, Council notes that works could be proposed to ensure Basin 3B at Cecil Hills can function as required in a modified form.

Response

Sydney Water understands flood detention basin 3B is located on Hinchinbrook Creek to the east of the M7 and near Kensington Close in Cecil Hills. Figure 4-17i in Chapter 4 of the EIS indicates the construction footprint for the brine pipeline alignment is about 20 metres from the edge of the basin will therefore not impact flood detention basin 3B. During construction, potential surface water impacts are temporary and can be effectively managed by erosion and sediment control measures proposed in management measure SW01 and flood management measures (G06) in Table 15-3 of the EIS. These measures will ensure that detention basin 3B will function as required during construction activities.

6.3.8 Traffic and transport

Issue description

Liverpool City Council notes that the SIDRA modelling results indicate that the intersection of Elizabeth Drive and Clifton Avenue will be operating at a Level of Service (LoS) F during construction in 2023 and operation in 2025 peak hours. Council notes that 2023 traffic baseline link flows along Elizabeth Drive will reach its capacity (i.e. >100%).

Council notes that the proposed treated water pipeline (1.2 m in diameter) will be along Elizabeth Drive. The section of the pipeline along the northern section of Elizabeth Drive in front of the Western Sydney International Airport will interact with the proposed metro alignment and the M12 Motorway access road to the airport.

As a result, Council provides several recommendations in relation to traffic. Table 6-4 responds to each of these.

Response

Table 6-4 Response to Liverpool City Council's traffic recommendations

Issue raised	Response
Consideration of transport upgrades and initiatives to support the construction and operation of the development.	Sydney Water notes Liverpool Council's recommendation for transport upgrades and initiatives to support the construction and operation of the development of the project. However, during construction, impacts from pipeline construction

Issue raised	Response
	activities will be temporary, as construction moves progressively along the alignment. During operation, the brine pipeline will be underground therefore no ongoing operational impacts are expected. Sydney Water commits to the implementation of a Rehabilitation Management Plan (management measure G05 in Table 15-3 of the EIS) to restore pipeline work sites as soon as possible to the pre-existing condition and will continue to consult and work with Liverpool Council as outlined in management measure G08.
Consultation is undertaken with Transport for NSW (TfNSW) for the: a. Provision of interim treatment at the Elizabeth Drive/Clifton Avenue intersection to facilitate turning movements, of heavy vehicles in particular, prior to the upgrade of Elizabeth Drive. b. Determination of an appropriate intersection treatments, such as right turn movement restrictions or an interim roundabout c. Ensuring that all works within the road reserve are to be at the applicant's cost and all signage is to be in accordance with the TfNSW Traffic Control at Worksites Manual and the RMS Delineation Guideline. d. Required approval for any traffic signal adjustments	Sydney Water has consulted with TfNSW throughout the development of the reference design and EIS. Consultation will continue to occur as outlined in management measures G10 and TT01 in Table 15-3 of the EIS. Any required upgrades or modifications to the Elizabeth Drive/ Clifton Avenue intersection is out of scope of this project. The Site Specific Construction Traffic Management Plans (SSCTMPs) outlined in management measure TT01 in Table 15-3 of the EIS will outline specific management measures to minimise the impacts of construction traffic on the traffic network. These plans will also be prepared in accordance with relevant guidelines, including the TfNSW Traffic Control at Worksites Manual and the RMS Delineation Guideline. The Framework Construction Traffic Management Plan (CTMP) outlined in section 11.4.7 of the EIS will be finalised prior to construction as per management measure TT02. This will include requirements to comply with all relevant legislation and approvals from relevant authorities, such as councils and TfNSW
Construction traffic from the subject project minimises traffic movements during AM and PM peak hours.	Management measure TT04 in Table 15-3 of the EIS commits to minimising traffic movements during AM and PM peaks.
A cycle lane or shared path is provided along Clifton Avenue to connect to the planned future network along the M12 Motorway and Elizabeth Drive.	Upgrade works associated with Clifton Avenue are out of scope of this project. Sydney Water is not responsible for owning or managing Clifton Avenue. Therefore, Sydney Water is unable to commit to this recommendation.

Issue raised	Response
Prepare a SSCTMP that: a. Details site specified construction vehicle routes, number of trucks, hours of operation, access arrangements and traffic control for future developments. b. Outlines the need for a Road Occupancy Permit issued by Council or Road Occupancy Permit issued by the Transport Management Centre. c. Is submitted to Liverpool City Council's Traffic and Transport Section for approval at least 10 days prior to commence of work.	Management measure TT01 commits to preparing SSCTMPs. These will be prepared in consultation with local councils, impacted residents, businesses and TfNSW. These will include identification of haulage routes, construction access points. The Framework CTMP outlined in Section 11.4.7 of the EIS will be finalised prior to construction as per management measure TT02. This will include requirements to comply with all relevant legislation and approvals from relevant authorities, such as councils and TfNSW. The SSCTMP and Framework CTMP will not outline traffic control of future developments as this is outside the scope of the project.
The following additional applications be made to Council's Traffic and Transport Section if applicable: a. If a works zone is required, an application that to indicate the exact location required and the applicable fee is to be included. b. If parking restrictions are in place, an application to have the restrictions moved, will need to be made.	The Framework CTMP outlined in Section 11.4.7 of the EIS will be finalised prior to construction as per management measure TT02. This will include requirements to comply with all relevant legislation and approvals required from relevant authorities, such as councils and TfNSW. Sydney Water will continue to consult with Liverpool City Council as outlined in management measure G08 in Table 15-3 of the EIS regarding relevant applications and permits required for construction.
Council's on-street assets such as footpath be protected at all times. a. Any damages should be rectified to Council satisfaction. b. A road opening application is required for any intrusive digging in the public road or footpath: https://www.liverpool.nsw.gov.au/council/Fees-Forms-Policiesand-Enforcement/forms	Management measure G05 in Table 15-3 of the EIS commits to developing and implementing a Rehabilitation Management Plan to restore pipeline work sites to pre-existing condition or as otherwise agreed with the relevant landowner or council. The Framework CTMP outlined in section 11.4.7 of the EIS will be finalised prior to construction as per management measure TT02. This will include requirements to comply with all relevant legislation and approvals from relevant authorities, such as councils and TfNSW.
Consultation is undertaken with Transport for NSW (TfNSW) for the: a. Incorporation of water pipeline into the Elizabeth Drive upgrade design. b. Accommodation of the at-grade metro line and M12 Motorway access road through the construction and elevation of pipeline section	Sydney Water has consulted with TfNSW throughout the development of the reference design and the EIS. This includes where the project interacts with other major projects, including the M12 Motorway, Sydney Metro – Western Sydney Airport and Elizabeth Drive upgrade. Management measure G10 in Table 15-3 of the EIS commits to continue consultation and coordination with other

Issue raised	Response
along northern section of Elizabeth Drive in front of Western Sydney International Airport.	major projects and utility providers that may be impacted during construction.
Underbore is preferred for the proposed pipeline crossings under existing public roads.	The project pipelines will be constructed via a combination of tunnelled and trenched construction methodologies. Section 4.9.3 of the EIS outlines these methodologies in more detail. Sydney Water's preference for pipeline construction is open trenching due to reduced impacts to the community and a reduced construction timeframe. Tunnelled crossings of large roads will be required in some locations, such as the M7 Motorway and The Northern Road, to reduce disruptions to the traffic network. Figure 4-17 in the EIS shows the proposed tunnelled sections of the project pipelines.

6.3.9 Aboriginal heritage

Issue description

Liverpool City Council notes that the proposal does not impact on any local items under Liverpool's heritage register but does impact upon Aboriginal Cultural Heritage. Council provides three recommendations regarding Aboriginal heritage. Table 6-5 responds to each of these.

Response

Table 6-5 Response to Liverpool City Council's Aboriginal heritage recommendations

Aboriginal heritage recommendations	Response
Objects are managed in accordance with the wishes of relevant Aboriginal stakeholders	Section 11 in Appendix O of the EIS outlines the approach to managing salvaged objects, including consultation with Aboriginal stakeholders.
Slightly amend the positioning of plant and pipe work to minimise impacts on Aboriginal Cultural Heritage	As outlined in Chapter 3 of the EIS, project design included an extensive process of aligning the project to minimise environment and heritage impacts and achieve the required engineering design outcomes. Management measure AH01 in Table 15-3 of the EIS also commits to exploring opportunities to avoid or further reduce impacts on Aboriginal heritage during detailed design.

Aboriginal heritage recommendations	Response
Where necessary, recovery works are undertaken to ensure all objects are secure: a. Objects are recorded and photographed b. A report is prepared to be provided to the Aboriginal Land Councils and Liverpool City Council Library	Where objects are recovered they will be managed and reported on as outlined in Appendix C of the Aboriginal Cultural Heritage Assessment Report in Appendix O of the EIS.

6.3.10 Socio-economics - open space

Issue description

Liverpool City Council supports improvement and enhancement (visual, functional and environmental) of the ENZ land developed as a green space. Council notes that connectivity is key to the functionality and utility of green corridors planned for passive recreation.

Council notes that the proposal should not limit active transport and pedestrian pathway connections along the creek corridors, noting the considerations and mitigation of flooding impacts.

Response

Sydney Water notes Liverpool City Council's support for the improvement and enhancement of ENZ land as a green space.

There is an opportunity for this green space to be developed into a publicly accessible recreation area to form part of the Wianamatta-South Creek parkland proposed in the Western Sydney Aerotropolis Plan. This means the green space area could become part of active transport and pedestrian pathway connections along South Creek. Sydney Water is working with DPE to understand whether this is a realistic future opportunity, given the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 currently prohibits use of this land for a recreation area.

6.3.11 Project timing

Issue description

Liverpool City Council notes that there is a risk that servicing commitments may not be met within the Liverpool LGA (namely Austral). It is also noted that a substantial area of the development is to be used as a solar farm prior the completion of Stage 2.

Council suggests that the AWRC should ideally be bought forward to deliver the required infrastructure to support the development of the Aerotropolis and surrounding growth areas including Austral and Leppington North. Council notes that there is significant demand for development to occur in accordance with established planning policies and plans, with the current limitation of servicing causing delays for developers and businesses.

Response

Sydney Water's current program is for the project to be operational in mid-2025, given the time it takes to obtain approvals, and design and build major infrastructure of this nature.

Separate to the project, Sydney Water is currently preparing to deliver interim services to parts of Austral-Leppington. Wastewater from these areas will be temporarily transferred to Liverpool Water Recycling Plant until the AWRC is built.

6.3.12 Soils and contamination

Issue description

Liverpool City Council notes that the degree and extent of contamination has not been addressed to its full extent as the proposal has not been identified in accordance with 'Managing Land Contamination Planning Guidelines SEPP 55- Remediation of Land' (1998).

Response

Sydney Water notes that the former State Environmental Planning Policy No 55—Remediation of Land (1998) has been repealed and its provisions incorporated into State Environmental Planning Policy (Resilience and Hazards) 2021. This SEPP does not apply because the project is State significant infrastructure. The impact assessment and identification of areas of environmental concern described in Appendix N and section 9.5 of the EIS were informed by the preliminary site investigation (PSI) and detailed site investigation (DSI) for the reference design. The PSI and DSI are lengthy and detailed technical reports so were not included in the EIS, however the assessment approach followed the ASC NEPM 2013 and guidelines made or endorsed by the EPA. Sydney Water considers that Appendix N and section 9.5 of the EIS capture relevant content from these reports to fully address the assessment of potential contamination, identification of remediation requirements and identification of risk posed by any contamination found.

6.4 Penrith City Council

6.4.1 Supports project

Issue description

Penrith City Council notes in principle support for the aims of the project in facilitating population and economic growth. It also notes that delivering sustainable wastewater treatment and high quality recycled water aligns with Council's strategic planning. The submission supports various specific elements of the project including integrated and early approach to provision of infrastructure, renewable energy generation, Sustainability Management Plan and Operational Environmental Management Plan and alignment with EPA's Hawkesbury Nepean Nutrient Framework.

Response

Sydney Water notes Penrith City Council's support for the above elements of the project and considers that no further response is required.

6.4.2 Project description - recycled water opportunities

Issue description

Penrith City Council supports using treated water in place of drinking water for certain uses such as complementing stormwater in irrigation of open spaces, industrial processes and food production in the Agribusiness precinct. Council requests clarity on whether re-use is included in the scope of Stage 1 and encourages pursuing this as part of future development proposals. Council notes that should the construction timeline prohibit the inclusion of the outcomes of these discussions, then adequate 'future-proofing' should be included in scope to enable identified opportunities to be realised and encourage innovation.

Response

Sydney Water notes Penrith City Council's support of using treated water for certain uses to replace drinking water. Stage 1 of the project will produce a high-quality treated water that is suitable for re-use. This enables identified opportunities for recycled water to be realised. However, any schemes to deliver this recycled water to customers are out of scope for the project and will be subject to separate planning approvals. Separate to this project, Sydney Water's forward planning for recycled water is focused on establishing recycled water servicing plans for the initial Aerotropolis precincts (Northern Gateway, Aerotropolis Core, South Creek and Agribusiness), including for a range of land uses proposed for the Aerotropolis.

6.4.3 Project description - AWRC site green space area

Issue description

Penrith City Council supports the green space area and considers it as a key strength and opportunity for the project that will help deliver on green grid outcomes. Council also strongly encourages development of the green space area into a publicly accessible recreation area and that conditions of consent should be included to require the NSW Government to resolve this issue. It also notes a strategic opportunity for the green space area to connect to the M12 Motorway shared pathway proposed nearby, along the northern side of the M12. Council seeks clarification on the full scope of works in the green space area, particularly whether public access is part of the current proposal and will be delivered in Stage 1.

Council also notes that regardless of whether the recreational opportunity is realised, the urban design approach for the Advanced Water Recycling Centre (AWRC) site should align with the NSW Government's vision for South Creek and key green grid priorities and outcomes. It should also ensure that any visual and amenity impacts are mitigated for nearby properties and from key vantage points. However, Council's submission also notes that it does not support the green space area in its current location given it is located in the South Creek 1% Annual Exceedence Probability (AEP) floodway.

Council also refers to its recently adopted Green Grid document that has not been addressed in the EIS. It notes that proposed recreational connections to Kemps Creek corridor should be identified and enabled whether the recreational facility to the west proceeds or not. It also supports a walking trail with heritage satellite dishes and interpretation provided it is part of an open space recreational network.

Response

Sydney Water notes Penrith City Council's support for the green space area and public accessibility and notes its recent Green Grid Strategy has been finalised since the EIS was prepared. Sydney Water also notes Council's concerns about potential flooding impacts.

Sydney Water is seeking approval to establish the green space area as part of Stage 1 of the project and is proposing this as an opportunity to contribute to the Wianamatta-South Creek parkland proposed in the Western Sydney Aerotropolis Plan. The EIS provides an indicative concept for this green space area but the full scope of works will be developed as part of the Urban Design and Landscaping Plan (management measure UD01 in Table 15-3 of the EIS).

Sydney Water is seeking approval for the green space area to be publicly accessible for recreation as part of Stage 1 and is working with Department of Planning and Environment (DPE) to understand whether this aligns with their future intentions for the South Creek corridor. Whether or when a public recreation area is delivered here depends on whether the NSW Government supports use of the land for this purpose. Sydney Water supports the NSW Government resolving this issue but considers conditions of approval for this project are not the appropriate pathway to place obligations on other parts of the NSW Government.

If the publicly accessible recreation area is realised, Sydney Water can explore opportunities for links with M12 shared pathways through ongoing consultation with the M12 Motorway project team as part of the Urban Design and Landscaping Plan. Similarly, if adjacent areas along South Creek and Kemps Creek are being established as recreational areas, Sydney Water can also explore opportunities for connection.

Table 4-4 of the EIS (reproduced below as Table 6-6), outlines Sydney Water's principles for urban design of the AWRC site, even if the publicly accessible recreation area is not realised. This includes alignment with various Government plans, policies and strategies that present a vision for South Creek, subject to site constraints such as flooding, airport safeguarding and bushfire protection. As outlined in the table, Sydney Water will also design the site to mitigate visual amenity impacts.

Sydney Water notes Penrith City Council's concerns that the intended use of the green space area is inappropriate in flood prone land. The types of infrastructure proposed in the green space area include pedestrian paths, open water bodies and riparian revegetation works that adopt a similar floodplain roughness to the existing floodplain roughness planning. As noted in section 4.4.1 and management measure UD01 in Table 15-3 of the EIS, flooding is a key constraint that Sydney Water will factor in as design of this area progresses. Sydney Water considers that green space is a suitable use of this land in the floodplain, provided it is designed to avoid adverse impacts on flooding.

Table 6-6 Summary of the urban design themes, principles, and opportunities for the AWRC site

Urban design theme	Urban design principles	Opportunities to be considered in detailed design
Water treatment Safe and sustainable water treatment that addresses the ever-increasing issue of water security and drive awareness and education in water management.	Future proof expansion and the introduction of advanced technologies in water treatment and recycling with a flexible design.	Use natural topography of the site where possible to maximise use of gravity treatment processes.
Resource recovery Generation of: • clean water for recycling • biosolids for beneficial reuse • renewable energy through solar and co-generation.	Maximise opportunities in implementing circular economy approaches. Optimise nutrient recovery through biosolids processing. Maximise ecosystem services opportunities. Minimise waste and maximise reuse. Minimise energy use and maximise energy recovery. Maximise opportunities for stormwater harvesting stormwater runoff.	To be considered as part of design of operational components of AWRC.
Sustainability Showcase innovation and leadership in sustainable water management, energy capture, waste reduction and environmental management.	Minimise off-site impacts of treated water release. Restore and protect waterway health and amenity values; the natural landscape; and biodiversity. Minimise impact of built form and hard surfaces. Demonstrate an integrated functional design and landscape-led design across the site, aligning to the Western Sydney Aerotropolis Plan (WSAP) and Western Parkland vision. Ensure high-quality landscaping that is sympathetic to Western Sydney climate and native environs Maximise integration of water in the landscape to mitigate urban heating and create green and vibrant places.	A range of landscape zones such as riparian corridors, wetlands and grasslands in the parkland area and streetscaping in the operational area. Use landscaping, earthworks, material selection and architectural screening to mitigate visual impact from key viewpoints Landscape design supporting passive or interactive education opportunities (if recreation area progresses). Capture resource recovery and sustainability principles in architectural design.

Urban design theme	Urban design principles	Opportunities to be considered in detailed design
Community Continue to contribute to the site's rich cultural and environmental context, playing an important role in the future of Western Sydney.	Maximise opportunities for partnership with local community and businesses, including Aboriginal communities. If recreation area proceeds, provide quality public amenity by connecting into existing and future recreational and social infrastructure and networks.	Celebrate Aboriginal and non-Aboriginal heritage on the site. Consider opportunities to co-design features or architectural treatment with community and stakeholders where appropriate. Retain select existing heritage features such as parabolic antennas associated with Fleur's Radio Telescope for use in the landscape. Align layout to celebrate the cross formation of the former radio-telescope array.
Built environment approach A unique opportunity to positively integrate with the natural environment and urban fabric of the Western Parkland City.	Built form responds to the contextual landscape and future urban character. Design accommodates the functional properties of the AWRC. Address aerial views experienced by passengers departing and arriving at the new airport. Minimise negative environmental impacts. Embody the urban design principles of surrounding district and precinct plans.	Quality and sustainable architecture for the administration building. Set the administration building within its landscape and incorporate open spaces, natural lighting and ventilation. Unified architectural language across the site, for example in cladding and screening.

6.4.4 Project description - sustainability opportunities

Issue description

Penrith City Council encourages inclusion of key opportunities on page 9 of the EIS into Stage 1 of the project and requests further detail of which beneficial uses will be implemented and delivered as part of the project. It notes a strong encouragement for Sydney Water and DPE to identify and scope these opportunities and progress any consents or approvals under the *Environmental Planning and Assessment Act 1979* (EP&A Act). Council also notes that circular economy opportunities identified in the EIS should be explored in greater detail and delivered over the life of the project. It encourages Sydney Water to work with key stakeholders in the market to develop plans for future energy generation, procurement and resource recovery at the AWRC to maximise circular economy initiatives and enable future technologies to improve overall sustainability performance.

Response

Table 6-7 outlines which of the key opportunities on page 9 of the EIS are in and out of scope of this project. Some of the out of scope opportunities may be delivered while Stage 1 of the project is operating, but as separate projects with separate planning approvals. Planning for the out of scope opportunities is not far enough progressed to seek consents or approvals as part of this project.

As noted in section 3.5 of the EIS, Sydney Water is continuing to explore a range of future circular economy opportunities outside of the scope of the current project. Section 12.1.5 of the EIS also notes future sustainability measures Sydney Water is exploring outside the scope of the current project. Delivery of these will be subject to a range of factors including commercial decisions, business cases, technology, market forces and planning approvals. The current project represents a foundational element for circular economy opportunities which can be built on over time.

Table 6-7 Circular economy opportunities in and out of project scope

In project scope	Out of project scope
High-quality treated water for environmental flows in waterways	Recycled water schemes to supply industry agriculture and to complement stormwater in irrigating open spaces. The AWRC will produce suitable water but the schemes are out of scope.
Organic material recovered during wastewater treatment process	Bioenergy hub for waste collection, reuse, resource recovery and renewable energy generation
Renewable energy from co-generation and solar energy generation	

6.4.5 Project description - education hub

Issue description

Penrith City Council proposes an Education Hub be established on the AWRC site for public access and school groups, to align with Sydney Water's Western Sydney Regional Master Plan and to support the Western City Deal's commitment to education opportunities and job creation. Council notes this would also present an opportunity to exhibit Sydney Water's investment in future infrastructure needs, sustainability of growth in Western Sydney and alignment with Infrastructure NSW's Smart Place and Smart Infrastructure Policy.

Response

As outlined in section 4.4 of the EIS, Sydney Water is proposing a range of community opportunities for the green space area at the AWRC site, including heritage interpretation, recreational use, walking/cycling connectivity and informal outdoor educational opportunities. Sydney Water is not currently proposing a Visitors Centre as part of project scope.

Sydney Water has other educational facilities in Western Sydney such as an educational van and a Visitor Centre at a small-scale purified recycled water demonstration plant at the Quakers Hill Water Recycling Plant, to help educate the community on water literacy.

6.4.6 Issues beyond the scope of the project - bioenergy hub

Issue description

Penrith City Council notes that it does not support a Bioenergy Hub at the AWRC site for waste collection, reuse, resource recovery and renewable energy generation. Council notes that although this aligns with multi-utility principles, details of waste streams and impacts would need to be reviewed given the AWRC site is in an environmentally sensitive area, adjacent to creeks.

Response

A Bioenergy Hub is not part of project scope. Sydney Water has referenced a Bioenergy Hub at the AWRC site as a potential future opportunity enabled by the project. If this opportunity progresses, details of waste streams and impacts would be addressed as part of future environmental impact assessment and planning approvals.

6.4.7 Issues beyond the scope of the project – stormwater management

Issue description

Penrith City Council encourages a proactive and integrated approach for stormwater management in the Aerotropolis.

Response

Stormwater management in the Aerotropolis is not in project scope for this planning approval. Separate to the project, Sydney Water intends to implement servicing that integrates stormwater with recycled water in initial Aerotropolis precincts.

6.4.8 Issues beyond scope of the report - servicing area

Issue description

Penrith City Council considers the project provides an opportunity for the villages of Luddenham and Wallacia (currently in Priority Service Areas) to be included in a reticulated system.

Response

As outlined in section 4.14.1 of the EIS, the wastewater collection network is out of scope for the project. However some information is included below about Sydney Water's investment approach to wastewater servicing and the status of wastewater servicing for Luddenham and Wallacia.

Sydney Water's plans for the roll-out of water and wastewater services aims to keep pace with rezoning of land for new housing and development. Sydney Water can fully fund the planning, design and delivery of trunk infrastructure to support the NSW Government's programs for land release and new development.

While Sydney Water endeavours to meet everyone's needs, investment needs to be timed appropriately to safeguard existing customer services, meet new customer demand and demonstrate to the Independent Pricing and Regulatory Tribunal that funds are spent prudently and efficiently.

Sydney Water works with all planning authorities, government agencies, and private sector partners to help determine the optimal water and wastewater servicing solutions to support growth and development in Western Sydney.

Sydney Water is also working to meet the Western Parkland City vision and is planning to deliver integrated water services for the Aerotropolis and surrounding precincts. However, it is important that Sydney Water delivers infrastructure to meet development timeframes and works closely with other agencies to ensure it is servicing the right areas at the right time. As part of this, Sydney Water is progressing with planning to provide wastewater services to the Agribusiness Precinct, including Luddenham Village, by 2026. This includes Luddenham Village west of Northern Road.

Although Sydney Water does not generally service existing significant rural areas, the Priority Sewerage Program (PSP) is focused on providing improved wastewater services to existing unsewered urban villages in areas of high environmental sensitivity. Part of Wallacia is serviced by a PSP scheme. However, Wallacia is not within a growth area and ultimate and annual future growth projections for the area are unknown. Sydney Water is happy to work with the NSW Government to investigate growth opportunities and will continue to monitor for further information or changes in land use.

6.4.9 Strategic context - alignment with strategic planning

Issue description

Penrith City Council notes that the Phase 2 Development Control Plan (DCP) for the Aerotropolis is currently on public exhibition and the EIS should be updated to detail how design of the AWRC has considered the DCP, particularly in relation to airport safeguarding and tree planting controls.

Response

As noted by Penrith City Council, DPE released the draft Western Sydney Aerotropolis Development Control Plan – Phase 2 (Phase 2 DCP) for exhibition in October 2021. This document would supersede the Phase 1 DCP. At time of writing, this DCP remains a draft. The draft Phase 2 DCP applies to development applications under Part 4 of the EP&A Act and therefore does not apply to the project, which is assessed under Part 5 of the EP&A Act.

The Phase 2 DCP includes more detailed and refined objectives than the Phase 1 DCP, although the general themes are consistent across both documents. Appendix B of the EIS considered project alignment with the general performance outcomes in the Phase 1 DCP and that assessment remains relevant to the draft Phase 2 DCP.

The draft Phase 2 DCP includes provisions around enhancing tree canopy, protection of biodiversity and includes preferred plant species to be used in the future development of the Aerotropolis. The project is not seeking to subdivide or develop land in a manner that would require a detailed analysis of street tree requirements in accordance with the DCP. The project includes the installation of pipelines through the area to which the DCP will apply when in force. The green space area on the AWRC site is also located in the area covered by the DCP. Sydney Water has assessed the project's impacts on biodiversity in detail in section 9.1 of the EIS and outlined the ways in which it has sought to minimise impacts in sections 3.3 and 3.4. Sydney Water has also included a range of management measures in Table 15-3 of the EIS to further manage and minimise impacts on biodiversity (measures TB01-TB10). In relation to tree planting controls, Sydney Water has amended management measures G05 and UD01 in Appendix B to reference consideration of the tree planting controls in the Phase 2 DCP in developing the project's Rehabilitation Management Plan and Urban Design and Landscaping Plan.

The draft 'Aviation Safeguarding Guidelines – Western Sydney Aerotropolis and surrounding areas' was also released with the draft Phase 2 DCP. Sydney Water has reviewed these guidelines in line with the impact assessment provided in section 13.1 of the EIS. Sydney Water considers that the project aligns with these draft guidelines and further consideration is provided in section 5.18.2 of this report.

6.4.10 Stakeholder and community engagement

Issue description

Penrith City Council recommends robust and regular community consultation, including regular and detailed updates on work locations, timelines, details of community information sessions, where information can be found and contact details. It also notes that in finalising detailed design and operational plans, consultation with relevant stakeholders should be undertaken to ensure design and operation of the AWRC continues to meet water quality objectives and impacts are identified and managed.

Council also notes it is important the monitoring of proposed geomorphology impacts is done in consultation with relevant stakeholders in affected reaches of the waterways.

Response

Sydney Water is committed to ongoing consultation with the local community and stakeholders as the project progresses. Management measure G08 in Table 15-3 of the EIS commits to this ongoing consultation as part of Sydney Water's Community and Stakeholder Engagement Plan. This would include consulting with relevant stakeholders during design, construction and operational planning (including monitoring of potential geomorphology impacts).

6.4.11 Design requirements

Issue description

Penrith City Council notes that the EIS is not detailed enough to fully understand the location and design dimensions of pipelines and related infrastructure, and is concerned that minor pipeline realignments are being considered. It also notes that detailed design of AWRC structures is not provided and requests architectural and landscape plans for the site. Council also requests visual impact analysis of structures on the AWRC site including the administration building, solar collectors, structures above 20m and 30m and reflectivity of materials.

Response

The detailed design phase of the project has not yet started. It is during this stage that the specific details including design dimensions and related infrastructure will be determined. Section 4.13 of the EIS outlines the flexibility proposed for the project. Any changes to project alignments would need to align with the proposed flexibility. Sydney Water's general principle for flexibility is that changes to design, construction and operation will be consistent with or better than the environmental impact, environmental performance outcomes and management measures described in this EIS. Sydney Water has assessed several minor pipeline alignment changes as part of an Amendment Report for the project (Sydney Water, 2022) and any future changes would be assessed for consistency with the EIS and modifications to the approval would be sought if required.

Section 4.4.1 of the EIS outlines the urban design standards and elements for the AWRC. This includes Figure 4-4, 4-8 and 4-9 of the EIS that give indicative visualisations of the AWRC and green space areas. Table 4-4 of the EIS also outlines the urban design themes, principles and opportunities for the AWRC site. More detailed architectural and landscape plans have not yet been developed and will be part of detailed design.

Section 11.3 of the EIS includes a landscape character and visual impact assessment of the project. Table 11-27 in the EIS provides a summary of the visual impact of the AWRC during operation from a range of surrounding viewpoints and receptors.

The design of the AWRC will continue to evolve and develop throughout the detailed design phase. Management measure UD01 in Table 15-3 of the EIS commits to preparing an Urban Design and Landscaping Plan for the AWRC site that aligns with the principles in Table 4-4 of the EIS.

6.4.12 Impacts on Wallacia township – heritage, biodiversity, landscape character

Issue description

Penrith City Council notes the importance of limiting impacts on Wallacia township:

- Wallacia is significant for scenic and landscape quality and heritage. There are heritage listings in the area, including a cluster around Park Road and Greendale Road. The area is also significant to Aboriginal people and the likelihood of encountering items of cultural significance is high.
- Open trenching along Park Road will remove native trees and vegetation that contribute to local character, scenic, landscape and biodiversity values and local amenity.
- Open trenching details at creek crossings should be detailed and impacts (noise, vibration, sediment and erosion, earthworks, civil works, night works, lighting) on sensitive flora and fauna should be addressed, including platypus which have been sighted in these waters and riverbanks.
- It also notes the entry gateway to Wallacia Village is significant in Council's plans.

Response

Penrith City Council's comments about the importance of limiting impacts to the Wallacia township and the importance of the entry gateway are noted. The following provides a response to specific points raised:

- The Aboriginal and non-Aboriginal heritage impacts of the project have been assessed in the EIS in Appendix O (Aboriginal Cultural Heritage Assessment Report) and Appendix P (Statement of Heritage Impact) respectively. Where the project has been identified as potentially impacting heritage the project has sought to avoid these impacts in the first instance and minimise these impacts where they cannot be avoided. In addition, management measure AH02 in Table 15-3 of the EIS includes preparation of a Heritage Management Plan for project construction that will incorporate an unexpected finds procedure.
- Sydney Water's general approach for pipeline construction is to use a trenched methodology for safe, fast and efficient construction which is described in Chapter 4 of the EIS. Sydney Water has sought opportunities to select or refine the treated water pipeline construction footprint as far as practical to avoid and minimise environmental and community impacts. These are detailed in section 3.4.2 of the EIS and include avoiding some stands of sensitive vegetation along Park Road.
- Where avoiding the removal of native vegetation is not possible, management measure G05 described in Table 15-3 of the EIS commits to implementing a Rehabilitation Management Plan to restore pipeline worksites. Measures in the plan will ensure areas of native vegetation are rehabilitated to the highest ecological condition possible and

opportunities will be investigated to reduce impacts to streetscape character and visual amenity where street trees cannot be replaced like for like.

- Section 4.9.3 of the EIS described the methodology for open trench construction at creek crossings. Potential impacts, as noted by Penrith City Council, to sensitive flora and fauna have been addressed as follows:
  - The Aquatic Ecology Impact Assessment (Appendix H of the EIS) assessed impacts from sediment and erosion and earth works (including civil works).
  - The Biodiversity Development Assessment Report (Appendix J of the EIS) assessed impacts from noise, vibration, sediment and erosion, earthworks, civil works, night works and lighting.
  - The World Heritage Assessment (Appendix Q of the EIS) assessed the potential impacts on platypus in Nepean River.
- Management measures have been developed to mitigate any potential impacts and these will be further detailed in the Construction Environmental Management Plan (CEMP) and specific management plans including the Biodiversity Management Plan. Management measure TB06 in Table 15-3 of the EIS requires the engagement of qualified ecologists to undertake pre-clearance surveys prior to vegetation clearing or trimming. This includes the banks of watercourses.

6.4.13 Flooding – general

Issue description

Penrith City Council considers that, based on the comments relating to the flood impact assessment the proposed development cannot be supported as EIS does not adequately assess flood impacts and parts of the proposal are located in South Creek floodway defined in Council 2015 flood study.

Response

The AWRC TUFLOW flood model has been used to provide a reasonable basis for comparing pre and post development flood impacts for a range of flows up to and including the Probably Maximum Flood (PMF) event. It is not the intention of the modelling to exactly match the results of Penrith City Council's 2015 flood study or define flood planning levels for the AWRC.

Hydrographs for Kemps, South and Badgerys Creeks provided by Infrastructure NSW (INSW) have now been modelled as adopted for the 1% AEP event in the Penrith City Council's 2015 study. This assessment is included in Appendix C. This provides a basis for existing scenario flood behaviour in a range of flows as well as the PMF event flows which are comparable to those used in the Penrith City Council's 2015 study. Sydney Water's responses to specific comments on this topic are addressed in the sections below.

6.4.14 Flooding at the AWRC site - alignment with Penrith City Council flood study

Issue description

Penrith City Council raises a range of concerns about the flood modelling completed for the project and alignment with Penrith City Council's adopted South Creek Flood Study (WorleyParsons 2015a) and the NSW Floodplain Development Manual (DPINR 2005). Table 6-8 addresses each of the issues raised.

Response

Sydney Water notes that several comments from Penrith City Council relate to calibration and validation of the AWRC TUFLOW model described in Appendix L which are similar to issues raised by DDPE Biodiversity and Conservation (BCD). Calibration and validation are discussed in detail in section 5.4.1 of this report.

Table 6-8 Response to Penrith City Council comments on alignment with council flood study

Issue raised	Response
ARR used Penrith City Council notes that the 1D/2D hydraulic model has been undertaken using TUFLOW based on Australian Rainfall and Runoff (ARR) 2016 utilising a 10m grid resolution. It seems that this model did not follow the Floodplain Development Manual requirements. Penrith City Council's preference is to use the existing Council's adopted South Creek Flood Study 2015 model.	The modelling undertaken for the flood impact assessment in Appendix L of the EIS is based on recent topographical information (2019 LiDAR data) and uses a three metre grid resolution. The hydrology was developed using ARR2019. Sydney Water notes that reference to ARR2016 in Appendix L of the EIS is an error and that ARR2019 has been used for hydrology inputs. Sydney Water considers that the assessment in Appendix L meets the requirements of the Floodplain Development Manual. This is because the AWRC reference design uses Penrith City Council 2015 adopted flood model to set flood planning levels and locate the AWRC outside Penrith City Council's 2015 1% AEP existing flood extent. This means there is no encroachment into the floodplain and no impacts to existing flood behaviour. The modelling described in Appendix L has used the Floodplain Development Manual to guide the modelling approach so that the AWRC TUFLOW model is appropriate to assess flood impacts (the relative change in flood level). Sydney Water has undertaken further assessment in Appendix C which addresses Penrith City Council's concerns on the flows used in the AWRC TUFLOW model.
Flow rates used	The assessment described in Appendix L of the EIS does not aim to compare existing scenario results

Issue raised	Response
Penrith City Council raises concerns that there is no comparison for existing scenario between two flood model results to fully understand difference in flood levels and the reason behind using lower flow rates not appreciated. All results should be sourced from Council 2015 study so flood impacts of AWRC can be investigated and fully assessed. The Flood Impact Assessment keeps referring to Council adopted South Creek FS 2015, while the results presented are based on completely different modelling parameters. There is no comparison for existing scenario between the two flood model results to fully understand the difference in flood levels. Also, the reason behind using lower flowrates is not fully appreciated. The results for the existing case should be sourced from Council adopted South Creek Flood Study 2015 so the Flood Impact Assessment of the proposed WARC can be investigated and fully assessed. Currently, the Flood Impact Assessment using lower flowrates and assess the pre and post scenarios. The Flood Impact Assessment did not show the full impact of the proposed WARC using Council adopted flood results. Penrith City Council notes that Table 4-8 shows modelled flow rates for all design events well below Council 2015 study - provides some examples and notes these are massive differences and cannot be accepted. Notes for consistency, same flow rates modelled in Council 2015 study should be adopted in AWRC TUFLOW model along with ARR1987 to establish flood behaviour for existing scenario. Chapter 6 of Appendix L Part 1 documents the WARC modelled existing flood behaviour results using ARR2016 guidelines. These results are with lower design flowrates. WARC model adopted lower flowrates for the estimation of flood levels, and hence resulted lower flood levels. The flowrates modelled in Council South Creek FS 2015 must be used by the WARC TUFLOW model together with the ARR1987 guidelines. The existing scenario is not correctly defined	from the AWRC TUFLOW model with Penrith City Council's 2015 adopted flood model. This is because the AWRC TUFLOW model uses ARR2019 (which is industry best practice) and more recent topographical data so differences in modelled flood levels are expected. Sydney Water reiterates that Penrith City Council's 2015 adopted flood extent has been used to inform the AWRC reference design so that the AWRC operational area and detention basins are located above Penrith City Council's 2015 adopted 1% AEP flood extent. This means that for the pre and post development scenario there is no encroachment on the 1% AEP floodplain, no changes to conveyance or flood storage within the flood plain. The validation exercise described in Appendix L of the EIS was undertaken using ARR1987 only to enable comparison between the AWRC TUFLOW model and Penrith City Council's 2015 adopted flood model. Table 5-2 Response to DPE BCD comments on existing case flood model validation and calibration and Appendix C in this report provide further clarification on validation and calibration (including different modelling parameters). A discussion on flow differences (Table 4.8) is provided in section 4.4.7 of Appendix L of the EIS and describes how the ARR2019 1% AEP peak flow yields a lower discharge than the Penrith City Council's 1% AEP adopted peak flow. It also notes the ARR2019 peak flow rates are within the 90% Confidence Limits produced by WMA Water (2019) in that location and show agreement with the flood frequency estimates. ARR2019 is industry best practice, it uses a different modelling methodology to ARR1987 and is not necessarily underestimating flows. It is noted that the ARR2019 1% AEP peak flow rate is considered in modelling described in Appendix L of the EIS but is not used to set flood planning levels on the AWRC site. To address Penrith City Council's concerns on the use of lower flow rates modelled from ARR2019 XP RAFTS as inputs for the AWRC TUFLOW model, Sydney Water has undertaken additional assessment in Appendix C using 1% AEP hydrographs from the *Wianamatta South Creek – Existing Case Report* (Advisian, 2020). These are the same as those

Issue raised	Response
	adopted by Penrith City Council's 2015 flood study. These are the only hydrographs Sydney Water has been able to obtain from INSW. The assessment in Appendix C provides a reasonable basis for defining existing scenario flood behaviour for a range of flows including the PMF event flows (which are comparable to those used in the Council 2015 study).
Range of flood events assessed The hydrology and hydraulic modelling assessed the impacts on flooding conditions of South Creek for a range of flood events from 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and PMF. The assessment did not address the requirement of Flood Development Manual where the impact on existing flood behaviour should be assessed for the full range of flood events including up to the probable maximum flood (refer to Table 3-1 row 31 (b)). For instance, the Flood Impact Assessment did not assess the 5% and 2% AEP design storm events.	The storm events simulated as part of the hydraulic modelling described in Appendix L of the EIS and Appendix C of this report encompass a reasonable range of flood frequencies (10%, 1%, 0.5%, 0.2% AEP) up to and including the PMF to assess the impact on existing flood behaviour. Sydney Water considers this fully addresses the requirements of SEARs 31(b) (Table 3-1 in Appendix L). The NSW Floodplain Development Manual requires the assessment of the full range of floods up to and including the PMF when developing the floodplain management plan. As noted above, the purpose of the study in Appendix L is not to inform a floodplain management plan or set flood planning levels but to assess flood impacts resulting from the development of the AWRC. The assessment in Appendix L of the EIS tested the hydraulic model with flows ranging from 115 to 1,651 m^3/s (including 538 m^3/s which is the 1% AEP event obtained from Flood Frequency Analysis of the Elizabeth Drive gauge reported in the 2020 Advisian Study). These flows correspond to a range of flood events including the PMF. Given insignificant impacts for the range of events considered (10% to PMF), it is expected that other events falling within the range assessed (such as the 5% and 2% AEP events) will result in similar or improved findings. As noted above to address Penrith City Council's concerns on lower flow rates adopted in the AWRC TUFLOW model, Sydney Water has undertaken additional assessment shown in Appendix C and also discussed in Table 5-2.

Issue raised	Response
Critical duration The WARC TUFLOW model was validated against Council South Creek FS 2015 using the ARR1987 and 36-hour critical duration. However, the WARC TUFLOW then modelled the existing and developed scenarios using ARR2016 procedures and 12-hour critical duration. In this case the validation process of the TUFLOW model is questionable as the model has been validated based on different parameters. Appendix L found 12 hour 1% AEP storm and 6 hour PMP storm event are critical storm durations at site. Council 2015 study found 36 hour is critical duration for 1% AEP storm. These could be reasons for differences in flow rates and AWRC TUFLOW should be matched with Council flow rates otherwise existing scenario not correctly defined.	ARR1987 hydrology and a critical duration of 36 hours were only selected for validation to enable a direct comparison of the AWRC TUFLOW model results with Penrith City Council's 2015 adopted flood model. The critical duration of 36 hours is the critical duration for the downstream extent of Penrith City Council's 2015 adopted flood model. The AWRC TUFLOW model described in Appendix L of the EIS used the ARR2019 for hydrology inputs to the AWRC TUFLOW model to define the existing case scenario. The AWRC TUFLOW model adopts a critical duration of 12 hours to reflect the location of the AWRC within the catchment. Sydney Water notes that the purpose and focus of Penrith City Council's 2015 adopted flood study was not the AWRC so the 36 hour critical duration is not relevant to the assessment described of Appendix L in the EIS. The AWRC TUFLOW model described in Appendix L has been refined to better focus on potential impacts at the AWRC site rather than the whole catchment. This is why a different critical duration modelling parameter has been used that is more applicable to the AWRC site. To address Penrith City Council's comments that the existing scenario is not correctly defined, Sydney Water has undertaken additional assessment in Appendix C (and discussed in Table 5-2) using 1% AEP hydrographs from the *Wianamatta South Creek – Existing Case Report* (Advisian, 2020).
Differences in flood levels compared with Penrith City Council 2015 flood study Comparison of 1% AEP flood levels in section 4.4.7, Table 4.7 and Figure 4.11 shows AWRC TUFLOW model results slightly higher than adopted Council 1% AEP flood levels. Difference is in range of 200 mm to 300 mm. Table 4-7 of Appendix L presents difference in 1% AEP flood levels between AWRC TUFLOW and Council 2015 study. Increase in flood levels along South Creek (downstream study area with increase 180 mm), upstream of Erskine Park (increase 330 mm), Badgerys Ck downstream Elizabeth Drive (increase 250mm) and upstream South Creek confluence (increase 210 mm) need second look	Sydney Water has used the 1% AEP flood extent from Penrith City Council's 2015 adopted flood study to inform the project's reference design. This means that the AWRC operational area and detention basins are located above the 1% AEP flood planning level so there is no encroachment into Penrith City Council's adopted existing 1% AEP flood extent. Section 4.4.7, Table 4-7 and Figure 4-11 in Appendix L of the EIS relate to validation of the AWRC TUFLOW model. Sydney Water has provided further clarification on the model validation exercise in Appendix C and Table 5-2. Flood levels reported in Table 4-7 in Appendix L of the EIS are not expected to match Penrith City

Issue raised	Response
as they are beyond acceptable limit. beyond the acceptable limit. Appendix L page 68 reports certain 1% AEP flood levels (listed in submission) that are lower by 0.5 m compared with Council's 2015 study. This difference is a real concern and modelling of existing scenario needs to be revisited to ensure flood levels comparable to Council adopted flood levels. Otherwise, use Council's model to assess flood impacts. Appendix L page 68, specific detail provided on differences between flood levels in AWRC TUFLOW model and Council 2015 study for 0.2% AEP event. Reiterates comment on ensuring flood levels comparable to Council's adopted flood levels.	Council flood study levels, largely because of differences (>0.5 m) in topography from different datasets. The AWRC TUFLOW model uses 2019 LiDAR data and Penrith City Council's 2015 adopted flood model uses ALS data from 2006. This comparison is shown in Figure 4-12 in Appendix L of the EIS and in Appendix C of this report. Given changes in the floodplain since 2006, Sydney Water considers it is best practice to use the more recent 2019 LiDAR data. This means differences in flood level of between 180 mm and 330 mm shown Table 4-7 of Appendix L for some locations are expected and are acceptable. Penrith City Council refers to differences in flood levels for the 1% and 0.2% AEP events. These differences are largely due to previously noted differences in topographical datasets (Appendix C) and differences between ARR1987 and ARR2019 so the AWRC TUFLOW model and PPC's adopted flood model are not expected to yield identical results. However, because the AWRC TUFLOW model will only be used to assess relative changes in flood level, this is acceptable. Additional assessment in Appendix C provides further evidence that the AWRC TUFLOW flood model is fit for the purpose of flood impact assessment.
Gauge 212320 is for South Creek at Elizabeth Drive. Page 39 of Appendix L should be corrected.	Sydney Water notes the error on page 39 of Appendix L of the EIS and agrees Gauge 212320 is for South Creek at Elizabeth Drive.
Appendix L page 40 notes AWRC model calibration should be undertaken in detailed design. Council notes detailed review of model calibration should be undertaken before proceeding with modelling to overcome any uncertainties with model.	Clarifications on ARR2019 XP RAFTS hydrology and AWRC TUFLOW calibration are provided in Appendix C and Table 5-2 of this report showing appropriate calibration has been applied. Sydney Water clarifies that the recommendation in Appendix L of the EIS means that additional calibration should be undertaken if additional data becomes available as this will support further refinement of the AWRC TUFLOW model.

Issue raised	Response
The flood impact assessment report says that "*The flood modelling undertaken was for the purpose of regional flood assessment and not considering the local flooding/runoff in detail*." Local overland flow flooding should also be considered in the AWRC modelling to ensure the proposed development is not affected by major overland flow-path from local catchment.	Impacts to local overland flow were assessed in section 9.2 and Appendix K of the EIS. The project's reference design includes stormwater detention basins to manage increases in peak flows resulting from the increase in impervious area at the AWRC site. Appendix K of the EIS describes modelling to size and test the detention basins which demonstrates that post development peak flows will not exceed pre development peak flows from the AWRC site (management measure SW02 in Table 15-3 of the EIS). The stormwater management system within the AWRC will be designed to manage local overland flow and avoid exacerbating existing downstream flooding conditions in South Creek.
Figure 6.3 shows 1% AEP from AWRC TUFLOW is narrower than in Council 2015 study. Results in Figure 4.11 not compatible with results in Figure 6.3 using same AWRC TUFLOW model.	The purpose of Figure 6-3 in Appendix L is to show the extent of the 1% AEP flood in vicinity of the site based on the Penrith City Council's 2015 flood study compared with the 1% AEP modelled flood extents from the AWRC TUFLOW model. Figure 4-11 shows the differential flood levels between Penrith City Council's 2015 adopted 1% AEP flood extent and the AWRC TUFLOW 1 % AEP flood extent. The differences in topography and modelled approach such as grid size mean that the flood outline does not exactly match.
Hydraulic categories in Figure 6-30 not consistent with hydraulic categories mapped in Council 2015 study. Heading of figure is misleading and incorrect. Figure shows the hydraulic categories based on parameters in Table 6-4.	Sydney Water notes that Figure 6-30 refers to WorleyParsons (2015a) 1% AEP flood extent (Penrith City Council's 2015 adopted 1% AEP flood extent). Figure 6-30 is based on the WorleyParsons 1% AEP flood extent however the floodway flood storage and flood fringe categories have been developed using the equations in Table 6-4 in Appendix L of the EIS. Figure 6-30 has been revised to address concerns that the plan is misleading and is included in Appendix C.

6.4.15 Flooding at the AWRC site – project design details

Issue description

Penrith City Council raises several issues about design at the AWRC site that could impact flooding. Table 6-9 responds to each of these.

Response

Table 6-9 Response to Penrith City Council comments on project design details relevant to flooding

Issue raised	Response
No details on proposed filling of the site are provided in Appendix L (Part 2). Extent and depth of filling in site should be described in appendix.	The post development flood modelling described in Appendix L of the EIS is based on the project's reference design which considers earthworks for the AWRC operational area only. The final design for the AWRC earthworks will be driven by site drainage requirements. Penrith City Council's 2015 adopted flood model has been used to inform the project's reference design. This means earthworks associated with the AWRC operational area do not encroach on the Penrith City Council's 1% AEP flood extent. The modelling described in Appendix L of the EIS assumes no filling in the green space area.
For proposed case Appendix L (Part 2) does not provide details of proposed three detention basins, their proposed drainage features and how they will drain to South Creek. Proposed swale from southern basin will be fully submerged in 1% AEP which may impact on proposed AWRC. Swale is in middle of South Creek floodway and this configuration not supported.	As noted above Penrith City Council's 2015 adopted flood model has been used to define the flood planning area and set flood planning levels for project's reference design (including detention basins). The detention basins are above Penrith City Council's adopted 1% AEP level and have been designed to function with Penrith City Council's adopted 1% AEP flood level as a tailwater. The basins have been designed in accordance with the requirements of Penrith City Council's design guidelines. Section 9.5 and Appendix K of the EIS detail the approach taken to size and test the detention basins to ensure that the post-development peak flow rates do not exceed the pre-development peak flow rates for the 50% and 1% AEP flood events. Sydney Water considers the swale is the best option for discharging across the floodplain given the flat nature of the floodplain. The low grades on the site preclude running pipe drainage underneath

Issue raised	Response
	the floodplain for discharge to South Creek and optioneering did not identify any other practical possibilities. The earthworks associated with the swale (Figure 7-3 in Appendix K) have been modelled in AWRC TUFLOW model and show an acceptable flood impact for a range of flows up to and including the PMF event. Section 4.4.1 of the EIS notes that the type of infrastructure to South Creek will be confirmed during detailed design based on more detailed hydraulic calculations.

6.4.16 Flooding at the AWRC site – design case assessment

Issue description

Penrith City Council raises several issues related to the flooding design case assessment. Table 6-10 responds to each of these.

Response

Table 6-10 Response to Penrith City Council comments on flooding design case assessment

Issue raised	Response
Fig 6.37 shows design case 1% AEP FFA peak flood levels and depths. Proposed filling of site encroaches the flood extent on eastern side causing minor localised blockage and displacement of flow. Report failed to quantify impact on flood levels for this event.	The magnitude impacts on flood levels at the eastern side of the site are quantitatively presented in section 7.2.4.8 and Figure 7-10 in Appendix L of the EIS. Figure 7-10 shows the change in flood level for the 1% AEP FFA event which indicates two small localised areas where the water level is reduced by up to 100 mm on the south west boundary and increased by about 30 mm on the north east boundary near Kemps Creek. Section 7.2.4.8 indicates a minor localised change to flow patterns but no overall impact on flood conveyance or flood levels outside of the AWRC site. Sydney Water notes that the AWRC operational area (including detention basins) does not encroach on the 1% FFA flood extent shown on Figure 6-37 in Appendix L.

Issue raised	Response
Under PMF in Fig 6-38, changes in flood levels and depths occur due to elevated pad which results in blockage of flow and loss of flood storage. Report failed to quantify impact on flood levels for this event. Access road is cut in PMF event and three proposed basins will be submerged.	The impacts to flood levels under PMF conditions are quantitatively assessed in section 7.2.4.7 and Figure 7-11 in Appendix L of the EIS. Figure 7-11 shows the modelled change in flood level for the PMF event which indicates a reduction in flood level of up to 50 mm on the south east corner and the northern boundary of the site. A localised increase in modelled flood level of up to 100 mm is shown on the eastern boundary. Section 7.2.4.7 notes that these changes are due to the operational area encroaching into the PMF floodplain resulting in some blockage of flow and some loss of flood storage. Sydney Water notes Penrith City Council's comments that the access road and basins are submerged in the PMF but this is considered acceptable for such a rare event. Sydney Water notes evacuation during operation will be managed in consultation with the SES, as discussed in section 6.4.17.
Proposed filling pad not mapped on Figure 6-53 suggesting site is affected by 1%AEP high flood hazard.	Sydney Water has updated Figure 6-53 to show the proposed AWRC operational area for the 1% AEP FFA event. This is included in Appendix C. Appendix L of the EIS indicates flood hazard categories under the 1% AEP FFA event are similar to the existing scenario because the AWRC operational area is located outside the 1% AEP FFA event. Accordingly, during the 1% AEP FFA event inundated areas within the proposed AWRC site boundary are mostly classified as H1 to H3 and limited areas of H4 and H5 are due to high flow depth or a high combination of flow depth and velocity. Sydney Water notes that Appendix L in the EIS and Appendix C in this report indicate the AWRC site is impacted by the 1% AEP FFA event however the AWRC operational area does not encroach on the 1% AEP FFA flood exent.

Issue raised	Response
Proposed green space area shown in Figure ES3 is located within South Creek 1% AEP floodway. This is not supported	The types of infrastructure proposed in the green space area include pedestrian paths, open water bodies and riparian revegetation works that adopt a similar floodplain roughness to the existing floodplain roughness planning. Figure ES3 presents an indicative representation of the green space area. As noted in section 4.4.1 and management measure UD01 in Table 15-3 of the EIS, flooding is a key constraint that Sydney Water will factor in as design of this area progresses. Sydney Water considers that green space is a suitable use of this land in the floodplain, provided it is designed to avoid adverse impacts on flooding.
Flood impact assessment of AWRC filling pad is based on lower flow rates in Table 4-8. Assessment should consider all flow rates in Council 2015 study for all design events to quantify flood impact from proposed filling pad on flood behaviour.	Lower flow rates in Table 4-8 and impacts resulting from the 1% AEP FFA event and PMF are discussed above. Additional assessment in Appendix C has shown that the AWRC TUFLOW model is appropriate for flood impact assessment and confirms there is no impact on 1% AEP flood behaviour because the AWRC operational area does not encroach on the 1% AEP flood extent.
Flood impact assessment did not include land classified as 'Future Development' in the report. If Sydney Water proposed to have future development for this section of site (including proposed filling) this should be considered in flood modelling and investigation to fully understand the impact on flood behaviour.	Sydney Water notes that reference to ‘future development’ within the EIS means future development of the Western Sydney region where the project is located. Chapter 4 of the EIS refers to ‘future stages’ which is the area with solar panels shown on Figure 4-17. Chapter 4 indicates the future stages will only require expansion of the AWRC as the pipelines will be built to the overall capacity. Flood modelling described in Appendix L of the EIS models the AWRC operational area for Stage 1 and future stages. The AWRC operational area does not encroach on the 1% AEP flood extent as adopted and there is no filling in the floodplain associated with the AWRC site. Sydney Water notes that any development within the AWRC site other than the AWRC operational area and the green space area will be subject separate assessment and approval.

6.4.17 Flooding AWRC site – evacuation

Issue description

Penrith City Council raises the following issues about evacuation from the AWRC site during a flood:

- the AWRC site is affected during PMF and the assessment does not include any discussion on this matter
- a flood evacuation strategy/plan is required.

Response

Sydney Water met with the NSW State Emergency Service (SES) and Penrith City Council in April and May 2021 to discuss flood model outputs, emergency management procedures and evacuation. The SES identified that emergency management would need to include early warning systems and procedures to evacuate the site prior to an extreme event occurring. This would manage the impacts associated with the access road being cut during the extremely rare PMF (Appendix L and section 9.3 also note that the access road is not affected by floods up to the 0.2% AEP event and partially flooded during the PMF). The SES also identified alternative evacuation routes for both the AWRC and the treated water pipeline near Nepean River which were noted in section 9-3 of the EIS. These matters and the approach to managing evacuation during extreme flood events are discussed in Section 7.4 in Appendix L and section 9.3 of the EIS. Sydney Water notes that the SES did not raise any concerns regarding evacuation for the project (for construction and operation) during consultation in April 2021.

Management measure FL01 in Table 15-3 of the EIS commits to preparing a flood preparedness procedure which includes early warning using systems like 'flood watch', identifying evacuation routes, rescue procedures and steps to resume normal operations and actions to be completed before, during and after flood events. FL01 also commits to ongoing consultation with Penrith City Council and the SES.

6.4.18 Flooding - pipelines

Issue description

Penrith City Council raises several issues related to the assessment of flood impacts associated with the project's pipelines. Table 6-11 includes responses to each of these.

Response

Table 6-11 Response to Penrith City Council comments on pipeline flooding impacts

Issue raised	Response
Proposed treated water pipeline crosses several creeks and floodplains and report does not provide	Pipeline construction techniques and general construction methodologies including the construction footprint and a general indication of

Issue raised	Response
details on how deep this pipeline will be and what impacts during construction if flooding occurred.	pipeline depths are described in Chapter 4 of the EIS. Exact pipeline depths will be confirmed during detailed design. Table 7-1 and 7-2 in section 7.1 of Appendix L in the EIS describe potential flooding impacts associated with compounds and pipeline watercourse crossings. This includes consideration of whether construction works have potential to be impacted by the 1% AEP flood event. Table 7-1 and Table 7-2 also identify the flood mapping datasets that were used. Section 7.1.5 and Table 7-3 in Appendix L of the EIS summarise the potential impacts which include obstruction of overland flow paths, loss of floodplain storage and hazardous working conditions. Section 7.1 in Appendix L of the EIS notes that because the duration of construction activities at each crossing location is temporary, the likelihood of a 1% AEP event occurring during construction is very low. However, Sydney Water has committed to several management measures in Table 15-3 of the EIS to address this risk: • management measure G06 commits to preparing construction site layout plans for waterway crossings and compounds that may be impacted by flooding. This includes identifying flood risk and where possible, locating temporary stockpiles and buildings outside the 1% AEP flood extent and away from drainage pathways. • management measure FL01 commits to a flood preparedness procedure for any works near flood prone land.
Table 7-1 needs to revisit sections C5, C6 and C7 of treated water pipeline as these are in floodplains and affected by 1% AEP Nepean River and overland flow flooding. Should be fully analysed and provide adequate details. Table 7-2 needs to be revised considering flooding from local catchment, to understand impact of proposed treated water pipeline on local flood behaviours. Particularly this pipeline crossing several creeks that are treated as mainstream (eg Jerrys Creek, Cosgroves Creek, etc)	Sydney Water considers that adequate details are provided in Tables 7-1 and 7-2 in Appendix L of the EIS for the assessment of temporary construction impacts associated with local (including overland flow) and mainstream flooding. The analysis is based on NSW SES floodplain mapping. Table 7-1 in Appendix L identifies that compounds C5, C6 and C7 are located in the Hawkesbury-Nepean catchments and are not impacted by the 1% AEP flood event so are therefore unlikely to impact on floodplain storage during construction. Table 7-2 identifies waterway crossings potentially

Issue raised	Response
	impacted by mainstream flooding (1% AEP flood extents) which includes the crossing at Jerrys Creek. This table also identifies some waterway crossing locations (including Cosgroves Creek) that are not impacted by the 1% AEP flood extent. Section 7.1.5 in Appendix L of the EIS also identifies potential temporary impacts from construction activities that may change local flood behaviours such as blocking overland flow or increasing flows due to surface compaction. Given the treated water pipeline will be underground, impacts to mainstream flooding or local overland flow are not expected during operation. As outlined in the response in the previous row, management measure G06 in Table 15-3 of the EIS will manage these temporary impacts including impacts to local overland flow.

6.4.19 Design requirements, hydrodynamics and water quality - flows to Nepean and Warragamba Rivers

Issue description

Penrith City Council raises concerns about additional flows to the Nepean and Warragamba Rivers upstream from pristine sections of the river that have high economical, recreational and biodiversity values. Specific impacts to recreation are discussed in separate issues below, however in general Council:

- notes the project should be designed to reduce wet weather and severe wet weather primary treatment and disinfection only flows through a combination of greater holding capacity, greater advanced treatment and tertiary treatment
- considers the treated water releases are a significant change to baseline flows, particularly the flow and nutrient regime. Council also notes that although the standard of treatment is reasonably high, the water will contain higher concentrations of nutrients and toxicants such as pharmaceutical and other chemical residues. It also notes that in extreme wet weather wastewater will only be treated at primary level (screened) and released into South Creek. Council requests further clarification and detail on these matters.

Response

Consideration of improved treatment and storage

Sydney Water notes that options to manage wet weather flows on a system-wide basis have been considered. This included storage and increasing the capacity of the advanced treatment plant. Options considered are summarised below:

- Provision of full advanced treatment to all wet weather flows at the AWRC. This is not feasible in this system since the treatment process needs consistent flows to operate effectively. If the AWRC was built to cater for (or store) infrequent wet weather flows, it would need to be several times larger, and its full capacity would rarely be used. As a result of these considerations, it is standard practice for wastewater treatment plants to provide reduced levels of treatment for incoming flows greater than normal dry weather flow thresholds.
- Storage of the wet weather flows in the network and progressively feeding them into the AWRC treatment process after the wet weather event is not considered feasible due to the high cost and space requirements for storage of such significant flow volumes across the network.
- Designing a low infiltration wastewater collection network to allow no more than 2% inflow and infiltration of stormwater is the most efficient and cost-effective approach to managing wet weather flows, and is considered industry best practice.

Further information about wet weather storage and releases to South Creek is provided in section 5.10.2.

Impacts to baseflows

Treated water flows to Nepean River will contribute to a rise in baseflows. Median flows in the river at Wallacia Weir are about 229 ML/day. Stage 1 of the AWRC will contribute up to 50 ML/day at full capacity. The Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) and the Ecohydrology and Geomorphology Impact Assessment (Appendix G of the EIS) assessed the impact of these additional flows in the river and concluded the following:

- The releases will result in a more consistent flow regime downstream of Wallacia Weir.
- The AWRC releases are predicted to result in moderate increases in water surface elevation upstream of the Wallacia Weir. Downstream of the weir, increases to water surface elevation are predicted to be minor.
- Changes to velocity and shear stress are generally minor, with one area showing a localised increase through a steep riffled section.
- Overall, predicted hydraulic and geomorphic impacts are considered minor.

In addition to these conclusions, the following points are also noted:

- With projected drying pressures under climate change future scenarios (eg extended drought periods), supplementing baseflow conditions with AWRC releases may help buffer against extreme low flows and the development of stratified river pools, with potential benefits for biota and reducing cyanobacteria risk at these times.
- Treated water flows to Warragamba River will be in accordance with WaterNSW releases from Warragamba Dam and are therefore not expected to impact existing baseflows.
- Treated water releases to South Creek will only occur in wet weather and will have a negligible impact to baseflows.

Impacts to nutrient concentration and toxicants

The potential impacts to nutrient and toxicant concentrations (including pharmaceuticals) as a result of treated water releases to South Creek, Nepean River and Warragamba River were assessed and reported in the Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS). Table 6-12 summarises the results for each waterway.

Table 6-12 Summary of predicted changes in nutrient and toxicant concentrations

Waterway	Predicted changes in nutrient concentrations	Predicted changes in toxicant concentrations
South Creek	• Short term reduction in nutrient concentrations when releases dominated by advanced treated water. • Episodic short term increases in some nutrients during severe wet weather impacts. • No change predicted to annual median concentrations.	Primary mixing zone criteria cannot be achieved during severe wet weather release events for ammonia and total chlorine. However, the potential for toxicity and environmental harm arising from these releases is considered low due to the infrequency of the events and typically short duration.
Nepean River	• Reduction in total nitrogen, total phosphorus, filterable reactive phosphorus. • Increases to oxidised nitrogen and ammonia. • Short term increases in nutrients predicted in wet weather when tertiary treated water is released.	Primary mixing zone criteria cannot be achieved during severe wet weather release events for aluminium, copper, manganese and zinc. However, the potential for toxicity and environmental harm arising from these releases is considered low due to the infrequency of the events and typically short duration.
Warragamba River (environmental flows pipeline)	• Marginal reductions in total nitrogen. • Limited increases to oxidised nitrogen, ammonia, total phosphorus, filterable reactive phosphorus.	Only advanced treated water will be released to Warragamba River. Toxicants are unlikely to be present in advanced treated water.

Overall, adverse water quality impacts are generally limited to periods of wet weather, when tertiary treated water is released to the Nepean River and either advanced treated water, or a blend of advanced and primary treated water is released to South Creek.

Treatment during extreme wet weather

During wet weather, when flows to the AWRC are greater than 1.7 x Average Dry Weather Flow (ADWF), treated water will be released to South Creek. Initially this will consist of advanced treated water only. When flows to the AWRC reach 3 x ADWF, the capacity of the advanced and tertiary treatment will be exceeded. At this point, releases to South Creek will consist of a combination of advanced and primary treated water. The primary treatment will include disinfection. These releases are predicted to occur, on average, two to three times per year, but frequencies may vary between zero and six events per year.

Similarly for the Nepean River, in more extreme wet weather, when incoming flows to the AWRC are greater than 1.7 x ADWF, the level of treatment provided to the releases will be carefully managed based on the capacity of the AWRC. Initially the releases to Nepean River will consist of a blend of advanced and tertiary treated water. The fractions of each stream will depend on the availability of advanced treated water, which will preferentially be released to South Creek. When flows to the AWRC reach 3 x ADWF, the releases to the Nepean River will consist of tertiary treated water (including disinfection). These releases are only predicted to occur, on average, two to three times per year, but frequencies may vary between zero and six events per year.

Further details about the release strategies are presented in section 4.6.3.5.1 of the Hydrodynamic and Water Quality Impact Assessment in Appendix F of the EIS.

6.4.20 Hydrodynamics and water quality - recreation in Nepean River

Issue description

Penrith City Council notes the importance of Nepean River (downstream of Wallacia Weir to Penrith Weir) for recreation including boating, fishing, rowing, kayaking, swimming and other activities. Council also notes works it has done to allow greater public access and enjoyment of the area.

Council refers to its River Watch Program which has been running for five years and monitors water quality between October and March. Council notes that its monitoring shows river grade is poor (but suitable for swimming) and considers there is a risk the project could cause water quality decline (from poor performance of wastewater treatment plant, partial treatments and failures) changing this to very poor. It also raises concerns that days unsuitable for swimming after rain could increase above the current three days, particularly as a result of the treated water releases moving pathogens from other sources (such as agriculture or septic systems) downstream into swimming areas. Council also notes that red alerts for blue-green algae are currently not common (that is where primary contact recreation is not advised), although green and amber alerts occur more frequently.

Council notes that if modelling is not robust or has gaps in information then short or long term impacts could be different than predicted. Particular notes about the modelling are:

- If background data used in the model is from the last two years it may not be representative of regular conditions given bushfires and floods in the catchment.

- If fewer than 100 samples were used for modelling 95%ile enterococci as specified in NHMRC guidelines then data may not be representative and result in erroneous conclusions.
- Although EIS modelling suggests this is unlikely, Council is concerned that the increase in bioavailable nitrogen and cumulative impacts from the catchment could result in escalation of green and amber blue-green algae alerts to red alerts and restrict primary contact recreation.

Council requests a detailed response to these matters and a justification of assumptions.

Council also notes that the lower level of treatment (tertiary) and release to Nepean River are not ideal given any decline in water quality could trigger algal blooms, increased aquatic weeds and risk to primary contact recreation. Council also note the risk of toxicants such as pharmaceutical residues entering river which can impact aquatic ecology, such as fish reproduction from increased hormones in the water.

Response

Sydney Water appreciates the importance of the Nepean River to the community, including for recreational use. As a result, recreation and aesthetics were captured as a value in the waterway objectives identified for the project. The management goals set for this value are to maintain or improve water quality for recreational activities such as swimming, boating and fishing and maintain or improve the aesthetic qualities of the waterways.

Calibration and validation of the EIS water quality models

For the EIS, hydrodynamic and water quality models were developed and applied to analyse the impacts of treated water releases from the AWRC. These Water Quality Response Models (WQRMs) took into account the bacterial contributions from a comprehensive set of diffuse and point sources, representative of the Nepean River catchment. With application of industry best practice approaches, the Hawkesbury Nepean WQRM was calibrated and validated across four years of monitoring data (spanning 2012 – 2018), including a range of climatic conditions. The years selected for calibration and validation of the WQRM were therefore not influenced by bushfires and floods in the catchment.

While there was significantly less monitoring data available for pathogenic indicators compared to the other water quality parameters, the Hawkesbury Nepean River WQRM generally correlated well with the field data collected. The calibration of the WQRMs was also peer reviewed by the University of New South Wales. Both the calibration report and independent review documentation are available upon request from Sydney Water.

Importantly, for the impact scenarios, the models were run over two distinct climatic years with a ‘time step’ of a few minutes. For each time step, the concentrations of enterococci were calculated at every point throughout the model mesh. As a result of these intensive calculations, the issue relating to 100 samples is not considered as a relevant limitation to the analysis. It is however significant in terms of how the model results are compared to the guidelines (ie the 95th percentile of the model results should be compared against the National Health and Medical Research Council (NHMRC) guideline values).

Analysis of recreational water quality

With respect to recreational waters, the focus is typically placed on the levels of bacteria and pathogens within the waterways. As outlined in the NHMRC guidelines, these generally guide how safe it may be to undertake both primary and secondary contact recreational activities. This is similarly demonstrated in Penrith Council's Recreational Water Monitoring Program which includes weekly bacteria testing of enterococci in the warmer months. Results are assessed applying the NHMRC guidelines to provide an understanding on the suitability of sites for swimming.

River water quality is typically influenced by a range of activities and conditions within the catchment. These can include diffuse sources such as agricultural runoff and urban stormwater through to point sources such as septic systems, overflows from sewer systems and releases of treated water from Sydney Water's treatment plants. With respect to bacteria/pathogens (particularly enterococci analysis), all these influences are present and relevant for the Nepean River.

Impacts from Sydney Water's existing treatment plants

Wet weather events often contribute to poor conditions within the river's recreational waters. This is generally a result of additional runoff and pollution upstream of the sites.

Sydney Water emphasises that releases of treated water to the Nepean River, from its wastewater treatment plants present a very low risk of bacterial/pathogenic pollution. Disinfection is provided on all releases except in rare events that require bypassing of the disinfection process.

Impacts from the AWRC releases

As discussed above, the modelling for the EIS included high frequency simulation of water quality parameters throughout the Hawkesbury Nepean River. In line with industry best practice as well as Sydney Water standards, all releases at Wallacia from the AWRC will be treated to ensure minimal pathogenic content (ie <1 cfu/100mL) is present in the treated water releases.

Due to these extremely low levels of bacterial/pathogenic content in the AWRC releases, concentrations of enterococci were predicted to be lower in the reaches within, and downstream of, the Wallacia Weir. The addition of the treated water effectively has a cleansing effect, diluting the bacteria concentrations that have entered from other sources.

Under all scenarios, locations and climatic conditions assessed, the impacts from the AWRC were predicted to have minimal or no impact on enterococci concentrations. This includes the recreational areas of Wallacia Weir, Nortons Basin (refer section 5.4.23) and Penrith Weir.

Reductions in enterococci concentrations were also predicted near, and downstream of the South Creek confluence. Other sites analysed downstream generally showed similar concentrations to background conditions in terms of temporal variations and statistical distributions.

While the NHMRC guideline is not statistically comparable to the modelling results presented, and the model has uncertainties in its predictions, the scenario results indicate that compliance with the NHMRC objectives is likely to be aided by the introduction of the releases from the AWRC when considering both wet and dry weather conditions combined.

6.4.21 Surface water, hydrodynamics and water quality - project options

Issue description

Penrith City Council notes that several options require further consideration as outlined below and requests further justification about why the option was selected and why the options below could not be considered:

- Release locations and quality of wastewater. Council considers South Creek is a more suitable release location than Nepean River because it is already significantly degraded, has limited recreational use and most wastewater generated will be from the South Creek catchment. Council requests a detailed rationale about why South Creek can receive poorly treated wastewater in extremely wet periods but cannot receive advanced wastewater when it is dry. Council considers that the modelling to establish dry weather flows to South Creek would not meet DPE EES waterway objectives does not appear to be robust and that the model acknowledges uncertainty around growth forecasts and development rates. Council also notes it is unclear how mean annual runoff volume (MARV) is so high at 4.2ML/ha/year for existing residential development and land where rezoning is on the way. Council also notes that it would be interesting to further investigate DPE EES objectives for South Creek.
- Alternative release locations. Council suggests that tertiary releases to Nepean River are not ideal and a greater level of protection would be achieved by only releasing advanced treated water to Nepean and Warragamba Rivers. Consideration should be given to alternative release locations including:
  - South Creek
  - Brine pipeline
  - Advanced water into Boundary Creek at Penrith
  - Directing wastewater to St Marys plant

Response

South Creek releases

Sydney Water assessed options based on the assumption that the project should contribute to achieving DPE EES waterway objectives and noting that treated water releases from the AWRC are only one source of flows in this catchment. As noted in Appendix D of the EIS, flow volumes from the AWRC, not treated water quality are the limiting factor in achieving the waterway objectives in South Creek during dry weather, given the high quality of treated water produced. The NSW Government has established waterway objectives to protect and restore South Creek and it is not for Sydney Water to further investigate these objectives as part of this EIS.

Modelling is based on assumptions and there is inherent uncertainty in growth forecasts and development rates which it is not possible to resolve. Sydney Water has led stormwater catchment modelling as part of the NSW Government's Aerotropolis planning. This knowledge was applied to make reasonable modelling assumptions based on best available information to help inform Sydney Water's decision about the release location for dry weather flows. A Mean Annual Runoff Volume of 4.2 ML/ha/yr corresponds to the volume of stormwater runoff expected from a typical suburban development with an average impervious fraction of 65%. An impervious fraction of 65% may be on the low side for lots and streets and this value may be as high as 75% considering previous development typologies. The modelling has adopted 65% using Penrith City Council's MUSICLink software.

The modelling in Appendix D of the EIS confirms that while there may be some capacity for short-term dry weather releases to South Creek, as other catchment flows increase, the objectives would be exceeded if treated water releases to South Creek continued. In addition, dry weather releases could not occur every day of the year due to the waterway objectives requiring 'no flow' days to restore the ecology of South Creek. This limits Sydney Water's ability to release to South Creek during normal dry weather conditions.

This means Sydney Water needs an option to release to a larger waterway. Sydney Water has decided it is prudent to have a release to Nepean River as part of Stage 1 of the project, given the uncertainties about how long dry weather flows to South Creek would be acceptable, the long lead times for building a pipeline and the opportunity to have the pipeline built in the early stages of Aerotropolis development to minimise future disturbance. This investment approach has been endorsed through Infrastructure NSW business cases.

In terms of water quality releases to South Creek, during extreme wet weather the primary treated water would be disinfected and dosed with chemicals to reduce phosphorus levels. It would also be mixed with advanced treated water. These releases also occur when flows in the creek will be higher due to stormwater runoff.

Releases of advanced treated water only

During normal dry weather conditions, treated water releases to Nepean River will be advanced treated water. Based on Sydney Water's modelling, tertiary treated water would be released to Nepean River about 15 - 46 days per year and for most of these events, the releases would also include advanced treated water. It is not feasible for Sydney Water to build a treatment plant that only produces advanced treated water because this treatment process needs consistent flows to operate effectively and is therefore not suitable for infrequent wet weather flows.

In addition, the EIS assessed maximum flow volumes to Nepean River which will be reduced depending on how much water is recycled.

Releases at Penrith or St Marys

The release of advanced treated water to Boundary Creek at Penrith is provided by a pipeline from the St Marys Water Recycling Plant (WRP) where flows from Penrith, St Marys and Quakers Hill are treated to an advanced level. Both the Penrith WRP and St Marys WRP also have local discharge of tertiary treated water, and during wet weather, the St Marys WRP has a bypass of primary treated water. Not all flows are treated through advanced treatment due to the technology constraints outlined above. The Upper South Creek AWRC has been designed to maximise flows treated through the advanced treatment train, achieving treatment of 100% of dry weather flows through reverse osmosis. The St Marys and Penrith WRPs treat over 60% of flows through advanced treatment.

The transfer of water to St Marys WRP was discounted as a preferred option due to the following:

- Site constraints prevent the expansion of the St Marys WRP to provide treatment of all flows from the Upper South Creek AWRC.
- High cost, risk and complexity of all wastewater transfer (including in wet weather) and/or treated water transfer.
- Limitations on the capacity of the discharge point at St Marys to accept the long-term increase in flows from the Upper South Creek Servicing Area.

The transfer of water to Penrith WRP and Boundary Creek was ruled out due to the following:

- Site constraints prevent the expansion of the Penrith WRP to provide treatment of all flows from the Upper South Creek AWRC.
- High cost, risk and complexity of wastewater transfer (including in wet weather) and/or treated water transfer.
- Limitations on the capacity of Boundary Creek to accept the long-term increase in flows from the Upper South Creek Servicing Area, and no difference in flows and loads to the Nepean River compared with the transfer to Nepean River at Wallacia Weir. Advanced treated water into Boundary Creek also flows to the Nepean River.

Releases to brine pipeline (Malabar system)

The brine pipeline will connect to Sydney Water’s Malabar wastewater system. The strategic option of transferring wastewater to the Malabar system was ruled out early in the options assessment process as described in section 3.2.4 of the EIS. This was the base case presented as part of Sydney Water’s strategic business case to Infrastructure NSW. Key reasons to not pursue this option were:

- It represents a lost opportunity to provide advanced quality water for replacement of proposed dam releases, local recycling or purified recycled water for drinking in the future.
- There is a high cost (roughly equivalent to production of high-quality advanced water for use in catchment) associated with upgrade of the coastal system tunnels to meet the increased flow requirements from the Upper South Creek Servicing Area.

6.4.22 Hydrodynamics and water quality - monitoring

Issue description

Penrith City Council notes that the baseline and post-commissioning monitoring program needs to have water quality, aquatic ecology and geomorphic components.

Council suggests monitoring in accordance with EPA licence requirements will not identify changes in river and water from altered flow and nutrient regime nor immediate risks to river users. Council recommends additional monitoring including:

- wireless communication remote monitoring stations and data loggers along the river to provide real time monitoring of chlorophyll *a*, algae, conductivity, dissolved oxygen, pH, turbidity, clarity, total suspended solids, water temp, enterococci, *E.Coli* and any other recreational water quality parameter
- additional sampling and sampling sites monitoring blue-green algae and enterococci in accordance with NHMRC guidelines for recreational water
- additional research facilitated by Sydney Water into transport of pathogens in the river, particularly between Wallacia and Penrith Weir and die off rates of pathogens in the river to better understand risk to those using the river and understand after how many days after rain river is safe for swimming. This should be used to develop and expand Council's existing River Watch program.

Response

Baseline monitoring

As part of the project, Sydney Water is currently undertaking an extensive baseline monitoring program, as outlined in section 8.2.2 of the EIS. Sydney Water has also committed to undertaking post-commissioning monitoring, as outlined by management measures WW23 – WW34 in Table 15-4 of the EIS. This program will monitor the following aspects:

- Water quality upstream and downstream of the release points. This includes the parameters listed by Penrith City Council, with the exception of clarity and total suspended solids (turbidity is considered a representative parameter) and *E.coli* (as enterococci is considered a more representative parameter with respect to primary and secondary contact guidelines under ANZG 2018).
- Aquatic ecology, including macrophytes, macroinvertebrates and fish.
- Potential impacts to geomorphology, including bank and bed erosion monitoring.

Water quality sampling is undertaken every three weeks and sampling for macroinvertebrates and macrophytes is undertaken each autumn and spring. Fish sampling also occurs at nominated sites twice per year. The baseline monitoring program will continue for a minimum of three years. Post-commissioning monitoring will occur for a minimum of two years and up to ten years for some of the geomorphology monitoring measures.

Ongoing monitoring for the project will be consistent with Sydney Water's Sewage Treatment System Impact Monitoring Program (STSIMP). The program is a requirement of Sydney Water's Environment Protection Licences and was developed in consultation with the NSW EPA to identify and quantify environmental impacts associated with Sydney Water's wastewater services across Sydney Water's area of operations. The program aims to monitor the environment within Sydney Water's area of operations to:

- determine general trends in water quality over time
- monitor Sydney Water's performance
- determine where Sydney Water's contribution to water quality may pose a risk to environmental ecosystems and human health.

The extent and timing of the baseline, post-commissioning and ongoing monitoring is consistent with the risks associated with the treated water releases and will ensure that changes due to the project are identified and risks to water users are identified.

Wireless remote monitoring

Penrith City Council recommends wireless communication remote monitoring stations and data loggers along the river to provide real time monitoring. Sydney Water notes that there are limited technologies available to collect instantaneous measurements on all the parameters listed by Penrith City Council. While data loggers or established technology exists to collect online data for chlorophyll *a* and other basic physico-chemical parameters (such as temperature, pH, conductivity), the value of the data collected is highly dependent on the frequency of maintenance and calibration. Sydney Water considers deployment of such equipment is not required given the significant level of monitoring proposed (post-commissioning and as part of the STSIMP), and also given the marginal impacts to water quality identified in the Hydrodynamic and Water Quality Impact Assessment. The structure of the proposed monitoring program is considered appropriate and will allow the impacts from the project to be identified. For example, daily monitoring of upstream and downstream sites is proposed during releases to South Creek (management measure WW32 in Table 15-4 of the EIS).

Blue-green algae and enterococci

Penrith City Council also recommends additional sampling and sampling sites for monitoring of blue-green algae and enterococci in accordance with NHMRC guidelines for recreational water. Sydney Water notes that additional sites are included in the baseline and post-commissioning monitoring program along the Warragamba and Nepean River where an impact may be evident from the releases (refer to Figure 8-1 in the EIS). A three weekly sampling frequency is also considered appropriate to track the temporal variations and trends in blue-green algae. The frequency of monitoring can be increased if there is a site with chronic blue-green algal bloom incidences (amber or red alerts) during warmer months. This has been added to management measure WW23 in Appendix B.

The release of treated water with elevated levels of bioavailable nitrogen can increase the risk of algal blooms, with potential negative impacts on primary contact recreation. As part of water quality modelling of treated water releases, Sydney Water modelled two key indicators, chlorophyll *a* and a cyanobacteria risk index, to assess the risk of algal blooms (in addition to the primary drivers of nutrients, light and temperature). Chlorophyll *a* is an indicator of phytoplankton abundance and biomass, and this is complemented by use of the cyanobacteria risk index that was derived from conditions that are considered conducive to cyanobacteria growth: temperature, salinity, oxidised nitrogen, ammonia, filterable reactive phosphorus, depth and velocity/stratification.

The Hydrodynamic and Water Quality Impact Assessment (Appendix F of the EIS) compared the change in predicted cyanobacteria risk and chlorophyll *a* concentrations between the impact, background and baseline scenarios. Key to the comparative analysis of cumulative impacts from the AWRC releases are the background and impact scenarios.

As a high level summary, the background scenarios represent the catchment and waterway conditions expected for future time horizons (circa 2036 and 2056) including conditions relating to a range of factors such as land use, population growth and associated increases in wastewater treatment plant (WWTP) and WRP releases, extractions. The impact scenarios then represent the same conditions as the background scenarios but with inclusion of the AWRC releases.

Predicted changes in the Nepean River, relative to background conditions, included:

- Reduction in annual medians of chlorophyll *a* predicted between the Wallacia release point and just downstream of the confluence with Warragamba River. Concentrations were predicted to be modified downstream but are predicted to be of similar magnitude to conditions without the releases.
- No overall increase in cyanobacteria risk index predicted.

While minor increases in bioavailable nitrogen were predicted, also of note is the potential influence of the flow regime on biogeochemical processes including algal growth. As noted in the Hydrodynamic and Water Quality Impact Assessment, under existing conditions, elevated chlorophyll *a* concentrations have often been observed in time periods when the inflow rates were low and the river was less flushed and potentially stratified. The chlorophyll *a* concentration tended to increase during dry periods and would exceed the waterway objective quickly in these times.

Therefore, although the modelling indicates that the risk of algal growth was not significantly changed, the introduction of the AWRC releases presents potential benefits by providing additional flow in the river that tends not to favour cyanobacteria or dinoflagellates.

As a potential consequence of the modified flow regime, and slight reductions in total nutrients, lower chlorophyll *a* concentrations were typically predicted when the AWRC releases were introduced, relative to the background scenario results. While Sydney Water acknowledges uncertainty in the model in simulating these complex interactions, the findings are consistent with the fact the AWRC release is blending lower nutrient water into the river except during short-lived rarely occurring events.

Sydney Water considers that additional research into the transport of pathogens in Nepean River is not required for this project, given the advanced and tertiary treated water releases will contain minimal amounts of pathogens (<1 cfu/100 mL). Most releases to Nepean River will be advanced quality water. As outlined in Table 4-6 of the EIS, pathogens including enterococci are removed during advanced and tertiary level treatment processes at the AWRC. Tertiary treated water will be released to Nepean River only during wet weather events as outlined in Table 4-7 of the EIS. During these periods, Nepean River will be receiving significant stormwater flows from the catchment which would have a more significant contribution to reduced water quality and pathogen levels. Therefore, the potential for the project to spread these bacteria or pathogens to downstream river sites during these wet weather events is considered insignificant. Due to these extremely low levels of bacterial/pathogenic content in the AWRC releases, concentrations of enterococci were predicted to be lower in the reaches within, and downstream of, the Wallacia Weir – that is the addition of the treated water has a cleansing effect, diluting the bacteria concentrations that have entered from other sources.

Sydney Water programs separate to the project

Clean waterways are fundamental to Sydney Water's vision of creating a better life with world class water services and separate to the project, Sydney Water has initiatives underway that may provide opportunities to partner with Penrith City Council on monitoring and improving water quality.

In early 2022, Sydney Water launched Urban Plunge, a program to accelerate the delivery of more swimming and aquatic recreation opportunities across the city. It builds on the expertise developed through Sydney Water's partnership with the Parramatta River Catchment Group (PRCG) to return swimming to the Parramatta River, by expanding this to other urban waterways in Greater Sydney.

Sydney Water's ambition is to support local councils, government agencies and private enterprise to open new swimming sites throughout Greater Sydney, including expanding its RiverWatch™ service offering from the Parramatta River to other catchments. Sydney Water has held initial discussions with Penrith City Council about opportunities to support existing or new swimming sites in the Hawkesbury-Nepean catchment and is happy to progress these conversations further to work towards Penrith City Council's objectives for amenity, recreation, and waterway health.

6.4.23 Hydrodynamics and water quality - waterway modelling

Issue description

Penrith City Council requests DPE review or have independent expert review of modelling and decision not to release all treated wastewater into South Creek and all nutrient and pathogen modelling relating to blue-green algae and recreational water quality.

Response

Sydney Water notes that independent expert review has been undertaken as follows:

- Two independent experts, Dr Chris Gippel and Dr Rick van Dam, reviewed the waterways assessments (including the Hydrodynamic and Water Quality Impact Assessment). Their review is included as Appendix I in the EIS.
- Brett Miller, Principal Engineer for Hydraulics and Modelling at the UNSW Water Research Laboratory was engaged to review the calibration of the Hawkesbury Nepean and South Creek hydrodynamic and water quality modelling. Mr Miller concluded that ‘the calibrated model the calibrated model is suitable for running the scenarios that are to be considered for the Environmental Impact Statement for the Upper South Creek Advanced Water Recycling Centre’. This is included in as Appendix I in this report.

In addition to the above, the Hawkesbury Nepean Science Working Group (consisting of the EPA, the Environment, Energy and Science (EES) group in DPE and Sydney Water) was also given an opportunity to review the calibration report.

6.4.24 Management measures

Issue description

Penrith City Council notes that the CEMP should address environmental aspects of the construction phase and include details on environmental management practices and controls throughout construction, including water quality management, noise control and hours of operation, dust suppression, waste management, erosion and sediment control, air quality.

Response

Management measure G01 in Table 15-3 of the EIS commits to preparing and implementing a CEMP consistent with *Environmental Management Plan Guideline – Guideline for Infrastructure Projects*. Section 14.1 of the EIS also outlines the sub-plans that will support the CEMP, with Table 15-3 providing more information about what each sub-plan will include. The CEMP and sub-plans will include details on environmental management practices and controls throughout construction, including water quality management, noise control and hours of operation, dust suppression, waste management, erosion and sediment control, air quality.

6.4.25 Traffic and transport - construction traffic impacts on Clifton Avenue

Issue description

Penrith City Council notes that Clifton Avenue is a local rural road not designed to cater for construction traffic volumes and suggests it will prematurely fail as a result. Council requests that Site Specific Traffic Management Plans for compound 8 address:

- geotechnical testing of existing pavement design life of Clifton Avenue

- required pavement upgrade works and localised widening of Clifton Avenue to accommodate expected construction traffic volumes
- dilapidation report of all existing Council assets along Clifton Avenue including drainage assets, signs, pavement, etc.

Council also notes that it will continue to advocate that road upgrades to any impacted local roads are undertaken by DPE, to ensure the assets are safe, fit for purpose and they do not become a financial maintenance burden to Council and residents.

Response

Sydney Water notes Penrith City Council's concern about the condition of Clifton Avenue and the potential impact from construction traffic volumes. Management measure U02 and U03 in Table 15-3 of the EIS commit to identifying utilities at risk of being damaged by construction and repairing any utilities damaged by construction works. If there is a risk of damage from construction, pre and post construction condition assessments will be completed via dilapidation surveys.

Sydney Water has ongoing consultation with the Transport for NSW (TfNSW) M12 Motorway team regarding Clifton Avenue as both projects will require its use for construction traffic. Management measure G10 commits to ongoing consultation and coordination with other major projects and utility providers where cumulative impacts may occur.

Any modification or upgrade works to Clifton Avenue to facilitate the construction traffic from the project is out of scope of the project as outlined in section 4.14.4 of the EIS. Site Specific Traffic Management Plans will be developed as outlined in management measure TT01 in Table 15-3 of the EIS. These plans will include specific measures to manage impacts to traffic at specific locations impacted by project construction.

6.4.26 Traffic and transport - signage

Issue description

Penrith City Council recommends that directional and wayfinding signage be provided for the AWRC, in a signage and wayfinding strategy and plan. This should consider future signage along Elizabeth Drive and M12 Motorway advising of exit and access points.

Response

Sydney Water will provide adequate wayfinding around the AWRC site for the workforce and community. In addition, Sydney Water will also work with TfNSW to identify any further opportunities to provide wayfinding on surrounding state roads. A new management measure SELU10 has been included in Appendix B.

6.4.27 Human health and hazards

Issue description

In relation to the Preliminary Hazard Analysis, Penrith City Council recommends it be amended to:

- confirm which product is proposed to be used as the antiscalant additive in reverse osmosis procedure, as EIS noted this as still to be confirmed
- demonstrate there will be sufficient capacity to contain firewater in the event of a fire, as EIS noted stormwater design was not complete at time of writing.

Response

The product that will be used as the antiscalent additive during reverse osmosis will be determined during detailed design.

The exact sizing and capacity of the stormwater system will be determined during detailed design, including the ability for the system to capture and contain any firewater in the event of a fire.

6.4.28 Soils and contamination

Issue description

Penrith City Council raises several issues about land contamination:

- Supports approach for additional investigations as needed through unexpected finds along the pipeline alignments that are not areas of concern. Recommends Unexpected Finds Protocol be prepared prior to construction and address as a minimum contaminated soils, groundwater, buried building materials, asbestos, odour and staining.
- Supports Detailed Site Investigation (DSI) as part of detailed design for AWRC site for submission to consent authority before determination and prior to construction. Council considers that asbestos and heavy metal findings for the AWRC site mean Council is not yet satisfied that the land is suitable for its proposed use (in accordance with clause 7 of SEPP 55).
- Recommends a Remedial Action Plan following the DSI and be submitted to the consent authority prior to determination.
- Supports recommendation for Hazardous Materials Survey and notes it should provide recommendations for removal of hazardous materials, including preparation of Safe Work Method Statements and risk assessments.
- In addition to potentially impacted soil migrating from site, CEMP should address material imported to site. Council recommends no material be imported to site until a Validation Certificate (and accompanying report) has been provided and approved by the consent authority.

Response

Sydney Water notes Penrith City Council's support for additional investigations including a hazardous materials survey and recommendations for the preparation of a remedial action plan. Management measures CLS01-CLS04 in Table 15-3 of the EIS commit to additional sampling, implementation of an unexpected finds procedure and preparation of remedial action plans. These measures will be included in the Soil and Water Management Plan as part of the project's CEMP. The CEMP will be in place prior to construction and be prepared in accordance with Environmental Management Plan Guideline – Guideline for Infrastructure Projects (DPIE, 2020b).

Work required to manage the disturbance of contaminated soils will be appropriately managed by the construction contractor in accordance with management measures CLS01-CLS04. The construction contractor will be responsible for the preparation of documentation such as Safe Work Method Statements for the work.

Sydney Water notes Penrith City Council's support for a DSI. The areas of environmental concern described in Appendix N and section 9.5 of the of the EIS were informed by preliminary site investigations (PSI) and a DSI for the project's reference design. For the AWRC site (AEC1 in Appendix N and section 9.5), previous studies reviewed as part of the project's PSI indicated zinc and copper exceedances of ecological investigation levels for a proposed public open space land use. There were no exceedances of health investigation levels. For samples analysed as part of the project's DSI, there were no heavy metal exceedances of ecological or health investigation levels for commercial and industrial land uses (the proposed use for the AWRC site). The project's DSI indicated asbestos fragments were present but these were localised in soils surrounding current and former structures and within existing buildings across the AWRC site.

State Environmental Planning Policy No 55—Remediation of Land (1998), clause 7 relates to the consideration of contamination and remediation in determining a development application. This SEPP has recently been repealed and its provisions incorporated into State Environmental Planning Policy (Resilience and Hazards) 2021. This SEPP does not apply because the project is State significant infrastructure. However Sydney Water considers that Appendix N and section 9.5 of the EIS fully address the assessment of potential contamination and identification of remediation requirements that will ensure the AWRC site is suitable for its proposed use.

Sydney Water notes Penrith City Council's recommendation for validation of imported material. Section 4.10.3 of the EIS notes that imported material (fill) will be required for construction and Sydney Water proposes to use excess spoil from pipeline construction at the AWRC site where suitability for proposed use and timeframes align. All imported material from outside the project will be classified and validated prior to receiving on site. Material identified for re-use within the project will be classified in accordance with the relevant EPA guidelines, resource recovery orders and exemptions. To ensure validation of imported material is captured as part of the CEMP, Sydney Water has included a new management measure (CLS05) in Appendix B to manage import of fill at the AWRC site. Sydney Water has also revised management measure W01 in Appendix B that ensures opportunities for material re-use within the project are considered.

6.4.29 Noise and vibration

Issue description

Penrith City Council raises several issues about noise impacts. Table 6-13 responds to each of these.

Response

Table 6-13 Responses to Penrith City Council comments on noise impacts

Issue raised	Response
Co-generation - clarify to what extent the predicted dB(C) will exceed dB(A) by more than 15dB, as low frequency sound produced has the potential to carry across large distances. Council is not satisfied the modifying factor is adequate without further clarification that demonstrates surrounding sensitive receivers are not significantly impacted in terms of noise.	The methodology for determining a 5 dB penalty for excess low frequency noise can be found in section 6.1.1.4 of the Noise and Vibration Impact Assessment in Appendix S of the EIS. This has been adopted from Table C1 of the Fact Sheet C: Corrections for annoying noise characteristics in the Noise Policy for Industry. It is predicted that there could be a 17 dB difference in dB(C) and dB(A). As per the Noise Policy for Industry (NPfI), the maximum penalty to be added to a receiver is 5 dB for low frequency noise if exceedances of 15 dB or more are predicted between the dB(C) and dB(A) levels. The penalty will not be higher if more than 15 dB between the dB(C) and dB(A) levels are predicted.
Air valves – clarify unknown sizing of air release valves and recommend suitable mitigation measures prior to determination.	The sizing of valves will be completed during detailed design. During surge events, as outlined in section 11.2.6 of the EIS, there is potential for increased noise emissions. However, this will only occur if the valves malfunction, and is not part of their design or standard operation. Due to the frequency and duration of surge events, as well as the valves being are located below ground, noise generation during surge events is expected to be minimal.
Detailed design – notes it is satisfactory that noise emissions from AWRC will be reviewed during detailed design including measures to reduce noise impacts. Suggests assessment is amended to address outstanding information is reviewed by consent authority prior to determination.	Management measure NV10 in Table 15-3 of the EIS commits to investigating opportunities to reduce the operational noise from the project, including the AWRC. Sydney Water considers that no further assessment is required at this stage.

Issue raised	Response
Land Use Survey – should be amended to ensure all sensitive receivers identified and correctly classified and the assessment updated to reflect any changes in potential noise impact or management measures. For example, several dwellings south-west of TP-T2 have been classified as industrial/utilities and a dwelling about 150 m north-west of compound 5a is not identified at all.	The Land Use Survey maps are included in Appendix B of the Noise and Vibration Impact Assessment in Appendix S of the EIS. These maps were used to identify sensitive receivers and land uses at a high-level within close proximity to the project. Sydney Water notes that there may be some minor inaccuracies with classification of receivers in these figures. This is based on a desktop assessment which is standard practice for this level of assessment. These maps will be updated as part of the CEMP and the Construction Noise and Vibration Management Plan (CNVMP) in management measure NV01. The dwellings south-west of TP-T2 are unlikely to be significantly impacted by the project due to the distance from the works, as well as the progressive nature of pipeline construction as outlined in section 4.9 of the EIS. Compound C5 is likely to be used as office space to support the construction of the project. As such, noise generated from this compound will be minor and is unlikely to impact surrounding dwellings.
Management plan – the Construction Noise and Vibration Management Plan should address noise impacts on surrounding sensitive receivers during construction and consider details of construction program, methods, equipment and vehicles in accordance with the Interim Construction Noise Guideline and appropriate standards for vibration assessment. Council recommends this plan be provided to the consent authority prior to determination.	Management measure NV01 in Table 15-3 of the EIS commits to preparing a CNVMP. This will address noise impacts on surrounding sensitive receivers during construction. The CEMP and the Site Specific Construction Traffic Management Plans (SSCTMPs) will address construction program, methods, equipment and vehicle movements.

6.4.30 Air quality

Issue description

Penrith City Council generally considers the odour and air quality impact assessment is acceptable but raises several concerns:

- For 100 ML/day modelling at the AWRC site, the 4 odour unit (OU) contour extends slightly beyond the site boundary to the north-west and north-east and the 2OU contour extends significantly into ENZ land to the north-west, north, and north-east of the site. This is a concern as it is likely to adversely impact on future users of this land and needs further assessment and discussion.
- Requests confirmation that a stack at least six metres high will be used.
- Considers it essential that the CEMP covers dust monitoring and control measures.

Response

Dispersion modelling of odour was carried out for a conceptual future AWRC operating at 100 ML/day. The results of the modelling (Appendix C in Appendix R of the EIS) showed that the 4OU contour (the assessment criterion) will not extend to any existing or potential private sensitive receptors or residential areas. The 2OU contour extends off the site into ENZ land. However, 4OU not 2OU is considered the relevant odour criterion for the project. All modelling has been undertaken on a conservative basis to address worst case impacts meaning experienced impacts would likely be lower.

EPA (2016) defines a sensitive receptor as a 'location where people are likely to work or reside'. The modelling indicates that the odour impacts of the AWRC, operating at 100 ML/day will not extend to any existing or potential private sensitive receptors. Further confirmation of this outcome will be included in the future EIS that will be required to expand the AWRC to 100 ML/day. By this time, potential changes to land use zoning and population density in the immediate area are likely to be more certain and the design of the AWRC would be assessed in that context.

There is potential for some land on the AWRC site to be opened up as parkland for transient recreational use. The expected infrequent use, low numbers of people and short durations mean that impacts would be minor and only experienced by people transient through the area. Impacts are proposed to be managed in accordance with best practice odour controls. There would be no permanent receivers in these areas who could be impacted.

Sydney Water confirms that a stack height of at least six metres will be used for each cogeneration engine.

As outlined in management measure AQ02 in Table 15-3 of the EIS, Sydney Water has committed to measures to manage dust during construction as part of the CEMP.

6.4.31 Aquatic ecology and surface water - design impacts on waterways

Issue description

Penrith City Council raises the following issues about appropriate design to address impacts on waterways:

- For waterway crossings, it is important that detailed design makes adequate consideration of design and safeguarding of creeks and that all disturbed areas are revegetated following works.
- Notes that stormwater management on the AWRC site is iteratively sized to achieve DPE Environment, Energy and Science (EES) water quality objectives and Council pollution load reduction targets but that inadequate information is included in the EIS to assess this in detail. Council suggests that the opportunity for further review and assessment should be provided once final design is prepared.

Response

The EIS includes a range of management measures to ensure that the detailed design of waterway crossings further considers geomorphology, aquatic ecology and groundwater (including measures WW01, WW07, WW14, WW15 and GW05 in Table 15-3). These measures are considered adequate to ensure the design minimises potential risks to waterways. In addition, disturbed areas will be stabilised and revegetated in accordance with management measures G05, UD01, WW05, WW11 and WW18.

Sydney Water considers that the assessment of stormwater impacts is commensurate with the project's expected impact. Section 9.2 and Appendix K of the EIS detail the approach taken to assess impacts to surface water at the AWRC site during project construction and operation.

During construction, impacts to waterways will be managed by a range of measures included in a Soil and Water Management Plan as part of the CEMP. As outlined in measure G01 in Table 15-3 of the EIS, the CEMP will be in place prior to construction and be prepared in accordance with Environmental Management Plan Guideline – Guideline for Infrastructure Projects (DPIE, 2020b).

During operation, the assessment demonstrates through modelling that changes to surface runoff can be effectively managed by implementing a range of Water Sensitive Urban Design measures on the AWRC site. Management measure SW02 in Table 15-3 of the EIS commits to the design and implementation of a range of Water Sensitive Urban Design measures that ensure the operational releases achieve water quality and flow objectives (Western Sydney Planning Partnership, 2020b) for South Creek and pollution load reduction targets in Penrith City Council DCP (2014). These Water Sensitive Urban Design measures will be developed during detailed design.

6.4.32 Aquatic ecology

Issue description

Penrith City Council raises several issues related to aquatic biodiversity impacts:

- The project appears to have permanent change on hydrology and further scrutiny required to determine if project will have impacts on aquatic environment as a result of altered hydrology and type of water to Warragamba and Nepean River. Council recommends DPE engages an independent consultant to undertake critical review. Rivers contain habitat for threatened species and iconic fauna species such as platypus that could become significantly impacted if not appropriately assessed. Council notes risk of algal blooms and aquatic weeds that could lead to long term degradation of aquatic environments.
- It is difficult to scrutinise or determine whether impacts on aquatic environment are adequately assessed. Council recommends that DPE EES commission independent review of documentation by relevant species and ecological experts to review information in the EIS and ascertain whether the project will have irreversible impacts on aquatic environments in Warragamba and Nepean River.

Response

The Aquatic Ecology Impact Assessment (Appendix H) provided a detailed assessment of the impacts to the aquatic environment as result of treated water releases to Warragamba and Nepean Rivers. Sydney Water engaged an expert panel to review the assessment and their report was provided in Appendix I of the EIS.

The assessment included identification of and assessment of impact to threatened species, as required by the *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Only one threatened species, Macquarie Perch, was identified as potentially impact by treated water releases. A Seven-part Test of Significance has been undertaken in accordance with the FM Act and an Assessment of Significant Impact has also been undertaken in accordance with the EPBC Act. The results of these assessments indicated that the project's impacts on this species are not considered significant, given impacts on its habitat and food sources in Nepean and Warragamba rivers will be minor.

Work by CT Environmental (2016) identified iconic species in the South Creek catchment, including Australian Bass, microbats, floodplain and woodland birds and Cumberland Plain vegetation. Potential impacts to Australian Bass were assessed in the Aquatic Ecology Impact Assessment. Potential impacts to microbats, floodplain and woodland birds and Cumberland Plain vegetation have been assessed as part of the terrestrial biodiversity assessment in section 9.1 of the EIS.

In Nepean River, impacts on the platypus and echidna were assessed in the World Heritage Assessment (Appendix Q of the EIS). The assessment concluded that potential impacts are negligible.

As part of water quality modelling of treated water releases, Sydney Water modelled two key indicators, chlorophyll *a* and a cyanobacteria risk index, to assess the risk of eutrophication and algal blooms. This is explained further in section 5.11.1 of this report. In summary, the modelling predicted no increased risk of eutrophication and algal blooms in the downstream waterways for the scenarios that include releases of AWRC treated water to South Creek and Nepean River.

In Warragamba River, the modelling results predict a small increase in the risk of eutrophication and algal blooms within the downstream reaches of the Warragamba River. However, these impacts are limited with respect to magnitude and spatial extent with the effects predicted to not extend beyond the confluence of the Warragamba and Nepean rivers. The risk is also predicted to be limited to the summer months when nutrient availability, climatic and flow conditions are optimal and as modelling of dissolved oxygen shows, the periods of low dissolved oxygen are short lived. The increased risk of algal growth is not expected to alter the trophic state of the river, meaning any potential impacts would be minor.

The Aquatic Ecology Impact Assessment identified that the increase of available nutrients may promote aquatic plant growth which has potential, if excessive growth occurs, to impact the aquatic ecosystem through changing the trophic status in the same way as excess algae growth. However, this effect may provide additional habitat for species that rely on macrophytes such as Odonata (dragonflies and damselflies) and juvenile fish (such as Australian Bass) which may result in an increase of aquatic biodiversity and increase of prey for higher order fauna.

The addition of available nutrients can also promote colonisation of weed species in the riparian community, however changes in hydrology are not expected in Warragamba River and therefore the risk is considered low.

6.4.33 Terrestrial biodiversity

Issue description

Penrith City Council notes that overall, the project will result in impacts to terrestrial biodiversity which is comparably small in respect to overall size of project. The project has demonstrated it has been designed to avoid (to practical level) areas containing high biodiversity values. However, Council notes several comments on biodiversity:

- Targeted flora survey should be undertaken before approval for the area that was inaccessible around Cross Street and Kemps Creek as there may be other species here not assumed present or detected previously.
- Consider options for locating pipelines in less biodiversity constrained areas (for example relocating pipeline around Cross Street and Kemps Creek to previously cleared area).
- Consider cumulative impact with Warragamba Dam wall raising project as the project has potential to affect the modelling of future flood risk and associated impacts.
- Address inconsistencies in threatened ecological community (TEC) amounts in Tables 45, 58, and 59 of the Biodiversity Development Assessment Report compared to Table 1 and the BAM credit calculator.

Response

Sydney Water notes Penrith City Council's acknowledgment that the biodiversity impacts are relatively small compared to the project's size. Responses to the specific comments about biodiversity are provided below:

- Where targeted surveys could not be undertaken and therefore species presence could not be verified, the assessment has assumed presences of listed species based on habitat type. Where required species experts have been engaged to further verify the project potential to impact on certain threatened species in these areas. This conservative approach has been undertaken in accordance with the Biodiversity Assessment Method (BAM). Management measure TB07 in Table 15-3 of the EIS has been adopted requiring qualified ecologists to undertake pre-clearance surveys to monitor for sensitive biodiversity values in areas to be cleared and make further recommendations to minimise impacts to biodiversity.
- As outlined in Chapter 3 of the EIS, project ecologists worked with the design team early on in the project to identify biodiversity constrained areas and seek to find the best pipeline alignment for minimising biodiversity impacts whilst still meeting engineering and design parameters. In addition, Sydney Water is proposing an amendment to the project around Kemps Creek and Cross Street to move the brine pipeline alignment into previously cleared areas. This is outlined in the project's Amendment Report (Sydney Water, 2022).
- The EIS included consideration of the potential cumulative impacts of the project. The EIS for the Warragamba Dam wall raising project was not publicly available during preparation of Sydney Water's EIS. Given the Warragamba Dam wall raising EIS is now available, section 5.4.46 of this report includes an assessment of cumulative impacts with that project.
- As a result of amendments to the project footprint since the exhibition of the EIS a review of the biodiversity impacts of the project has been undertaken. This included reviewing the impact areas of TECs and updating the BAM credit calculator. An updated and revised assessment of the impact to TECs and the resulting offset requirements are included in the project's Amendment Report (Sydney Water, 2022). This has rectified the inconsistencies in these tables. The amendments to the project since exhibition of the EIS have resulted in an overall reduction in impacts to TECs.

6.4.34 Terrestrial biodiversity - conservation works

Issue description

Penrith City Council notes that significant volunteer-led conservation works have occurred around Jerrys Creek and Crossman Reserve to restore and protect the reserve. It also notes that Council has recently committed to planting 2,000 trees in the area. Conservation works in Crossman and Fowler Reserves has also been committed in partnership between Western Sydney Airport, Conservation Volunteers Australia and Council. Council notes that proposed works must not detract from planned and already undertaken conservation works.

Response

Sydney Water proposes to use tunnelling methods to build the section of the treated water pipeline along Park Road adjacent to Crossman Reserve and across Jerrys Creek, which will avoid vegetation impacts in these areas. A scour valve is also proposed to Jerrys Creek which may require removal of some vegetation mapped as urban exotic/native in Figure 5-25 in Appendix O of the EIS.

Most works in Fowler Reserve are located in existing cleared areas, also shown in Figure 5-25 in Appendix O of the EIS. The main exception is building the pipeline from Shelley Road into Fowler Reserve, which will impact some vegetation mapped as PCT835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion – Thinned.

Sydney Water would seek to avoid impacts on any planned or already undertaken conservation works in these areas where possible. Sydney Water will further discuss these matters with Penrith City Council during detailed design in accordance with the Community and Stakeholder Engagement Plan in measure G08 in Table 15-3 of the EIS.

6.4.35 Landscape character and visual amenity, terrestrial biodiversity

Issue description

Penrith City Council raises several issues related to landscape and visual impact including impacts on street trees. Table 6-14 responds to the issues relating to landscape and visual impact and Table 6-15 responds to the issues relating to street trees.

Response

Table 6-14 Response to Penrith City Council comments on landscape impacts

Issue raised	Response
Council considers greatest landscape and visual impact is at release locations in Wallacia and streetscapes where pipelines are located in road reserves.	The landscape and visual impact assessment in section 11.3 and Appendix T of the EIS describe views towards the treated water release location and of some streetscapes in Wallacia. During operation, the greatest visual impacts along the treated water pipeline are associated with permanent tree removal and visibility to sensitive receivers. Visual impacts at the release location are described as ‘moderate low’ and in Wallacia, some visual impacts to streetscapes are described as ‘high moderate’ and are associated with tree removal. To effectively manage impacts, a Rehabilitation Management Plan (management measure G05 in Table 15-3 of the EIS) commits to like for like revegetation. Where this is not possible, opportunities to further reduce impacts to

Issue raised	Response
	streetscape character and visual amenity will be investigated.
Council notes that planting proposed to ameliorate visual impacts at the AWRC seems comprehensive but constrained by airport requirements and there is insufficient detail to provide comment.	As detailed design of the AWRC progresses, Sydney Water will consider a range of measures including planting to manage visual impact, as part of the Urban Design and Landscaping Plan for the AWRC described by management measure UD01 in Table 15-3 of the EIS. UD01 will ensure airport safeguarding constraints are addressed.
Council does not support green walls as they considered unsustainable unless there is budget for ongoing maintenance	Sydney Water notes Council does not support green walls. Sydney Water will consider a range of opportunities to address visual impacts as detailed design progresses as part of management measure UD01 in Table 15-3 of the EIS, with the need for ongoing maintenance being a consideration in this decision-making.
Council requests consultation with design teams throughout the design process.	Management measure G08 in Table 15-3 of the EIS specifies that councils will be consulted throughout the project, including during detailed design.
Existing vegetation should be retained where possible and protected according to Australian Standards during construction	The EIS includes measures to maximise retention of existing vegetation, particularly management measures TB02-TB04 in Table 15-3 of the EIS. Management measure TB05 in Table 15-3 of the EIS commits to protecting trees to Australian Standards.
Site compounds should avoid existing vegetation. If this is not possible, vegetation must be treated as a high value asset and protected and maintained in healthy state during construction	The proposed compound locations for the project are detailed in the EIS. Compound locations have been chosen based on a range of factors including minimising biodiversity impacts. Site compounds will be rehabilitated in accordance with the Rehabilitation Management Plan outlined in management measure G05 in Table 15-3 of the EIS. This may include revegetation or for example in the case of an agricultural property returned to grazing land.

Issue raised	Response
Quantity of vegetation should be documented as with revegetation	Records will be kept of vegetation removed and revegetation. Sydney Water has amended management measure TB01 in Appendix B to clarify that the monitoring and auditing requirements included in the Biodiversity Management Plan will include recording areas and locations of vegetation removed and revegetation.
The area of canopy at 10 years should not be less than existing area and replacement ratio to be identified	It is not practical to require canopy areas to be comparable over a 10 year period as this may be impacted by variables such as species selection, age of the existing cover or impacts from other projects. Sydney Water proposes a pragmatic approach to providing planting of appropriate species that are compatible with constraints associated with the pipeline and AWRC site, as outlined in management measures G05 and UD01 in Table 15-3 of the EIS. Sydney Water will also develop a Biodiversity Offset Strategy as outlined in management measure TB10 in Table 15-3 of the EIS.
Figure 4.5 illustrates pipe jacking tunnel being max 3m deep under existing vegetation. Height of tunnel not indicated and concerns that tunnel and its construction may negatively impact root zone of extensive existing vegetation.	Figure 4-5 provides an indicative tunnel design and more specific details including confirmation of depth will be developed during detailed design. Management measure TB05 in Table 15-3 of the EIS commits to protection of trees to Australian Standards and engaging an arborist to assess impacts where roots greater than 50mm are likely to be impacted. This applies to trenching and tunnelling methodologies.
Proposed like for like replacement of vegetation not reflective of aim to enhance, protect and re-invigorate landscape in Aerotropolis Plans and Precincts. Given urban heat of Western Sydney, project should deliver optimal vegetation to contribute to cooling of Western Sydney, within constraints set by Aerotropolis.	Management measure G05 in Table 15-3 of the EIS aims to manage the impact to sensitive vegetation where removal cannot be avoided during pipeline construction and includes measures to improve the existing state and increase habitat values. For the AWRC site, the Western Parkland City landscape vision has been a fundamental input to Sydney Water's urban design approach. Sydney Water will develop and implement an Urban Design and Landscaping Plan as described in management measure UD01 in Table 15-3 of the EIS. This plan will align with the principles outlined in Table 4-4 of the EIS, which include commitments

Issue raised	Response
	relating to landscaping and contributing to mitigating urban heat.
Specialists should be engaged to work with engineers to maximise potential for effective revegetation. Council has species list guide for LGA which can be provided on request.	Sydney Water has amended G05 and UD01 in Appendix B to clarify that relevant experts will be engaged in preparing the Rehabilitation Management Plan and Urban Design and Landscaping Plan and to refer to tree planting provisions of the Phase 2 Aerotropolis DCP.
NSW Greener Places Draft Policy and Guidelines should be addressed as design progresses.	Sydney Water has considered a range of NSW Government policies in developing the urban design principles (Table 4-4 of the EIS) for the AWRC site. These are described in section 2.11.2 of the EIS and include Better Placed (Government Architect NSW, 2017a), Greener Places (Government Architect NSW, 2017b), and Premier's Priorities 11 (Greening Public Spaces) and 12 (Greening our City). Sydney Water will continue to consider relevant elements of these policies as detailed design progresses.

Table 6-15 Response to Penrith City Council comments on street trees

Penrith City Council comment	Response
Pipeline alignment in road reserves is not supported due to the negative impact it will have on future street trees and the impact its canopy will have on cooling the city as well as visual amenity. The report proposes low level vegetation as replacement for the removal of street trees (for example in Wallacia). The impact is much greater as the potential for effective canopy tree planting is removed. The project should provide effective and localised replacement (compensatory) canopy plantings. Council is committed to Cooling the City (Strategy) and is actively planting canopy street trees across the LGA.	Pipelines are proposed in road reserves to minimise impact to private property and allow access for future maintenance. Various management measures in Table 15-3 of the EIS have been proposed to minimise and manage these impacts, including: • TB03 and TB04 require consideration of further opportunities to protect vegetation • G05 describes how impacts on street trees will be rehabilitated • TB10 describes how biodiversity offsets will be provided.

Penrith City Council comment	Response
When not avoidable, pipelines in road verges should be consolidated with other utility infrastructure to reduce the footprint impact. This can involve alignment on the side of road with overhead wires, thereby maximizing potential for canopy planting on the non-wired side of the road.	The co-location of pipelines with other utility assets would be undertaken in accordance with the design requirements for spacing assets as required by various asset owners. Design requirements and siting limitation have driven the pipeline alignment and it is not practical to amend the alignment based on proximity to overhead wires.
Council does not support low-level vegetation (shrubs and groundcovers) in road verges as they are maintenance and management liabilities and can create pedestrian / community safety issues due to lack of passive visibility.	Where street trees are impacted Sydney Water will seek to replace on a like for like basis. The planting of large tree species above buried underground assets can result in damage to the assets and potential tree instability. Therefore appropriate species need to be considered with the planting of canopy species considered where practical.
Any revegetation in the public domain requires establishment maintenance. Refer to Council's Street and Park Tree Management Plan.	Sydney Water has revised management measure G05 in Appendix B to clarify that the project's Rehabilitation Management Plan will document maintenance approach during the establishment phase of revegetated areas.

6.4.36 Non-Aboriginal heritage

Issue description

Penrith City Council raises several issues relating to non-Aboriginal heritage impacts:

- Council supports engaging an archaeologist during on-site construction works.
- The heritage report for Fleurs Radio Telescope site does not include options that consider retention (or partial retention) of buildings on the site, which is not in line with the Burra Charter, Council or Heritage NSW development control guidelines. Council recommends heritage assessment be amended to consider this.
- Council requests several reports and plans be provided to Council for approval prior to issue of a construction certificate:
  - Report from heritage consultant outlining their involvement during construction works, what was found and what measures were taken for archaeological findings, including details of negotiation with local indigenous groups.
  - A detailed Interpretation Plan showing locations, text, materials and sizes

- Council requests further details about what elements of the remains of the Fleurs Radio Telescope heritage items will be preserved or removed from site. Where elements are preserved, Council requests a detailed schedule of works, specifications and drawings showing conservation measures to be taken. Information regarding location of heritage items should include a clear and detailed overall scaled site plan (particularly for Fleurs Radio Telescope item).
- Council notes that given the site is directly opposite a heritage item, that building design should be further developed:
  - a setback from the front boundary is appropriate, as per relevant DCP guidelines for the area
  - high quality landscaping especially adjacent to front boundary is further developed so that the bulk of building is ameliorated, as per relevant DCP guidelines
  - recommend that front facade is sufficiently modulated along long length of proposed front. It is noted that there is a corner feature that is modulated, however, all elevations and prominent points of view shall be considered in a similar regard.

Response

Responses to issues raised by Penrith City Council are addressed below:

- Sydney Water notes Council's support for engaging an archaeologist during construction. For clarity, as outlined in management measure NAH05 in Table 15-3 of the EIS, archaeological test excavations are proposed in several Potential Archaeological Sites (PAS). Archaeological monitoring is only proposed at the Upper Canal and monitoring at other locations is not considered necessary. An unexpected find procedure would be implemented across the entire project impact area to manage the potential of an artefact being uncovered as a result of construction works.
- Council's comment about amending the assessment to consider retention or partial retention of buildings on the Fleurs Radio Telescope site is noted. The project has considered the retention of heritage fabric if possible. However, due to their location and condition, it is not practical to retain these structures in their current form. The Statement of Heritage Impact (SOHI) has recommended the preparation of a Heritage Interpretation Strategy including a variety of measures aimed at incorporating the history of the site into the AWRC design. This commitment is captured in management measure NAH04 in Table 15-3 of the EIS and includes considering the following:
  - Landscaping, structure plan and road alignments within the AWRC to incorporate historic features such as the radio telescope arrays.
  - Public art installation within the AWRC site including interpretation of the site's heritage.
  - Retention of two parabolic antennas as an interpretative installation.

- Collection of a meaningful assemblage of historic material/equipment and historic resources, such as photographs that relate to the radio telescope functions of the site, and creation of a heritage display within the AWRC.
- Preparing digital resources that are available to the public which will further promote the heritage significance of the place to a wider audience. This will be particularly effective for expressing the historical significance of sites such as Fleurs Radio Telescope.
- Preparing an oral history of the Fleurs Radio Telescope site.

- Information is not yet available about how specific elements of the Fleurs Radio Telescope site will be preserved or removed from the site, nor a detailed schedule of related works, specifications and drawings. It is envisaged that the specific detail will be developed during detailed design, following determination of the project. Development of this specific detail will include consultation with key stakeholders to ensure works are sympathetic to the history of the site.
- Architectural design of the AWRC will form part of detailed design and Sydney Water has made a commitment in management measure UD01 in Table 15-3 of the EIS to develop an Urban Design and Landscaping Plan for the site that takes into account its visibility from adjacent viewpoints, surrounding heritage character and appropriate landscaping and finishing to soften the industrial aesthetic.

6.4.37 Aboriginal heritage

Issue description

Penrith City Council recommends that detail be provided about liaison with Deerubbin Local Area Land Council and other Aboriginal stakeholders.

Response

Consultation undertaken for the project is comprehensively described in section 6.4.2 of the EIS and the Aboriginal Cultural Heritage Assessment in Appendix O of the EIS. Consultation has been completed in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010b). This includes consultation with Deerubbin Local Aboriginal Land Council and other Aboriginal stakeholders, including 26 Registered Aboriginal Parties.

6.5 Wollondilly Shire Council

6.5.1 Design requirements

Issue description

Wollondilly Shire Council notes support for the overall objectives and outcomes of the project but raises concerns about the level of definitive commitments and impacts on properties close to project infrastructure.

Response

Sydney Water notes Wollondilly Shire Council's support for the overall objectives and outcomes. Commitments and impacts on nearby properties are addressed in response to specific issues in the following sections.

6.5.2 Design requirements - minimising wastewater discharges to waterways

Issue description

Wollondilly Shire Council refers to its Integrated Water Management Policy and Strategy. Although noting the project's releases to Nepean River will be highly treated and unlikely to impact water quality, Council strongly advocates for minimising wastewater discharges to waterways and seeks and supports exploring other more sustainable uses of wastewater in line with their policy and strategy.

Response

Sydney Water also supports exploring sustainable uses of wastewater and has set corporate targets to increase recycled water supply by 50% before 2025. The project has potential to make a significant contribution towards this target. The project also aims for all treated water produced during normal conditions to be reused for beneficial use that saves valuable drinking water supplies. This includes both local recycling and releases to waterways.

Section 7.4 of Wollondilly Shire Council's Integrated Water Management Strategy (Wave Consulting, 2020) identifies a range of options for managing wastewater including reuse and environmental flows, noting that consideration of environmental flows should be subject to careful consideration about the timing and quality of water to avoid impact on waterways. The project's releases to waterways will be high quality water that can contribute to sustaining environmental flows in the Nepean River, by partially replacing water that would otherwise be released from Warragamba Dam.

Given the Western Sydney Aerotropolis Growth Area (WSAGA) and South West Growth Area (SWGA) are still developing and there is uncertainty around timing, volume and location of recycled water demand, the supply of recycled water to residents and businesses is not part of the project scope. In addition, Sydney Water's analysis is that demand for recycled water for household, business and irrigation uses shows it is unlikely to exceed the volume produced at the Advanced Water Recycling Centre (AWRC). Recycled water demand is highly seasonal, with more water used in summer than winter, and more in dry weather than wet weather. This means Sydney Water expects the ultimate use of treated water from the AWRC will always be a combination of uses, including releases to waterways for environmental flows and a range of other recycling options.

For the purpose of the EIS, project scope and assessments were based on releasing all treated water to Nepean River via the treated water pipeline or environmental flows pipeline. Sydney Water has taken this approach given the need for certainty in providing a wastewater service to meet population growth projections, without being contingent on set volumes of recycled water use which are currently uncertain. However, in addition to releases to waterways, Sydney Water is exploring a range of opportunities for beneficially using treated water from the AWRC, including third pipe recycled water to homes, businesses (such as data centres), agriculture (including intensive agriculture) and open space. In addition, future uses could include adapting the AWRC for supplying purified water for drinking, subject to community support and government policy change.

6.5.3 Stakeholder and community engagement and design requirements

Issue description

Wollondilly Shire Council raises several issues relating to ongoing consultation:

- It requests continued consultation with Council and the community as the project is implemented.
- The EIS includes limited detail about the project's strategic framework and opportunities it presents for Council on matters such as agribusiness and agri tourism. Council seeks further consultation with Sydney Water on these matters.
- Concerns about whether the project will restrict ability for a second crossing or duplication of the Blaxland Crossing bridge and a request for Sydney Water to consult with Council on alignment of this crossing.

Response

Sydney Water is committed to ongoing consultation with Wollondilly Shire Council and the local community as the project progresses. Management measure G08 in Table 15-3 of the EIS commits to consulting with local councils and the community as part of Sydney Water's Community and Stakeholder Engagement Plan.

Sydney Water met several times with Wollondilly Shire Council during project development and EIS preparation, most recently in November 2021 while the EIS was on public exhibition. During these meetings, Council raised with Sydney Water the alignment of the treated water pipeline across the Nepean River and potential uses of recycled water for agriculture.

Sydney Water originally proposed to locate the treated water pipeline crossing of Nepean River at the Blaxland Crossing bridge. However, consultation with Wollondilly Shire Council early in the design process in July 2020 identified Council would potentially duplicate or have a second crossing at the Blaxland Crossing bridge, including widening of Silverdale Road. As a result, Sydney Water moved the treated water pipeline crossing of Nepean River about 150 m south of the existing bridge and realigned it to avoid impacts on adjacent sections of Silverdale Road. This included moving the treated water pipeline from Silverdale Road east of the bridge to the back streets of Golfview Drive, Green Street, Driver Avenue, Eagle Street and Byron Avenue. This was to ensure the pipeline avoids any potential road upgrade works of Silverdale Road associated with the Blaxland Crossing bridge upgrades.

Given the pipelines will be built underground, Sydney Water considers the project is unlikely to negatively impact the capacity for agribusiness or agritourism in the Wollondilly Local Government Area (LGA). The project also has limited ability to influence opportunities for these industries in the Wollondilly LGA. The AWRC will produce recycled water that is suitable for a range of uses including agriculture. Sydney Water's current planning for recycled water produced by the AWRC is focused on establishing recycled water servicing plans for the initial Aerotropolis precincts (Northern Gateway, Aerotropolis Core, South Creek and Agribusiness). Sydney Water can consider other specific requests for commercial arrangements to supply recycled water on a case-by-case basis, but this is outside the scope of the current project.

Sydney Water will continue conversations with Wollondilly Shire Council on matters of interest to them as part of our commitment to consultation in management measure G08 in Table 15-3 of the EIS.

6.5.4 Strategic context - alignment with Council strategies and plans

Issue description

Wollondilly Shire Council's submission notes that in its view the EIS does not contain any reference to Council's Local Strategic Planning Statement, Local Environmental Plan or any current strategic studies relevant to growth in the Wollondilly LGA. Council requests consideration of these documents prior to approval.

Response

Sydney Water considers that the EIS has adequately assessed project alignment with relevant strategic studies and planning instruments for the Wollondilly LGA. The sections below further clarify this.

Local Strategic Planning Statement

Table 5-11 in section 5.2.3 of the EIS assesses the project's alignment with relevant planning priorities from the Wollondilly Local Strategic Planning Statement (Wollondilly Shire Council, 2020). Table 6-16 below reproduces content that was included in Table 5-11 of the EIS.

Table 6-16 Project alignment with Wollondilly LSPS

Planning priority	Project alignment
1 – aligning infrastructure with community needs	Although the project will contribute to wastewater servicing for large areas in Western Sydney, the project scope does not include providing wastewater services in the Wollondilly LGA. The project has been redesigned in consultation with Wollondilly Shire Council to avoid conflict with potential future upgrades of the Nepean River road crossing at Wallacia.

Planning priority	Project alignment
7 – cultivating a creative and cultural destination connecting people with places	Sydney Water has avoided or minimised impacts on heritage where practical and developed measures to manage its potential impacts.
8 – enhancing vibrant, healthy and sustainable local towns and villages	Warragamba and Silverdale are listed under this planning priority. The project is expected to have limited impact on these townships as the environmental flows pipeline will be constructed underneath these communities using tunnelling methods.
12 – Valuing the ecological health of Wollondilly's waterways	The operational releases from the AWRC to Nepean and Warragamba Rivers will be very high and high-quality treated water. This provides the opportunity to replace some of the proposed environmental flows from Warragamba Dam.
13 – Protecting biodiversity and koala habitat corridors 15 – delivering an urban tree canopy	Sydney Water has avoided and minimised the project's biodiversity impacts where practical and will restore impacted areas and offset impacts where relevant. The project is unlikely to impact koalas.
14 – planning high quality and well connected open spaces	Given the pipelines are largely below ground, the project is unlikely to impact on future open space strategies.
16 – enhancing and protecting the diverse values of the Metropolitan Rural Area	Project infrastructure will be located in the Metropolitan Rural Area. Sydney Water does not expect the project to fragment rural areas or prevent continuation of rural land uses. Some rural areas will be temporarily affected by construction activities, mostly along existing roads and in several areas where construction compounds or waterway releases structures are required.
18 – living with climate impacts and contributing to the broader resilience of greater Sydney	Given the pipelines will be built below ground, they have minimal risk to or from natural hazards. The operational releases from the AWRC to Nepean and Warragamba Rivers will be very high and high-quality treated water. This provides the opportunity to replace some of the proposed environmental flows from Warragamba Dam. This will provide greater resilience to Sydney's drinking water supply.

Local Environmental Plan

Section 5.2.1 of the EIS addresses local environmental plans relevant to the project, including Wollondilly Local Environmental Plan 2011. Section 5.22 of the EP&A Act provides that environmental planning instruments (including local environmental plans) do not apply to State significant infrastructure projects. There are several exceptions to this, including that they are relevant in determining whether the project is development without consent. Accordingly, the EIS considers the Wollondilly Local Environmental Plan 2011 in relation to land use zoning and project permissibility.

Project infrastructure in the Wollondilly LGA includes the environmental flows pipeline, part of the treated water pipeline and their associated release structures. These project components are primarily located in the RU1 and SP2 land use zones as shown in Figure 5-3 of the EIS, with tunnelled components of the environmental flows pipeline also located beneath the RU2 and R2 land use zones. In accordance with clause 2.125 of the State Environmental Planning Policy (Transport and Infrastructure) 2021, this infrastructure is permissible in these land use zones without consent.

Strategic studies relevant to growth in Wollondilly LGA

As outlined in section 2.4 of the EIS, the primary objective of the project is to provide wastewater services to the WSAGA and SWGA, in line with the NSW Government's long-term population forecasts. The key growth areas in Wollondilly LGA are around Wilton and Greater Macarthur. The project does not propose any infrastructure in these areas and it is outside the scope of the project to provide wastewater services to them. Accordingly, the project is expected to have limited interaction with any strategic studies relevant to growth in Wollondilly LGA.

6.5.5 Aboriginal heritage

Issue description

Wollondilly Shire Council raises a concern about the level of consultation with Aboriginal groups and requests the Department of Planning and Environment (DPE) require consultation with the Gundungurra and Darug people before the project is determined.

Response

An Aboriginal Cultural Heritage Assessment Report (ACHAR) (Kelleher Nightingale, 2021) was prepared for the project and formed Appendix O to the EIS. The ACHAR was prepared in accordance with the relevant codes and guidelines including:

- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010a)
- Guide to investigation, assessing and reporting on Aboriginal Cultural Heritage in NSW (OEH 2011)
- Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW 2010b).

Section 10.1.2 of the EIS provides a summary of the Aboriginal heritage consultation activities that were completed for the project. These consultation activities have been summarised in section 8.2.2 of this report.

In addition to consulting with the 26 RAPs through the ACHAR, during EIS preparation, Sydney Water spoke with the Chair of the Consultative Committee for the Gundungurra Indigenous Land Use Agreement and has offered to brief the committee about the project.

Separate to the project, Sydney Water is also completing an Aboriginal Cultural Values Study in consultation with local Aboriginal communities to better understand intangible Aboriginal cultural values of the Western Sydney region, focused on the cultural values of water in the South Creek catchment and parts of Nepean River. This study is separate to the project but its outcomes may help inform ongoing management and design of the project, including design of the green space area on the AWRC site and heritage interpretation. Sydney Water has contacted a broad range of Aboriginal stakeholders (including Gundungurra and Darug people) inviting them to a workshop and to nominate cultural knowledge holders to be involved in the study. In November 2021, Sydney Water sent further information about the study to this broad range of stakeholders, including information about the Upper South Creek Advanced Water Recycling Centre project. This included contact details for people who want to be involved or would like more information.

Sydney Water is committed to undertaking further consultation with Aboriginal communities as the project progresses, through the Community and Stakeholder Management Plan outlined in management measure G08 in Table 15-3 of the EIS and during assessment of changes to impacts on Aboriginal heritage as outlined in new management measure AH06 in Appendix B.

6.5.6 Terrestrial biodiversity

Issue description

Wollondilly Shire Council's submission raises several issues relating to terrestrial biodiversity impacts:

- The submission notes the proposed removal of River flat Eucalypt Forest as part of the pipeline installation for the Warragamba release and suggests Sydney Water be required to minimise the area of this community in the development footprint. Council also notes that the biodiversity assessment adequately identifies impacts and proposes offsets.
- The submission notes the EIS refers to Koala SEPP 2020 but that the relevant document is Koala SEPP 2021. It acknowledges that neither of these SEPPs applies to projects assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. It notes Council's legal advice that Koala SEPP 44 would be applicable and may require additional consideration of koala habitat.
- The submission notes that Council agrees in principle with the measures in the biodiversity assessment and preparation of a Construction Environmental Management Plan (CEMP). It would expect to see measures including activities to minimise and mitigate impacts to biodiversity, detailed pre-clearance surveys, measures to minimise impacts on any identified threatened species and appropriately offsetting any identified hollows in trees for removal.

Response

Each of the points raised by Wollondilly Shire Council is addressed below:

- In relation to minimising the removal of River flat Eucalypt Forest, management measures TB03 and TB04 in Table 15-3 of the EIS include management measures to further minimise vegetation impacts and protect sensitive areas where possible.
- As noted in Council's submission, neither Koala SEPP 2020 nor Koala SEPP 2021 apply to projects assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. In addition, since EIS exhibition, both these SEPPs have been repealed and their provisions incorporated into State Environmental Planning Policy (Biodiversity and Conservation) 2021. Koala SEPP 44 was repealed in 2020 and is not relevant. Despite this, the EIS (section 9.1 and Appendix J) includes a thorough assessment of the project on all relevant biodiversity including the Koala. This included undertaking field surveys and impact assessment in accordance with NSW and Commonwealth requirements. This assessment found that the project would not have a significant impact on Koalas.
- Sydney Water notes that Council agrees in principle with the measures in the biodiversity assessment and preparation of a CEMP. Management measures TB01-TB10 in Table 15-3 of the EIS outline Sydney Water's management measures for minimising biodiversity impacts (including on threatened species), pre-clearance surveys and offsets. The measures also include a Biodiversity Management Plan as part of the CEMP. The Rehabilitation Management Plan (management measure G05) also includes a measure about re-use of tree-hollows in rehabilitating areas where native vegetation is removed.

6.5.7 Aquatic ecology

Issue description

Wollondilly Shire Council's submission raises several issues relating to aquatic biodiversity impacts:

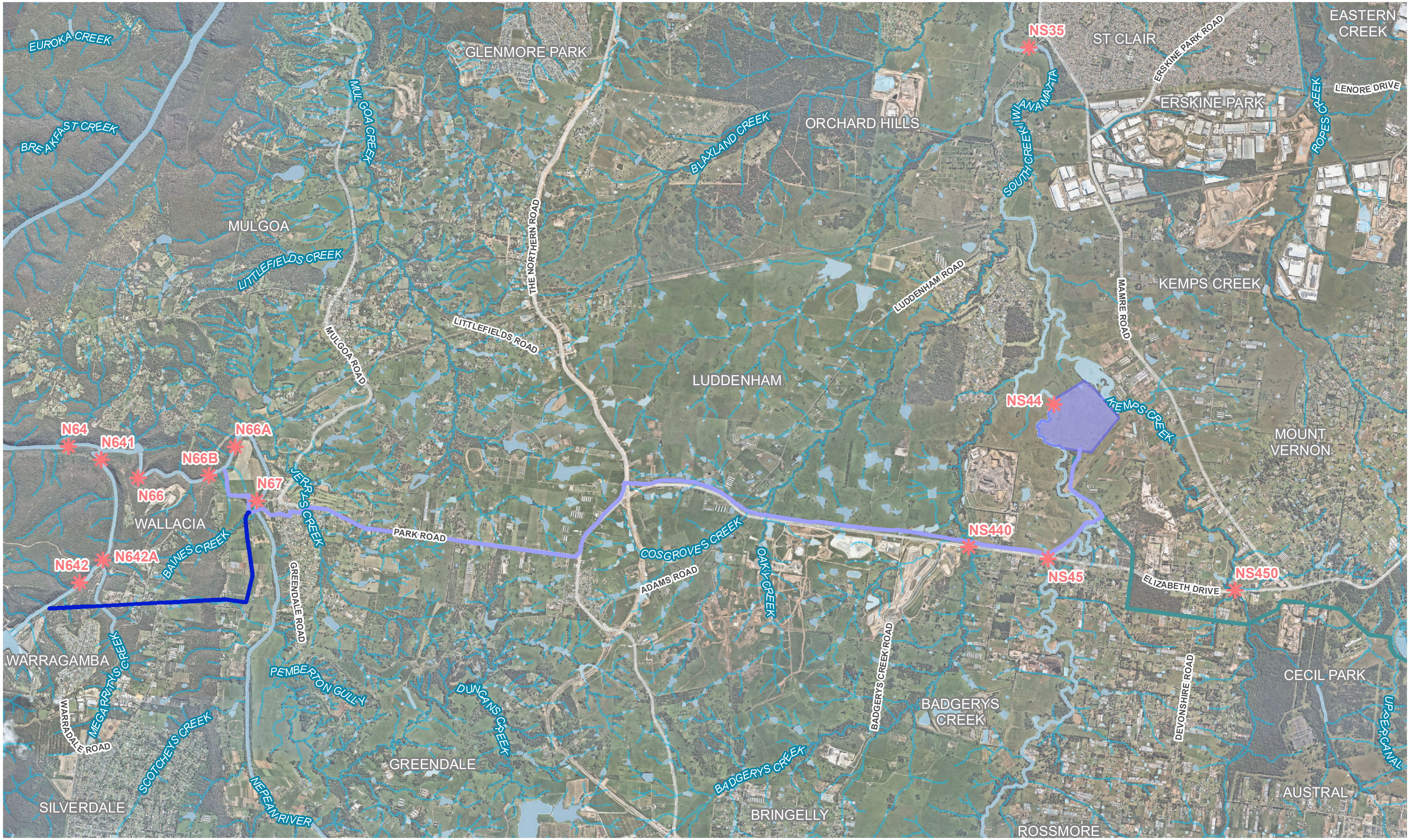
- The submission supports using modelling and monitoring to identify impacts and the assessment of cumulative impacts with the Warragamba Dam wall raising project.
- The submission notes the limitations outlined in the aquatic assessment that modelling is constrained by data availability. It notes this is consistent with advice Council has from its specialists that modelling needs to be supported by baseline data. It recommends DPE require an ongoing aquatic biodiversity monitoring program to support numerical modelling and existing Sydney Water monitoring sites.

Response

Sydney Water notes Wollondilly Shire Council's support for the use of modelling and monitoring to identify impacts and the assessment of cumulative impacts with the Warragamba Dam wall raising project.

In March 2020, Sydney Water commenced baseline monitoring at the locations shown in Figure 6-1. This involves monitoring of surface water quality, macroinvertebrates, macrophytes and fish. Sampling sites are located upstream and downstream of the project's release points to South Creek and Nepean and Warragamba rivers. There are also sites located on Kemps and Badgerys Creek upstream of their confluence with South Creek.

At each site, water quality sampling is undertaken every three weeks and sampling for macroinvertebrates and macrophytes is undertaken each autumn and spring. Fish sampling occurs at seven of the sites twice per year (NS45, NS44, NS35, NS66A, NS66B, N66, N64). The baseline monitoring program will continue until the project starts operating as outlined in management measure WW22 in Table 15-4 of the EIS. Results from the baseline monitoring program assisted in characterising the existing environment.



Environmental monitoring sites

Advanced Water Recycling Centre

Treated water pipeline

Brine pipeline

Environmental flows pipeline

Waterbody

Watercourse

1:77,000

0 1 2 km

Figure 6-1 Location of baseline monitoring

Source: Aurecon, Sydney Water, LPI, Nearmap, ESRI

Projection: GDA2020 MGA Zone 56

Post-commissioning water quality and aquatic ecology monitoring will also be undertaken for a minimum of two years post-commissioning as outlined in management measure WW23 in Table 15-4 of the EIS. The results from the monitoring will be compared to impacts predicted by the water quality modelling.

6.5.8 Surface water

Issue description

Wollondilly Shire Council's submission notes the stormwater assessment has shortcomings in describing potential impacts to surface waters, including a statement in the Executive Summary 'Overall, with the implementation of the proposed mitigation measures, the impacts of stormwater discharges associated with the Project would be acceptable during both the construction and operation phases.' inferring contravention of the *Protection of the Environment Operations Act 1997.*

The submission also notes that assessment of impacts and management measures during construction of pipelines and underboring the Nepean River is generic in nature. Council supports preparation of a Soil and Water Management Plan and water quality monitoring program as part of the CEMP and requests these plans be required to have a demonstrated outcome of negligible impacts to watercourses and definitive actions with measurable performance indicators. Council also requests that these plans are received and acceptable prior to commencement of work.

Response

Sydney Water is not proposing that the project will contravene the *Protection of the Environment Operations Act 1997*. The project will obtain an environment protection licence under this Act for construction and operation as outlined in sections 5.2.5 and 5.2.6 of the EIS. Sydney Water also proposes a range of management measures in Table 15-3 of the EIS (measures SW01 to SW07) to effectively manage surface water during construction and operation.

Sydney Water considers that the assessment of stormwater impacts associated with pipeline construction and tunnelling beneath the Nepean River is commensurate with the project's expected impact. Section 9.2 and Appendix K of the EIS detail the approach taken to assess impacts to surface water in these locations during project construction and operation.

During construction, potential impacts to surface water are temporary while construction activities are underway and can be effectively managed by measures such as erosion and sediment control considering the guidance in Managing Urban Stormwater: Soils and Construction Guide Volume 1, 4th Ed. (Landcom, 2004). This and a range of other measures will be included in a Soil and Water Management Plan as part of the CEMP for the project.

During operation, pipelines are expected to have a minimal impact on surface water because they will be located underground. All potential impacts are considered negligible or low and relate to a minor increase in impermeable surfaces from above ground structures at the Warragamba and Nepean River release locations and releases from occasional pipeline maintenance. These pipelines will become part of Sydney Water's existing network and therefore managed in accordance with its existing management systems.

Sydney Water notes that Wollondilly Shire Council supports the preparation of a Soil and Water Management Plan as part of the CEMP. As outlined in measure G01 in Table 15-3 of the EIS, the CEMP will be in place prior to construction and be prepared in accordance with Environmental Management Plan Guideline – Guideline for Infrastructure Projects (DPIE, 2020b). This guideline requires environmental measures to have measurable outcomes.

Sydney Water notes that Council supports a water quality monitoring program. The monitoring program is already in place. Sydney Water has commenced a baseline water quality monitoring program which will continue until the project starts operating (refer to management measure WW22 in Table 15-3 of the EIS), and then move to a post-commissioning phase (management measure WW23 in Table 15-3 of the EIS). The program describes monitoring actions to be undertaken and will not have a negative impact on watercourses.

6.5.9 Noise and vibration

Issue description

Wollondilly Shire Council's submission raises concerns about potential noise impacts at receivers around compounds C1 and C2 for environmental flows pipeline tunnelling and requests where possible works should be carried out in daylight hours only.

Response

Sydney Water considered several alignment options for the environmental flows pipeline, as outlined in Table 3-7 in section 3.4.3 of the EIS. Compounds C1 and C2 are required to support the tunnelling activities for the construction of the environmental flows pipeline between Bents Basin Road and Warragamba River. Due the length of the tunnelled alignment between Bents Basin Road and Warragamba River and the complexity of construction, it is ideal that this work is completed 24/7. Around the clock construction will reduce:

- the overall construction timeframe and duration of impacts to residents
- potential for bore to fail if tunnelling activities are continually paused, which may result in the pipeline construction being unsuccessful
- potential for groundwater and drilling fluid to escape the bore and enter the environment if pumps are switched off.

Management measure NV06 in Table 15-3 of the EIS commits to consulting with residents who will be impacted by out of hours work (OOHW), including those on Bents Basin Road impacted by compound C2. Consultation will include managing impacts in accordance with the Interim Construction Noise Guidelines (ICNG). Management measure NV01 in Table 15-3 of the EIS commits to preparing a Construction Noise and Vibration Management Plan for the project which will include appropriate management measures to minimise noise impacts from the project.

As the project continues into detailed design and construction planning, there may be opportunities to reduce the potential noise impacts from these tunnelling works on surrounding residents. Sydney Water will continue to consult with impacted residents and landowners as outlined in management measure G08 in Table 15-3 of the EIS.

6.5.10 Soils and contamination

Issue description

Wollondilly Shire Council's submission notes reference to asbestos impacted soils at Warragamba Viewing Platform and Eighteenth Street. Council considers existing contamination risks and soil quality are not a constraint to pipeline construction and operation in this location. The submission also notes that potential impacts and mitigation measures are outlined in the EIS and further site specific investigations are proposed.

Response

Sydney Water notes Wollondilly Shire Council's response on contaminated land impacts and it has not raised any issues that require further response.

6.5.11 Issues beyond the scope of the project

Issue description

Wollondilly Shire Council requests DPE note and provide a response about the project being planned, delivered and accelerated at a higher level than other development for the Wilton Priority Growth Area without commitment for a similar scheme. Council also notes inconsistencies with nutrient loads and impacts between the project and the Picton Water Recycling Plant and considers a level of concurrency and transparency is needed across the areas covered by the Western City District Plan.

Response

Sydney Water notes that this request is directed to DPE but Sydney Water's response is included here for completeness.

Servicing of the Wilton Priority Growth Area and nutrient loads and impacts associated with the Picton Water Recycling Plant are issues that are beyond the project's scope and servicing area and it is therefore not relevant to further address them here.

Wollondilly Shire Council has raised these matters with Sydney Water in consultation on other relevant projects. Sydney Water is continuing to plan for a solution to service growth in the Wollondilly LGA and to consult with Council as this progresses.

7 Response to organisation submissions

> This chapter provides Sydney Water's response to issues raised in submissions from organisations and stakeholder groups.

Two submissions were received from organisations in this category. Each submission has been addressed separately and broken down into discrete issues. Appendix A summarises the submissions received, categories of issues raised and the section in the submissions report where they are addressed.

Appendix B is based on Tables 15-3 and 15-4 in the EIS. Those tables in Appendix B contain new or amended management measures resulting from a submission. The new measures shaded orange and changes to existing measures in red text.

7.1 Endeavour Energy

7.1.1 Utility provider procedures and requirements

Issue description

Endeavour Energy notes that Sydney Water should continue to complete the application for connection of additional load process with Endeavour Energy's Network Connections Branch.

Endeavour Energy also notes in its submission that the recommendations and comments provided in the previous submission for the Secretary's Environmental Assessment Requirements (SEARs) for the project remain valid.

Response

Sydney Water will continue to complete the application for connection of additional load process with Endeavour Energy's Network Connections Branch including requesting certification for the proposed method of supply. Sydney Water has appointed Ultegra (Citywide Group) as their Accredited Service Provider (ASP) to commence this work for the supply to the Advanced Water Recycling Centre (AWRC) site.

As design progresses, Sydney Water will apply formally to Endeavour Energy for low voltage supply to the brine pipeline connection location at Lansdowne Reserve, Lansdowne and the treated water flow splitter structure at Bents Basin Road, Wallacia. The ASP for this work will be selected during the detailed design phase.

Sydney Water notes the recommendations and comments previously provided by Endeavour Energy in their submission for the SEARs, which have been addressed in section 13.2 of the EIS.

7.2 Western Sydney Leadership Dialogue

7.2.1 Support for the project

Issue description

Western Sydney Leadership Dialogue's submission supports the project for a range of reasons, including:

- A comprehensive EIS has been completed.
- It helps advance a sustainable and prosperous future for the people of Greater Western Sydney.
- It provides a wastewater service for future population growth.
- It is flexible and adaptable and demonstrates planning agility by staging the project allowing future technology and circular economy opportunities to be accommodated.
- It has included thorough community engagement which gives social licence to the project.
- It moves to assessing the project using a cost benefit approach.
- It provides the potential for water recycling and contributes to evolving aspects of Sydney's water system, including increasing optionality and diversity of water sourcing.
- It incorporates measures to manage community impacts.
- The option selected provides the best pathway for water recycling.
- It produces treated water suitable for a range of uses.
- It demonstrates Sydney Water's utilities leadership.
- It contributes to the green spine along South Creek and has the potential to contribute to urban cooling and environmental flows.
- It contributes to activating post-COVID economic recovery.

Response

Sydney Water notes Western Sydney Leadership Dialogue's support for the project and considers that no further response is required.

8 Response to individual submissions

This chapter provides Sydney Water's response to issues raised in submissions from individuals.

Four individuals made submissions on the project. Each submission has been addressed separately and broken down into discrete issues. Appendix A summarises the submissions received, categories of issues raised and the section in the submissions report where they are addressed. In some instances, the subsections below respond to more than one issue, where the issues are related or very similar.

New or amended management measures resulting from a submission have been noted in the response and added to the management measures in Appendix B. Appendix B is based on Tables 15-3 and 15-4 in the EIS, with new measures shaded orange and changes to existing measures in red text.

8.1 Steven Broussos

8.1.1 Support for the project

Issue description

The submission notes support for the project and that if water is recycled by the project, perhaps drinking water could be harvested further upstream with minimal disruption to the amount of water.

Response

Sydney Water notes this submission's support for the project. In relation to the project's provision of recycled water, as noted in section 3.5 of the EIS, the Advanced Water Recycling Centre (AWRC) will produce high-quality treated water suitable for a wide range of uses including environmental flows, third pipe recycled water to homes, businesses (such as data centres), agriculture (including intensive agriculture) and open space. In addition, future uses could include adapting the AWRC for supplying purified water for drinking, subject to community support and government policy change.

In relation to the project's contribution to drinking water supplies, whether treated water is recycled or transferred to the Nepean or Warragamba Rivers as environmental flows, it will save drinking water supplies upstream in Warragamba Dam. This is because it can replace some drinking water that would otherwise be released from Warragamba Dam to support environmental flows or used by Sydney Water's customers for non-drinking purposes such as irrigation.

8.2 Matthew Fowler

8.2.1 Terrestrial biodiversity

Issue description

The submission raises concerns about impacts on *Diuris pedunculata ss* RBr, ground or terrestrial donkey orchid.

Response

The Biodiversity Development Assessment Report (BDAR) in Appendix J of the EIS completed an extensive desktop assessment to identify the likely flora species of concern within the project footprint, based on NSW government database records and habitat in the project's impact area. Detailed field investigations were then undertaken to ground truth the desktop assessment and record any additional biodiversity values not previously identified. No records of *Diuris pedunculata ss* RBr, ground or terrestrial donkey orchid, have been identified and therefore no impact to this species is anticipated as a result of the project.

8.2.2 Aboriginal heritage

Issue description

The submission mentions Mulgoie aka Mulgaway aka Mulgoa elders and Gundangurrah and their potential interest in drafting a submission. It notes that Gundangurrah referrals other than known, "registered" organisations, which might be influenced by others, "not of country" ie have no allodial title authority to, "speak for country".

The submission notes the author is very concerned about the apparent lack of established cross-cultural awareness, protocols, competencies.

Response

Sydney Water notes the submission's concern about consultation with Aboriginal communities. The consultation activities for the project were open, transparent and provided opportunity for any interested community members to contribute.

An Aboriginal Cultural Heritage Assessment Report (ACHAR) (Kelleher Nightingale, 2021) was prepared for the project and formed Appendix O to the EIS. The ACHAR was prepared in accordance with the relevant codes and guidelines including:

- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010a)
- Guide to investigation, assessing and reporting on Aboriginal Cultural Heritage in NSW (OEH 2011)
- Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW 2010b).

Section 10.1.2 of the EIS provides a summary of the Aboriginal heritage consultation activities that were completed for the project. Table 8-1 summarises the Aboriginal community engagement undertaken for the project.

Table 8-1 Summary of Aboriginal community engagement

Activity	Details
Government agency notification letters	Letters were sent to relevant local government and NSW Government agencies on 1 April 2020. Copies of the letters are included in the ACHAR.
Advertising for registered stakeholders in local media	Advertising in The Sydney Morning Herald on 16 April 2020.
Notification of closing date for registration	Notification indicated a final closing date for registration of 30 April 2020. Twenty-six Aboriginal community individuals and groups registered their interest in being a Registered Aboriginal Party (RAP) for the project.
Provision of project information and proposed cultural heritage assessment methodology	Project information and a draft methodology was provided to registered parties and allowance made for a 28-day review period which ended on 29 May 2020. Comments received were considered in finalising the methodology for preparation of the ACHAR.
Provision of draft ACHAR for review	Draft ACHAR issued to RAPs on 5 May 2021 (a minimum 28-day review period was provided and submissions were accepted beyond the 28-day period). Submissions were received from five RAPs and were considered in finalising the ACHAR.
Ongoing consultation with the local Aboriginal community	Sydney Water has sought to maintain an ongoing dialogue with the Aboriginal community through both the formal ACHAR consultation process, and through existing stakeholder interactions which occur independently of the project.

In addition to consulting with the 26 RAPs through the ACHAR, during EIS preparation, Sydney Water spoke with the Chair of the Consultative Committee for the Gundungurra Indigenous Land Use Agreement and has offered to brief the committee about the project.

Separate to the project, Sydney Water is also completing an Aboriginal Cultural Values Study in consultation with local Aboriginal communities to better understand intangible Aboriginal cultural values of the Western Sydney region, focused on the cultural values of water in the South Creek catchment and parts of Nepean River. This study is separate to the project but its outcomes may help inform ongoing management and design of the project, including design of the green space area on the AWRC site and heritage interpretation. Sydney Water has contacted a broad range of Aboriginal stakeholders (including Gundungurra and Darug people) inviting them to a workshop and to nominate cultural knowledge holders to be involved in the study. In November 2021, Sydney Water sent further information about the study to this broad range of stakeholders, including information about the Upper South Creek Advanced Water Recycling Centre project. This included contact details, for people who want to be involved or would like more information.

8.2.3 Project options

Issue description

The submission notes that the author's father said he "has already got two pipelines and that this would make three, which is unfair."

“The Silverdale Road side verge along "Grove Farm" was reserved for the Sydney Metropolitan Sewerage and Drainage Board.”

The submission notes that the author's father suggested that "the pipeline should go along Silverdale Road, turn right onto Norton's Basin Road then to the river."

Response

Although the submission is not specific about two existing pipelines on the property, it is likely that this and the reference to a reservation along Silverdale Road refers to WaterNSW's Warragamba Pipeline.

Sydney Water's option assessment for the project considered several alternatives to the preferred option, including an option for the pipeline to run along Silverdale Road and Norton's Basin Road as outlined in section 3.4.2 of the EIS. This option was ruled out due to extremely complex construction for the release structure and part of the treated water pipeline, with steep grades, difficult access and environment and heritage constraints.

8.3 Laurence Jones

8.3.1 Issues beyond scope of project and design requirements

Issue description

The submission notes that the author has family in Sydney and often visits. The submission identifies a range of documents that the author suggests demonstrate Sydney Water and the NSW and Commonwealth Government are committed to introducing sewage effluent directly into drinking water supply mains and are misleading the community. The author strongly objects to this. The submission refers to a range of media articles, guidelines and reports and lists a range of people and working groups, some of whom the submission suggests support the direct reuse of sewage effluent. The submission also suggests that direct reuse breaches a range of Australian and worldwide conventions and legislation. The submission questions which overseas indirect and direct potable reuse plants Sydney Water is basing its belief that treated sewage effluent will be 100% safe to consume. It also notes that Sydney Water proposes in Stage 1 to introduced planned indirect potable reuse of sewage effluent through a dam and after testing then dispose it into the

Nepean River and Warragamba River where it will enter Warragamba Dam and be withdrawn for human consumption.

Response

As outlined in section 3.5 of the EIS, the project scope does not include direct reuse of treated water for drinking. It does not include introducing treated water into drinking water mains or into Warragamba Dam. Treated water releases to Nepean River will be downstream of Warragamba Dam.

The Advanced Water Recycling Centre (AWRC) will produce a very high-quality water close to drinkable water. To enable purified drinking water supply, an extra treatment process step is required. It is possible that purified recycled water for drinking is an option that could be realised in the life of the AWRC, subject to community sentiment and government decisions, but Sydney Water is not currently seeking approval for this.

8.3.2 Strategic context

Issue description

The submission questions what has triggered the need for the AWRC at this time.

Response

As outlined in section 2.3 of the EIS, the main reason the AWRC is required now is to provide wastewater services to service Western Sydney International Airport from when it opens in 2026 and to service projected growth in the Western Sydney Aerotropolis Growth Area and South West Growth Area.

8.3.3 Construction and operation activities

Issue description

The submission questions who will pay for the plant's construction and who will own it. It also questions who will operate the plant and asks whether it will be Suez or their Australian Water Services.

Response

Every four years, the Independent Pricing and Regulatory Tribunal (IPART) reviews and sets Sydney Water's prices for water, wastewater, recycled water, stormwater and other services. These prices incorporate funding for Sydney Water's capital projects such as the Upper South Creek Advanced Water Recycling Centre. Project funding therefore comes from Sydney Water's revenue from customer bills.

Sydney Water will own the AWRC and intends to contract out its operation for at least the first five years. Sydney Water is currently running a procurement evaluation process to engage a contractor to operate the AWRC, and a decision is likely to be made later in 2022. Sydney Water reserves the right to consider different ownership or operation models in the future.

8.3.4 Operations activities - water quality monitoring

Issue description

The submission questions what testing will take place, how many contaminants will be tested in the treated effluent and at what intervals. It also asks whether the testing will be carried out by an independent body.

Response

As for its other wastewater systems, Sydney Water will obtain an Environment Protection Licence (EPL) for the project from the Environment Protection Authority (EPA). This EPL will specify the testing required for treated water, contaminants to be tested and testing intervals. Sydney Water or its contractors typically do this testing. Section 5.2.6 of the EIS provides more information about the types of contaminants that will likely be monitored.

8.3.5 Stakeholder and community engagement

Issue description

The submission raises several questions about the approvals process, including:

- Which company will be handling the submissions and will they include the number of environmental groups and members, Australian Water Association and Australian Water Services Association Members that submit submissions.
- The newspaper advertisement and information online is meaningless and misleading since Sydney Water is already committed to indirect and direct potable reuse. The advertisement does not mention that Stage 1 involves planned indirect potable reuse of treated sewage effluent. It also does not mention that Stage 2 involves direct potable reuse.

Response

In accordance with the *Environmental Planning and Assessment Act, 1979,* submissions on the project and its EIS were made to the Department of Planning and Environment (DPE). DPE collated submissions and made them publicly available on its website here Upper South Creek Advanced Water Recycling Centre | Major Projects - Department of Planning and Environment (nsw.gov.au). This website includes all submissions received, and none identified themselves as members of environmental groups, Australian Water Association or Australian Water Services Association. DPE provided these submissions to Sydney Water and this report includes Sydney Water's response to issues raised in the submissions.

Although the submission does not specify a particular newspaper advertisement, both DPE and Sydney Water placed newspaper notifications about the project in October 2021. Online information and newspaper notifications do not mention indirect potable reuse or direct potable reuse because neither is part of project scope.

8.4 Nicholas Nasser

8.4.1 Air quality and issues outside scope of project

Issue description

The submission is on behalf of owners of a property immediately adjacent to the Advanced Water Recycling Centre (AWRC) site and objects to the project. The submission notes that based on planning for the Mamre Road precinct the owners expected most of their land could become part of an employment hub, bordered to the south by a university hub.

The submission notes that use of the AWRC site for a sewage treatment plant changes the landuse from a university hub and affects the potential future uses of their land. The submission notes the importance of the project in servicing Western Sydney but raises concerns that the owners' land adjacent to the AWRC site will not be suitable for Environment and Recreation uses given it is adjacent to the AWRC.

The submission notes a lack of clarity in the size of the AWRC in the odour assessment and that the AWRC will ultimately be larger than expected.

The submission also requests Sydney Water purchases part of the owners' land that they consider will be sterilised by the AWRC.

Response

Land use zoning in the Mamre Road precinct is not Sydney Water's responsibility and is therefore not addressed further here. However, sewage treatment plants are a permitted land use on the existing rural zoning of the AWRC site. The AWRC is located in the Kemps Creek precinct of the Western Sydney Aerotropolis, which has not yet been rezoned. However, Sydney Water considers the AWRC is compatible with the proposed adjacent land use zoning, which is outlined in the Western Sydney Aerotropolis Plan (NSW Government, 2020) as being primarily Enterprise and Environment and Recreation.

Land use zoning for the purposes of environment or recreation is common adjacent to Sydney Water's wastewater treatment plants and water recycling plants across Sydney, with examples in Western Sydney including at Penrith, St Marys, Castle Hill, Rouse Hill and Liverpool.

As part of the project, Sydney Water has undertaken extensive environmental investigations and identified the potential worst case impacts that may arise from the project, including amenity impacts (such as noise, odour and visual impact) on current and potential future receivers near the AWRC. The submission does not raise specific impacts of concern, but Chapter 11 of the EIS assesses amenity impacts in detail and demonstrates compliance with relevant legislation, guidelines and policies in relation to potential offsite impacts on neighbouring properties. The EIS also includes a range of management measures to further minimise impacts and to continue consulting with surrounding residents and landowners.

The submission references the odour study for the project and the size of the AWRC assessed. Sydney Water prepared the EIS, including the odour assessment, focusing on Stage 1 of the AWRC, where it operates to treat up to 50 ML/day of wastewater. This is because Sydney Water is seeking approval to build Stage 1 of the project now and will prepare another EIS in the future to seek approval to expand the AWRC to treat up to 100 ML/day of wastewater. However, the odour assessment in Appendix R of the EIS also includes modelling of the expected odour impacts when the AWRC is expanded to 100 ML/day to demonstrate the project's potential impacts at its ultimate size and its compliance with EPA offsite odour criteria.

Given compatible land use zoning in the area and impacts complying with relevant guidelines, Sydney Water considers that the land referenced in this submission and zoned Environment and Recreation is not sterilised by the AWRC and the AWRC does not prevent its use for this purpose.

As outlined in EIS management measure G08, as part of its Community and Stakeholder Engagement Plan, Sydney Water will continue to consult with this landowner and other landowners surrounding the AWRC site as the project progresses, to understand specific concerns about the project, keep them informed and resolve any issues raised.

9 Updated project justification

This chapter updates the project justification in section 15.6 of the Environmental Impact Statement (EIS), taking into account issues raised in submissions and project amendments proposed since EIS exhibition.

9.1 Project need

The EIS noted a range of drivers for the project which are briefly summarised below and outlined in more detail in section 15.6.1 of the EIS:

- Significant residential and economic growth is expected in the Upper South Creek Servicing Area over the next 35 years, and wastewater treatment is crucial to enable and support that growth.
- The Western Sydney City Deal includes commitments from a partnership between Commonwealth, NSW and local government that is fundamental in delivering the Western Parkland City vision. The project forms part of the backbone infrastructure to ensure government commitments in the Western Sydney City Deal can be realised.
- A new wastewater treatment plant with advanced treatment is critical to:
  - avoid long-term reliance on on-site systems, such septic tanks, because they are not suitable in urban environments to treat large wastewater volumes
  - redirect wastewater flows temporarily being directed to Sydney Water's Liverpool and West Camden Water Recycling Plants (WRPs)
  - provide an advanced treatment process with reduced nutrient loads so treated water can be released to the Hawkesbury-Nepean river system.

Several submissions either explicitly supported or acknowledged the need for the project in facilitating development of the Western Parkland City, including submissions from Western Parkland City Authority, Fairfield City Council, Liverpool City Council, Penrith City Council, Western Sydney Airport and Western Sydney Leadership Dialogue.

Western Sydney Planning Partnership also noted that it considers the project is consistent with the vision, objectives and principles in the Western Sydney Aerotropolis Plan (WSAP), in particular the key consideration to deliver water and wastewater infrastructure and to enable the Upper South Creek Advanced Water Recycling Centre (AWRC) to be delivered.

Several submissions questioned timing of the project, in terms of why the project is needed now and whether the project can be delivered early to service development in the Liverpool local government area. Sydney Water considers these matters are appropriately addressed in sections 8.3.2 and 6.3.11 of the Submissions Report respectively and the project timing remains as outlined in the EIS. One individual submission opposed the project on the basis that the submitter understood the project was proposing direct reuse of treated water for drinking. As outlined in the EIS and reiterated in section 8.3.1 of this report, this is not part of project scope.

No submissions raised concerns about or support for the need to provide a centralised wastewater treatment system for new development rather than relying on septic tanks. Similarly, no submissions mentioned the need to transfer flows from existing treatment systems at capacity. Penrith City Council and Wollondilly Shire Council made comments about servicing of particular areas. Although this is out of project scope, Sydney Water has addressed these matters in sections 6.4.8 and 6.5.11 of this report respectively.

In terms of the level of treatment, several submissions supported an advanced level of treatment, particularly in relation to meeting the Environment Protection Authority's (EPA) Hawkesbury-Nepean nutrient framework. This included submissions from Penrith City Council and Western Sydney Leadership Dialogue. Submissions raised a range of issues about water quality, level of treatment of different wastewater streams and release locations which are addressed throughout Chapters 5-8. However, these submissions did not question the fundamental need for an advanced level of treatment.

On balance, Sydney Water considers that the submissions were generally supportive or neutral about project need. Sydney Water therefore considers that the project need outlined in the EIS remains valid.

9.2 Key project opportunities

Table 15-6 of the EIS described a range of project opportunities in scope for the project and enabled by the project. Table 9-1 below reproduces this table with an additional column considering relevant matters raised in submissions and whether any of these influence the opportunities identified in the EIS.

Table 9-1 Key project opportunities

Project opportunity	In project scope	Opportunities enabled by the project	Matters raised in submissions
Enabling a circular economy	High-quality treated water to be used as environmental flows in waterways, which can also be made available for reuse locally. Organic material recovered during secondary wastewater treatment processes, known as biosolids, as an alternative to chemical fertilisers in farming and gardening. Renewable energy from co-generation within the AWRC and solar energy generation.	A circular economy hub in the Western Parkland City with opportunities for digestion of additional waste such as food waste (to generate energy and reduce waste to landfill) or co-location of suitable industries. Contributing to the NSW Government's environmental flows regime from Warragamba Dam to offset drinking water releases. Direct augmentation of Sydney's drinking water supplies, subject to future government decisions and community support.	Several submissions raised issues relating to environmental flows, including: • Acknowledgement that treated water releases may present a potential resource to contribute to environmental flows (EPA). • Seeking clarification about the timing and operational regime for environmental flows (WaterNSW). Sydney Water's responses to these are in sections 5.10.5 and 5.15.2 respectively. Although submissions did not comment in any detail on the reuse of biosolids and production of renewable energy, there was general support for circular economy initiatives in several submissions including from Fairfield City Council, Penrith City Council and Western Sydney Leadership Dialogue. Some submissions raised concerns about a food waste hub (Penrith City Council) and direct augmentation of Sydney's drinking water supplies (an individual submission). However, these elements are out of project scope and would be subject to further assessments and approvals if they proceed. Sydney Water considers that the submissions are generally positive or neutral towards these circular economy opportunities, provided: • the opportunities are effectively managed as the project proceeds

Project opportunity	In project scope	Opportunities enabled by the project	Matters raised in submissions
			• further assessment, approvals and consultation occurs for the elements out of project scope.
Supporting the health of South Creek and Nepean River	A green space area on the AWRC site along South Creek to enhance biodiversity on the site, use best practice water sensitive urban design and provide visual screening of the AWRC. The green space area is an important link in the green spine along South Creek envisaged in the NSW Government's vision for the Western Sydney Aerotropolis Growth Area (WSAGA). Treated water releases to support flow and water quality objectives in South Creek through best-practice management of stormwater, transferring treated water to Nepean River in normal conditions and releasing advanced treated water to South Creek in wet weather conditions (blended with primary treated water in severe wet weather). High-quality treated water for environmental flows released to Nepean River or Warragamba River. The water is treated to a high level through an advanced treatment	Public access to the green space area to form part of the Wianamatta-South Creek parkland envisaged in the Western Sydney Aerotropolis Plan.	Several submissions (including Liverpool City Council and Penrith City Council) supported enhancing the green space area, including providing public access and connection to active transport links and adjacent public spaces. Penrith City Council also noted a concern about suitability of the green space area for an open space land use given its location in the 1% Annual Exceedance Probability (AEP) flood zone. Western Sydney Airport raised a concern about ensuring the AWRC site, including the green space area, is effectively designed and managed to avoid contributing to the risk of wildlife strike. As noted in section 4.4.1 of the EIS, Sydney Water will manage these risks as detailed design progresses. In relation to flooding, the operational areas of the AWRC are all outside the 1% AEP flood zone defined by Penrith City Council. Whether Sydney Water progresses with the public access element of the green space area remains subject to management measure UD02 in Table 15-3 of the EIS, where Sydney Water has committed to further consultation with Department of Planning and Environment (DPE) on this matter. In relation to South Creek releases, several submissions supported not releasing dry weather flows to South Creek (including DPE Biodiversity and Conservation Division (BCD) and WaterNSW). However, one submission (Penrith City

Project opportunity	In project scope	Opportunities enabled by the project	Matters raised in submissions
	process that produces water so clean it could be used for drinking. This helps protect aquatic ecosystems, reduce weeds and the frequency of algal blooms. It also protects the values of the downstream Blue Mountains World Heritage Area.		Council) indicated a preference for releases to South Creek over releases to Nepean River. Some submissions sought further justification or detail about wet weather or stormwater releases to South Creek, particularly EPA and DPE BCD. These are addressed in Sydney Water's responses to a range of issues in sections 5.10 and 5.4. Sydney Water considers that the responses in this report address the matters raised in those submissions about South Creek releases. Wet weather releases to South Creek remain part of project scope for which Sydney Water is seeking approval. Issues raised about environmental flows to Nepean and Warragamba River are discussed in the previous row of this table. Various submissions sought further clarifications about the project's impacts on aquatic ecosystems, frequency of algal blooms or impacts on the Blue Mountains World Heritage Area, including EPA, DPE BCD, Penrith City Council and Wollondilly Shire Council. Sydney Water has responded to these in Chapters 5-8 of this Submissions Report. Sydney Water is committed to best practice wastewater treatment and has designed the project to produce the highest quality of treated water to protect and enhance waterways. Sydney Water considers that the EIS and this Submissions Report demonstrate the negligible impacts of these releases on waterways and potential benefits to aquatic ecosystems in Nepean River.

Project opportunity	In project scope	Opportunities enabled by the project	Matters raised in submissions
Liveability, productivity and sustainability in Western Sydney	Produce high-quality recycled water suitable for a range of uses supporting liveability, productivity and sustainability. Urban design of the AWRC and green space area to align with place-making principles and celebrate the site's Aboriginal and non-Aboriginal heritage.	Use recycled water to support some or all of the following uses: • complement stormwater (top-up of rainwater and stormwater tanks/basins), in the irrigation of open spaces and street trees to provide cooling and support recreational or sporting activities and active transport for residents and workers in Western Sydney. • industrial processes and cooling towers to support industries around Western Sydney International Airport • food production in the Agribusiness Precinct.	General support for recycled water use was noted in several submissions including Penrith City Council, Greater Sydney Parklands, and Liverpool City Council. Some submissions also advocated for specific elements of recycled water use including: • Stormwater top up (DPE BCD) • Preference for recycled water use over release to waterways (Wollondilly Shire Council). One individual submission opposed the project on the basis that the submitter understood the project was proposing direct reuse of treated water for drinking. As outlined in the EIS and reiterated in section 8.3.1 of this report, this is not part of project scope. Some submissions suggested that recycled water (Penrith City Council) or stormwater integration (DPE BCD) be considered a core part of project scope rather than a future opportunity. Sydney Water's position remains that the project for which approval is being sought now will produce treated water suitable for a range of recycled water uses. However, the schemes to deliver this recycled water to users are outside project scope and subject to separate approvals. Limited specific issues were raised about place-making principles and celebrating the AWRC site's heritage. Penrith City Council noted support for aligning with the principles of the Greener Places strategy and developing a Heritage Interpretation Plan for the site. Sydney Water will continue to progress these opportunities as outlined in the EIS.

9.3 Biophysical, social and economic impacts

As a fundamental part of options selection and design for the project, Sydney Water has identified opportunities to avoid and minimise the project's biophysical, social and economic impacts. This included:

- designing a treatment plant using best-practice technology to ensure the highest quality of water is released to waterways
- selecting project infrastructure locations and refining alignments to avoid biodiversity and heritage constraints
- proposing construction methodologies such as tunnelling or narrower construction corridors to further avoid or minimise impacts.

Chapter 3 of the EIS documents these in more detail.

The EIS completed a comprehensive assessment of the project's residual impacts, including biophysical and socio-economic impacts as summarised in Table 15-3 of the EIS. The EIS noted that although some impacts remain, they could be effectively managed through the measures outlined in that table.

As detailed in Chapter 3 of this report, of the 430 issues raised in submissions, 73% related to economic, environmental and social impacts. Of the biophysical, social and economic matters assessed in the EIS, submissions raised issues on most of these, with the exception of waste management and sustainability.

The categories with most issues raised overall were hydrodynamics and water quality, flooding, terrestrial biodiversity, aquatic ecology, noise and vibration and surface water. The categories raised in the most submissions were terrestrial biodiversity, aquatic ecology, noise and vibration, surface water and Aboriginal heritage.

One submission explicitly supported the project and three explicitly opposed it. The remaining submissions provided issues for further consideration, although some also supported or opposed particular project aspects.

Chapters 5-8 of this report provide Sydney Water's response to all issues raised. Preparing these responses included a range of tasks such as:

- clarifying or expanding on content in the EIS on a range of matters
- additional assessment relating to waterway modelling, flooding, surface water, groundwater, aquatic ecology and cumulative impacts which reinforced that project impacts are not significant
- providing further detailed technical information on waterway modelling to EPA and DPE BCD
- providing a copy of the detailed site investigation (for contaminated land) to EPA
- consulting with various stakeholders to follow up matters raised in submissions

- considering changes to statutory and strategic context
- amending existing management measures and adding new management measures to address issues raised, as outlined in Appendix B.

Sydney Water has also prepared a separate Amendment Report (Sydney Water, 2022) seeking approval for changes to several aspects of the project described in the EIS. Sydney Water initiated these changes as a result of consultation with stakeholders during EIS preparation. Some of these matters were also raised in submissions as outlined below:

- Realignment of brine pipeline and construction compound near Bartley Street in Cabramatta, which was raised by Fairfield City Council. The project amendment is proposed to avoid impacts to Cabravale Memorial Park.
- Realignment of brine pipeline alignment and change in construction methodology around Kemps Creek, which was raised by EPA, DPE BCD and Penrith City Council. The project amendment is proposed to reduce removal of native vegetation by using an existing cleared pipeline corridor. In addition, the construction method to cross Kemps Creek will involve tunnelling through an existing pipeline casing rather than open trenching.
- Minor realignment of brine pipeline through Western Sydney Parklands which was raised by Greater Sydney Parklands. The project amendment is proposed to avoid a paved road and fencing in the Western Sydney Parklands.

Sydney Water has provided a comprehensive response to issues raised on biophysical, social and economic impacts (including strengthening management measures) and has reduced the project's impacts as described in the EIS. Sydney Water considers that the EIS conclusion about the project's biophysical, social and economic impacts remains valid. That is, although some impacts remain as a result of the project, they can be effectively managed through the measures outlined in Table 15-3 of the EIS and updated in Appendix B of this report.

Cumulative impacts

The EIS assessed cumulative impacts associated with other major projects in the vicinity, including:

- Western Sydney International Airport
- M12 Motorway
- Northern Road upgrade (Glenmore Road to Bringelly Road)
- Sydney Metro – Western Sydney Airport
- Warragamba Dam wall raising.

The assessment also considered the changing nature of the environment in the WSAGA, where much of the project infrastructure is located. Urban development in this area will require extensive construction activity and result in substantial changes in the landscape over time.

Several submissions raised issues about effective management of cumulative impacts including:

- Amenity impacts with projects where construction schedules are likely to overlap (for example the M12 Motorway and Sydney Metro – Western Sydney Airport). Matters raised included construction traffic (Transport for NSW, Penrith City Council), noise and vibration (EPA) and general construction impacts (Western Sydney Airport).
- Other catchment inputs with potential to impact waterways including in relation to impacts on infrastructure (WaterNSW) and waterway health (Penrith City Council, EPA, DPE-BCD).
- Risk of wildlife attraction (Western Sydney Airport).

Chapters 5-8 respond to all of these matters, which Sydney Water considers can be appropriately managed through the management measures in Appendix B.

Several submissions also raised cumulative impacts with Warragamba Dam wall raising project (Penrith City Council, DPE BCD). Section 5.4.46 includes further consideration of the project's cumulative impacts with the Warragamba Dam wall raising project, based on information available in its EIS, which was not available at the timing of writing the EIS for the Upper South Creek AWRC project. The project's contribution to cumulative impacts with the Warragamba Dam wall raising project is minor.

The EIS concluded that the project makes a small contribution to cumulative impacts with other major projects given the measures taken to avoid and minimise impacts. Sydney Water considers this statement remains valid.

9.4 Ecologically sustainable development

Table 15-7 of the EIS demonstrated project alignment with ecologically sustainable development (ESD) principles as defined in the now repealed clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000, which has been replaced with clause 193 of the Environmental Planning and Assessment Regulation 2021.

Table 9-2 reproduces this table with an additional column to consider whether any issues raised in submissions influence project alignment with ESD principles.

Table 9-2 Project alignment with ESD principles

ESD principle	Project alignment with ESD principles	Matters raised in submissions
Precautionary principle	The precautionary principle relates to the scientific uncertainty about environmental impacts during decision-making processes. It states that where there is potential for irreversible environment impact and degradation, the absence of complete scientific certainty should not be a reason to postpone management measures to prevent the potential impact. This principle was considered throughout the options assessment and reference design processes in deciding the preferred location for the AWRC and pipeline alignments and the approach to construction and design. Multi-criteria analysis and risk assessments have been completed throughout the project to ensure serious and adverse damage to the environment is avoided. The EIS communicates and assesses the potential environmental impacts associated with the construction and operation of the project. The EIS has assessed worst-case impacts and has completed detailed technical environmental assessments to minimise environmental risks and identify appropriate environmental management measures. Throughout development of the EIS, Sydney Water has collaborated with the community and relevant government departments and agencies which has further informed the design and impact assessment process. Due to uncertainty in population growth forecasting in the servicing area of the project, multiple sizing and capacity options for the AWRC were considered. The EIS has assessed the worst-case scenario by assessing a larger sized plant. An initial Infrastructure Sustainability Council of Australia (ISCA) pathway assessment has been completed to assist the project in moving beyond a compliance approach to one that ensures best practice in sustainability and environmental responsibility. There has been a specific focus on ensuring that the AWRC has reduced its carbon emissions as far as practicable, by reducing the reliance on energy from the grid and incorporating technologies, such as photovoltaic solar and co-generation, to produce energy.	One submission explicitly raised the precautionary principle. DPE BCD noted limitations outlined in the EIS in relation to waterway modelling. The submission suggested additional effort should be applied to determine nutrient loads and flows into the Greater Blue Mountains World Heritage Area to demonstrate alignment with the Strategic Plan for this area that requires application of the precautionary principle. Section 5.4.21 responds to this issue and clarifies nutrient loads and flows into the Greater Blue Mountains Area. Sydney Water considers the assessment in the EIS and the additional clarifications represent a strong understanding of potential impacts and benefits on the Greater Blue Mountains Area, using industry best-practice approaches. This will be verified through the water quality monitoring program proposed in Table 15-4 of the EIS and updated in Appendix B of this report. Sydney Water considers that the project continues to align with the precautionary principle.

ESD principle	Project alignment with ESD principles	Matters raised in submissions
Inter-generational equity	Inter-generational equity relates to the equal distribution of economic, social and environmental costs and benefits for current and future generations. The AWRC will be delivered in stages, meaning it can provide wastewater and recycled water services to current and future generations. The environmental assessment and design of the project has considered intergenerational equity by considering the future ultimate capacity of the system and taking into consideration future sensitive receivers. The project's resilience to future changes in climate has been assessed, with specific adaptation measures incorporated into the design and operation. The AWRC will produce treated water suitable for a range of uses which can contribute to water resilience for future generations where the availability of water may reduce under future climate change scenarios. The components of the AWRC have a specific design life, however, the operation of the AWRC as a whole will be required well into the future and will support the needs of the current and future populations in Western Sydney. The project has been designed with a focus on energy efficiency and reduced carbon footprint during operation. This approach will reduce the reliance on the power grid for energy and incorporate technologies, such as solar and co-generation, to produce energy. This will reduce the greenhouse gas emissions of the project and contribute to slowing climate change. Construction and operation of the project will result in the consumption of fossil fuels, including diesel, which may negatively impact future generations. The project is considered to align with the principle of inter-generational equity firstly through its consideration of the long-term needs of its stakeholders and the community and has sought to embed ESD principles throughout the design and planning process to achieve these desired outcomes. This has resulted in the uptake of sustainability initiatives which have been integrated into the design and the decision-making process to ensure consistent actions towards desired outcomes through the life of the project, while advancing its social, environmental and economic performance.	No submissions raised the principle of inter-generational equity. However, several submissions supported the project's objective of servicing future development in the Aerotropolis and surrounding areas and contributing to a circular economy. Sydney Water considers that the project continues to align with the principle of inter-generational equity.

ESD principle	Project alignment with ESD principles	Matters raised in submissions
	The project will ensure that consumption of resources and materials during construction and operation will be significantly reduced compared to a ‘business-as-usual’ approach. This will be achieved through applying the rigorous standards prescribed by in the ISCA rating tool. A waste management plan will also be developed to ensure waste is reduced as far as possible and to prioritise diversion from landfill.	
Conservation of biological diversity and ecological integrity	Minimising and avoiding impacts to biodiversity and maintaining ecological integrity is a fundamental component of the outcome of the project. Impacts to biodiversity were considered throughout the development of the reference design, including the options selection process for the AWRC as outlined in Chapter 3. The reference design process was completed with the aim to identify biodiversity constraints, avoid, minimise and manage impacts. Sydney Water has designed the project to avoid and minimise impacts to biodiversity where possible, including the use of tunnelling construction methodology for some sections of pipelines. This can be seen in areas such as Lansdowne Reserve for the brine pipeline, and along Elizabeth Drive where the treated water pipeline will be tunnelled under several waterways. Alignment changes to avoid sensitive biodiversity, such as through Western Sydney Parklands, and along Park Road, Wallacia were also adopted to minimise the overall biodiversity impact of the project. About 13.77 hectares (ha) of native vegetation across eight plant community types (PCTs) will be cleared for the project. This includes impacts to vegetation listed under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The project will result in the removal of the following threatened flora individuals / habitat: • Downy Wattle – seven individuals, 0.16 ha of known habitat • Native Pear – zero individuals, 0.03 ha of known habitat • Sydney Bush-pea – zero individuals, 0.01 ha of known habitat • Spiked Rice-flower – zero individuals, 2.99 ha of expert mapped habitat	Terrestrial biodiversity issues were raised in eight submissions and aquatic ecology issues were raised in five submissions, with 55 issues raised across both categories. The types of issues raised included: • reducing impacts • impacts on particular species, communities or street trees • scale of impacts (for example Penrith Council noted impacts as comparably small compared to size of project; DPE-BCD noted concern about major biodiversity impacts and disagreed with two conclusions about significance of impact) • further clarification of impacts • assessment methodology and administrative matters • alignment with policy • offsets • conservation activities

ESD principle	Project alignment with ESD principles	Matters raised in submissions
	The project will result in the removal of the following habitat of 'known' threatened fauna: • 1.56 ha low potential breeding habitat for the Large Bentwing-bat • 3.48 ha additional species credit forage habitat for Large –eared Pied Bat • 7.62 ha of species credit habitat for Southern Myotis • 8.95 ha of expert mapped habitat for Cumberland Plain Land Snail • 14.45 ha of expert mapped habitat for Dural Land Snail. The total impact area of the project is about 213 ha, covering over 40 kms of linear area. The removal of 13.77 ha of native vegetation equates to just 6% of the total area impacted by the project. Substantial efforts have been made throughout the project to reduce and minimise impact to native vegetation habitats, and this process has resulted in the residual impacts being largely comprised of degraded, fragmented, and edge effected ecological values. The EIS outlines the management measures to further minimise impacts to biodiversity, and how the impacts will be offset. The project also seeks to improve biodiversity on the AWRC site as part of landscaping the green space area. Project impacts on aquatic ecology are expected to be minor, given the high quality of treated water released and minor expected changes to geomorphology and flows.	• construction methods and restoration, including across waterways. Chapters 5-8 of this report address all terrestrial biodiversity and aquatic ecology issues raised in submissions. In addition, Sydney Water submitted an Amendment Report (Sydney Water, 2022) for the project to DPE in March 2022. The proposed amendments have further reduced the impacts on terrestrial biodiversity and address some of the matters raised in submissions including impacts around Kemps Creek and impacts on waterways. Section 8.3 of the Amendment Report includes revised calculations for the impacts on threatened flora and fauna individuals, habitat and communities. The amendments reduce the overall impact on native vegetation communities by 1.09 ha, with impacts on PCT 849 (Cumberland Plain Woodland in the Sydney Basin Bioregion) reduced by 0.35 ha and impacts on PCT 835 (River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast Sydney Basin and South East Corner Bioregions) reduced by 0.74 ha. Sydney Water remains committed to the terrestrial biodiversity and aquatic ecology management measures outlined in the EIS and has updated some measures in

ESD principle	Project alignment with ESD principles	Matters raised in submissions
		Appendix B of this Submissions Report to address issues raised in submissions. Sydney Water considers that the project continues to align with the principle of conserving biological diversity and ecological integrity.
Improved valuation, pricing and incentive mechanisms	To ensure the successful integration of the principles of ESD and to secure long-term sustainable development, it is important that these measures and incentives are appropriately valued and costed into the project. The project has applied the Infrastruction NSW (INSW) business case gateway template that specifically addresses the social, economic and environmental sustainability requirements of the project. This will ensure ESD is appropriately considered, valued and priced at each stage of the project lifecycle. This is an important approach to the project as it allows for identification of more sustainable and resilient infrastructure as it can be identified and accounted for effectively in the INSW business case process and recognise the long-term value for the community and the environment. Sydney Water will also provide biodiversity offsets for the project in accordance with the Biodiversity Assessment Method, which essentially places a price on biodiversity impacts.	No submissions raised the principle of improved valuation, pricing and incentive mechanisms. Some submissions had specific comments on the logistics of providing biodiversity offsets, including DPI Agriculture and DPE BCD but Sydney Water considers these more administrative than related to this ESD principle. Sydney Water considers that the project continues to align with the principle of improved valuation, pricing and incentive mechanisms.

9.5 Conclusion

The project provides essential infrastructure and an opportunity to improve liveability, sustainability and the environment across the Western Parkland City. It also aligns with ESD principles. Through a rigorous options assessment process, the project has been identified as the best option to achieve project objectives.

Sydney Water has responded to the 430 issues raised across 30 submissions and has strengthened the management measures to address issues raised. Sydney Water has also assessed several project amendments in a separate Amendment Report (Sydney Water, 2022) to further reduce impacts and address matters raised in stakeholder consultation and some submissions.

This additional work supplements the comprehensive assessment of the project's biophysical, social, economic and cumulative impacts in the EIS. The combined assessment in the project's EIS, Amendment Report and this Submissions Report has shown that the project's residual impacts are acceptable and can be effectively managed through implementing a range of management measures.

10 Glossary and Terms

10.1 Glossary

Term	Meaning
50th percentile value	50 percent of sample values (for example flow, concentrations) are lower than this value. 50 percent of sample values are above this value. Equivalent to median
95th percentile value	95 percent of sample values (for example flow, concentrations) are equal to or lower than this value
Acid Sulfate Soils	Soils that contain appreciable sulfide and may general sulfuric acid where exposed to atmospheric oxygen and rainfall
Advanced treated water	Water that is treated to an advanced level, including microfiltration, ultrafiltration and reverse osmosis to filter out very fine particles. Also known as very high quality treated water
Ambient conditions	The existing condition of the receiving waterway including water quality, bathymetry and flow rates
Anaerobic digestion	Anaerobic digestion is part of the wastewater treatment process that occurs where bacterial processes break down organic matter to produce methane gas, which can be used to generate electricity
Ancillary infrastructure	Infrastructure that supports the operation of the AWRC and project pipelines
Annual Exceedance Probability	A measure of the frequency of a rainfall event. It is the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. For example, a one per cent event is a rainfall event with a one per cent chance of being exceeded in magnitude in any given year
Annual median concentrations	The median concentration of a water quality parameter over a one year period
Aquatic ecology	The study of plants and animals that live in rivers and streams
Average dry weather flow	The average amount of incoming wastewater the AWRC receives during operation over a 24 hour period under dry weather conditions
Bankfull	The maximum water level in the waterway channel before overtopping into the floodplain occurs
Bathymetry	The measurement of the depth of water in a watercourse

Term	Meaning
Bioavailable nutrients	Nutrients that are readily available for microbial and plant uptake
Biodiversity stewardship site	Land covered by a biodiversity stewardship agreement to permanently protect and manage land to improve biodiversity value
Bioenergy	A form of renewable energy that is derived from recently living organic materials (biomass)
Biosolids	Organic solids produced during wastewater treatment is processed to convert it into biosolids. Biosolids are a safe fertiliser product and can be used in farming and gardening as an economic alternative to chemical fertilisers
Biota	The animals and plants living in a particular habitat.
Brine	Concentrated solution of salt and other chemicals in water; a by-product of the reverse osmosis process.
Brine pipeline	A pipeline that is used to transport brine for disposal.
Catchment	The land area contributing to surface runoff and flow within rivers and creeks
Cease to flow	Zero flows within the waterway
Circular economy	A circular economy values resources by keeping products and materials in use as long as possible. In a water context, circular economy may include use of water, energy and materials to restore and regenerate the natural environment
Cofferdams	A watertight enclosure from which water is pumped to expose the bed within a waterway to allow safe construction
Co-generation	A process where gas generated in wastewater treatment is delivered to engines that convert it to electricity. A type of renewable energy
Confluence	The place where two or more waterways join
Contaminated land	The presence within land of a substance at a concentration above the level the substance is normally present in the land and that may also harm human health or any other aspect of the environment
CORMIX near field and toxicity modelling	Numerical software for the analysis of near field mixing of wastewater in watercourses
Cyanobacteria	Also called 'blue green algae'. Microscopic organisms that live in waterways

Term	Meaning
Detention basin	Surface storage areas or facilities that provide flow control through controlling stormwater runoff.
Dewatering	The removal of groundwater or surface water by various solid-liquid separation processes.
Disinfection	The process of destroying bacteria and pathogens in wastewater. This can be achieved mechanically, chemically or through ultra violet radiation
Dissolved oxygen	The amount of oxygen present in water
Drawdown	The lowering of the surface level of the water table caused by dewatering (pumping) activities
Dry year	A representative dry climatic year. Selected as 2013/14 in key waterway assessments
Ecohydraulics	Instream water conditions that relate to habitat such as velocity, shear stress and wetted perimeter
Ecohydrology	The study of linking ecosystem response to instream water conditions
Ecosystem	A community of organisms and their physical environment interacting together
Effluent	Partially treated wastewater that is passing through the different stages of treatment at the AWRC
Environmental flows (e-flows)	Water that is released from the dam to maintain downstream river health. The project proposes treated water from the AWRC can replace some of these drinking water environmental flows
Environmental flows (e-flows) pipeline	A pipeline that transports treated water from the AWRC to Warragamba River
Environmental planning instruments	Collective name for Local Environmental Plans (LEPs), State Environmental Planning Policies (SEPPs) and Regional Environmental Plans (REPs) under the *Environmental Planning and Assessment Act 1979* (NSW)
Eutrophication	Excessive plant and algal growth in waterways due to the increased availability of nutrients
Evapotranspiration	A natural process where water is removed from an area with vegetation and into the atmosphere
Excavated Natural Material	Excavated Natural Material is naturally occurring rock and soil

Term	Meaning
	that has been excavated from the ground, is mostly natural material (98% by weight) and does not meet the definition of Virgin Excavated Natural Material
Fauna	Animals
Flood	A high stream flow which overtops the riverbank and inundates land that is usually dry
Flood Hazard	The relationship between velocity and depth for floods within flood-prone land
Flood modelling	A combination of hydrologic and hydraulic models used to describe flood behaviour
Flood-prone land	The maximum extent of floodplain inundation caused by the Probable Maximum Flood
Floodplain	Area of land next to a river or creek which is subject to inundation from high stream flows
Flora	Plants
Flow (in waterways)	The flow of water in rivers and creeks. Water flowing in rivers or creeks comes from surface runoff and groundwater.
Flow regime	Patterns of high and low flows within a stream, river or creek
Flow splitter	A mainly below-ground structure that is used to divide pipeline flow into two or more parts and divert to different places
Geormorphology	The study of the physical form and function of features on the earth's surface and their relation to geological structures
Geotechnical	Relates to the engineering behaviour of earth materials (such as soil and rock)
Green space area	Parcel of land about 38 ha in size adjacent to the operational area of the AWRC.
Groundwater	Water that accumulates underground within cracks or pores in rocks. This water forms groundwater resources, which eventually flow into rivers, lakes or the ocean
Groundwater Dependent Ecosystem	Ecosystems that need access to groundwater to meet all or some of their water requirements to maintain their communities of plants and animals

Term	Meaning
Habitat	The natural resource, physical and biotic factors that are present in an area that support the survival of plants and animals
Hydrodynamics	The mathematical study that deals with the motion of water within a waterway
Hydrologic model	A predictive mathematical tool that describes catchment runoff and flow in rivers and creeks
Hydraulic model	A predictive mathematical tool which is used to describe the flow behaviour of waterways
Impact area	The area that will be impacted by the project
Impact assessment area	An area slightly larger than the impact area, within which Sydney Water is seeking flexibility to locate project infrastructure
Impervious	Surfaces that significantly limit the amount of rainfall that will soak through (eg pavements, roads, roofs and heavily compacted soils)
Indicators	A parameter that can be used to provide a measure of a pressure, stressor and/or ecosystem condition response
Inlet works	The location where untreated wastewater enters the AWRC prior to treatment
In-stream	The area within a river channel from top of bank to top of bank
Integrated Water Management	A process that brings together all stakeholders involved in the planning and management of all water across the entire water cycle. It ensures the liveability, resilience and sustainability outcomes are maximised across cities and regions
Intrusive investigation	A study that provides information on the type, extent and level of contamination at the site through soil sampling and laboratory analysis for contaminants
Irrigation	The artificial process of applying controlled amounts of water (including harvested stormwater) to land
Land use zones	Areas defined in environmental planning instruments that specify objectives and development controls for use of that land
Landscape character	The combined built and cultural aspects that make up an area and give it a sense of place
Landscape-led	A term used in planning for new development. The focus is creating a sense of community and liveability through outdoor spaces as well as

Term	Meaning
	buildings and considering the surrounding environment and site context in design. Place-making is a similar term
Light spill	When light falls outside the object or area to be illuminated
Long-term (needs, requirements, investment)	Represents infrastructure and/or non-infrastructure needs, requirements and investment to service development that is typically associated with later stages and/or ultimate development (beyond 10 years). This is tied to the long-term strategy, which by nature incorporates a level of uncertainty, and therefore represents a higher-level outlook that is more conservative in nature
Low flow (waterway)	Slow moving sustained flows sometimes limited to a narrow area of the river channel
Macroinvertebrate	Small animals that live for all or part of their lives in water (eg insect larvae, beetles and snails)
Macrophytes	Aquatic plants growing in or near water
Malabar system	The pipes, pump stations and treatment plants that collect, treat and transport wastewater from properties to Malabar Wastewater Treatment Plant and Malabar Deep Ocean Outfall.
Management goal (waterway objectives)	A statement used to assess whether community values or uses are being attained or maintained.
Mean annual flows	The average value of all recorded flows in one year
Mean annual runoff volume	The average volume of stormwater runoff or stream flow occurring over a year
Model calibration and validation	The use of real world data (eg water quality, hydrodynamic and flow data) to demonstrate a hydraulic, hydrologic or water quality model is capable of representing the waterway environment
Model scenarios - background	Represents catchment and waterway conditions expected in future years, including conditions relating to land use, WWTP and WRP releases, extractions, etc
Model scenarios - baseline	Represents current (circa 2020) waterway and catchment conditions relating to land use, WWTP and WRP releases, extractions, etc
Model scenarios - impact	Represents catchment and waterway conditions expected in future years with the addition of the releases from the AWRC
Non-potable (non-drinking water)	Water that is not intended for human consumption, but which has many other uses

Term	Meaning
Non-potable/non-drinking recycled water schemes (‘third pipe’ or ‘purple pipe’ recycling)	Where highly treated wastewater is supplied to industry or households where it can be used for industrial processes, irrigation and some non-drinking uses, such as flushing the toilet. This requires a separate plumbing system in the building and a ‘third pipe’ (purple pipe) distribution network.
Nutrients	Chemical elements and compounds essential to the growth and survival of living organisms
Operational area (AWRC)	The area on which facilities required for the operation of the AWRC are located
Pathogen	A very small organism that causes disease
Pollutant/nutrient load	Describes the quantity of pollutants or nutrients that may enter a waterway in a year
Potable (drinking water)	Water intended for human consumption, but which also has other uses
Probable Maximum Flood	The largest possible theoretical flood that can occur at a location within a catchment
Project	The ‘project’ as referenced throughout this Environmental Impact Statement is the whole Upper South Creek Advanced Water Recycling Centre project, including the AWRC and associated pipelines
Purified recycled water for drinking (‘potable reuse’)	Where highly treated recycled water is further treated to drinking water quality using advanced water treatment technologies before being returned to the drinking water system, usually via a dam, river or groundwater aquifer where it is diluted with other water sources and treated again at a conventional water filtration plant.
Recycled water	Recycled water is water that has been used before and is then cleaned to remove impurities. Recycled water (sometimes called reclaimed water) comes from wastewater, which includes greywater and stormwater. Sydney Water treats recycled water to Australian Recycled Water Guidelines and NSW Health standards so that it is suitable and safe for its intended use.
Reference design	Preliminary design to establish feasibility and design parameters, and to set the boundary conditions for approvals. During the tender and detailed design process, the contractor may change the design arrangement, as long as it is done within the approval footprint and conditions.
Releases (‘treated water releases’)	Treated water from the AWRC entering the waterway. The release point is location of the release.

Term	Meaning
Renewable energy	Energy from a source that is not depleted when used. In the case of this project, the main types of renewable energy discussed are co-generation and solar energy
Residence time	The amount of time water remains within a pool or ponded area within a river
Resource recovery	Recovery of valuable material from wastewater
Reverse osmosis	Reverse osmosis is a water purification process that uses membranes to remove particles such as nutrients, chemicals, bacteria and viruses
Riffles	Riffles are the shallower faster moving sections of a stream or river
Riparian vegetation	Plants that grow on the water's edge, the banks of rivers and creeks and along the edges of wetlands
Riparian zone	The interface between land and a river or stream
RMA2	A hydrodynamic modeling code that supports subcritical flow analysis, including wetting and drying and marsh porosity models.
Runoff	Flow of water on ground surfaces due to rainfall
Saline soil	A soil which contains sufficient soluble salts to adversely affect plant growth and/or land use
Sediment and erosion control	An approach to managing stormwater runoff during construction limiting soil loss from exposed surfaces and reducing sediment loads in runoff prior to entering waterways
Sediment basins	A pond like structure designed reduce flow velocities from runoff which then allows sediments to settle and be removed prior to discharge to a waterway
Shear stress	A measure of the force of friction from the flow acting on the bed of the waterway. Bed load movement and sediment transport are a function of the shear stress
Short-term (needs, requirements, investment)	Represents infrastructure and/or non-infrastructure needs, requirements and investment to service development that is typically associated with a 0-10 years planning horizon. This typically provides visibility in order to adequately respond over the short-term and in the context of the longer-term strategy and associated planning
Sodicity	A measure of a form of sodium in the soil. High levels adversely affect soil stability, plant growth and/or land use

Term	Meaning
SOURCE	Numerical modelling software for the analysis of catchment processes including water quantity, quality and environmental management.
Staged approval	A type of State significant infrastructure approval under the *Environmental Planning and Assessment Act 1979* where project approvals are staged in accordance with an overall project concept
Stormwater	Rainwater that runs off hard surfaces like roofs and roads and is carried away by stormwater drains flowing into local waterways
Stormwater reuse/ harvesting	Water generated from stormwater capture that is treated to provide fit-for-purpose water quality for non-potable use
Strahler stream order	Describes the hierarchy of streams from the top to the bottom of a catchment (where stream order 1 indicates the top of the catchment)
Tertiary treated water	Water that is treated to a tertiary level where any remaining organic particles and suspended materials are filtered out. Also known as high-quality treated water.
The aquatic ecodynamics modelling library	Community-driven library of modules and algorithms for simulation of 'aquatic ecodynamics' - water quality, aquatic biogeochemistry, biotic habitat and aquatic ecosystem dynamics
Toxicant	A toxic substance introduced into the environment
Treated water or treated effluent	Water that is produced after treatment at wastewater treatment or water recycling plants
Treated water pipeline	A pipeline that transports treated water
Treatment level – advanced	Advanced treatment may include microfiltration, ultrafiltration and reverse osmosis to filter out very fine particles
Treatment level – primary	Primary treatment removes large solid particles from wastewater
Treatment level – secondary	Secondary treatment removes organic matter and nutrients
Treatment level – tertiary	Tertiary treatment filters out remaining organic particles and suspended materials
TUFLOW	Hydraulic modelling software that enables flooding to be described
TUFLOW FV - finite volume hydrodynamic software	A finite volume numerical modelling software that simulates hydrodynamic, and advection/dispersion processes in oceans, coastal waters, estuaries and rivers

Term	Meaning
Tunnelling	A method of building a pipeline by drilling an underground bore in which the pipe is installed. It is a method of construction that reduces environmental and community impacts
Ultimate capacity	The capacity of the project once all future stages are built, treating average dry weather wastewater flows up to 100 ML/day
Upper South Creek Servicing Area	The wastewater catchment serviced by the Upper South Creek Advanced Water Recycling Centre. It includes most of the Western Sydney Aerotropolis Growth Area and South West Growth Area
Value (related to waterways or environment)	A particular value or use of the environment that is important for a healthy ecosystem or for public benefit, health, safety or welfare, and requires protection from the effects of stressors (https://www.waterquality.gov.au/anz-guidelines/resources/key-concepts/community-values).
Viewpoint	Views observed from specific receptors
Wastewater	Water used in homes, schools, businesses and industries that goes down drains from sinks, baths, showers, laundries and toilets and other drains inside buildings. Sometimes known as sewage.
Wastewater catchment	A wastewater catchment is a geographical area of the wastewater network that drains into a single point within the wastewater network
Wastewater collection network	The network of pipes and other infrastructure that transfers wastewater from homes, schools, businesses and industries to wastewater treatment plants or water recycling plants for treatment
Wastewater treatment plant	A facility where various processes are used to treat wastewater and remove pollutants
Water balance	Strategic estimate of water flows into and out of the study area (including rainfall, evaporation, potable water use, recycling and wastewater production)
Water quality modelling	A predictive mathematical tool that describes the condition (chemical, physical and biological characteristics) of the water in waterways
Water quality response model (WQRM)	Combination of numerical models used to simulate hydrodynamic and water quality responses in waterways
Water recycling plant	A facility where various processes are used to treat wastewater and remove pollutants and some or all of the treated water is reused
Water sensitive urban design	Measures to improve the ability of urban areas to capture, treat, and re-use stormwater before it enters waterways

Term	Meaning
Water surface elevation	The surface of the water in metres (using Australian Height Datum or AHD) along the waterway
Water velocity	The speed of water in a given direction
Waterway objectives	Waterway objectives consist of the community's environmental values and uses of the waterway and indicator(s) and criteria to assess whether the waterway will support a particular environmental value or use
Weir	A structure built across a river to control the upstream water level
Wet weather overflow	Discharge of untreated wastewater into the environment that is a result of rainfall
Wet weather quality water	Water that is produced after primary level of treatment and disinfection
Wet year	A representative wet climatic year. Selected as 2014/15 in the key waterway assessments
Wetted perimeter	The length of the cross-sectional area that is ‘wet’, meaning in contact with the flow. This is used to calculate changes in inundation
XP RAFTS	Hydrological modelling software that enables a catchment or site response to rainfall to be described

10.2 Abbreviations

Abbreviation	Definition
1D/2D model	One-dimensional / two-dimensional
AC	Activated Carbon
ACHAR	Aboriginal Cultural Heritage Assessment Report
ADWF	Average dry weather flow
AEC	Areas of Environmental Concern
AED2	Aquatic Ecodynamics Modelling Library
AEP	Annual exceedance probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit

Abbreviation	Definition
ANEC / ANEF	Australian Noise Exposure Concept / Australian Noise Exposure Forecast
ANZECC	Australian and New Zealand Environment and Conservation Council.
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
APZ	Asset Protection Zone
AQIA	Air Quality Impact Assessment
ARR	Australian Rainfall and Runoff
ASC	Assessment of Site Contamination
ASP	Accredited Service Provider
ASS	Acid Sulfate Soils
AWRC	Advanced Water Recycling Centre
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method - Calculator
BAU	Business as Usual
BC	Biodiversity Conservation
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BTF	Biotrickling Filter
CASA	Civil Aviation Safety Authority
CCTV	Closed-circuit television
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CIBSE	Chartered Institution of Building Services Engineers
CNVMP	Construction Noise and Vibration Management Plan
COPC	Contaminants of Potential Concern
CSEP	Community and Stakeholder Engagement Plan
CTMP	Construction traffic management plan
dB	Decibels
DBYD	Dial before you dig
DCP	Development Control Plan
DGV	Default guideline value

Abbreviation	Definition
DIN	Dissolved inorganic nitrogen
DO	Dissolved oxygen
DoS	Degree of saturation (a ratio of demand to capacity of the traffic network)
DPE	Department of Planning and Environment
DPE BCD	Department of Planning and Environment – Biodiversity and Conservation
DPE EES	Department of Planning and Environment – Environment, Energy and Science
DPI	Department of Primary Industries
DPIE	Former Department of Planning, Industry and Environment
DSI	Detailed site investigation
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ENV	Existing native vegetation
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2021 (NSW)
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FFA	Flood Frequency Analysis
FM Act	*Fisheries Management Act 1994*
FMZ	Flood management zone
FRP	Filterable reactive phosphorus
GBMA	Greater Blue Mountains Area
GBMWHA	Greater Blue Mountains World Heritage Area
GDE	Groundwater Dependant Ecosystem
GIS	Geographical Information System
GL	Gigalitre / billion litres
ha	Hectare
HEV	High Ecological Value

Abbreviation	Definition
HIA	Health Impact Assessment
HIPAP	Hazardous Industry Planning Advisory Paper
IAC	Impact Assessment Criterion
IBRA	Interim Biogeographic Regionalisation for Australia
ICNG	Interim Construction Noise Guideline
ILUA	Indigenous Land Use Agreement
INSW	Infrastructure New South Wales
IPA	Inner protection area
IPART	Independent Pricing and Regulatory Tribunal
ISCA	Infrastructure Sustainability Council of Australia, now Infrastructure Sustainability Council (ISC)
IUCN	International Union for Conservation of Nature
LCVIA	Landscape Character and Visual Impact Assessment
LEP	Local Environmental Plan
LGA	Local government area
LiDAR	Light Detection and Ranging
LoS	Loss of Service (measure of the average delay experienced by vehicles)
LSPS	Local Strategic Planning Statement
MARV	Mean Annual Runoff Volume
MBR	Membrane bioreactor
ML	Megalitre / million litres
ML/day	Million litres per day
MNES	Matters of National Environmental Significance
MP	Member of Parliament
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NASF	National Airports Safeguarding Framework
NEPM	National Environmental Protection Measure
NGRS	North Georges River Submain
NHMRC	National Health and Medical Research Council
NO3	Nitrate
NoRBE	Neutral or Beneficial Effect

Abbreviation	Definition
NOx	Oxides of nitrogen
NPfI	Noise Policy for Industry
NPV	Net present value
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment
OCF	Odour control facility
OCU	Odour control unit
OLS	Obstacle Limitation Surface
OOHW	Out of hours work
OU	Odour unit
OUV	Outstanding Universal Value
PAD	Potential archaeological deposit
PAS	Potential Archaeological Sites
PCT	Plant Community Types
PFAS	Polyfluoroalkyl substances
PHA	Preliminary Hazard Analysis
PMF	Probable Maximum Flood
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PRCG	Parramatta River Catchment Group
PRM	Parramatta River Masterplan
PSI	Preliminary Site Investigation
PSP	Priority Sewerage Program
PVC	Poly Vinyl Chloride
RAP	Registered Aboriginal Party
RBL	Rating background noise level
RBM	Relevant Biodiversity Measures
RMS	Roads and Maritime Service

Abbreviation	Definition
RRA	Rapid riparian assessment
RtS	Response to Submissions
SAQP	Sampling and Analysis Quality Plan
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environment Planning Policy
SES	State Emergency Service
SHR	State Heritage Register
SIDRA	Signalised & unsignalised Intersection Design and Research Aid
SOER	Specific odour emission rate
SOHI	Statement of Heritage Impact
SSCTMP / CTMP	Site Specific Construction Traffic Management Plans / Construction Traffic Management Plans
SSI	State significant infrastructure
STEL	Short-term exposure limit
STSIMP	Sewage Treatment System Impact Monitoring Program
SWGA	South West Growth Area
SWIA	Surface Water Impact Assessment
SWMP	Soil and Water Management Plan
TARP	Trigger Action Response Plan
TBM	Tunnel Boring Maching
TEC	Threatened ecological communities
TfNSW	Transport for New South Wales
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
TUFLOW FV	Two dimensional unsteady flow model
UNSW	University of New South Wales
USC	Upper South Creek
USIA	Urban Streamflow Impact Assessment
WFP	Water filtration plant (water treatment)
WGBs	Waste gas burners

Abbreviation	Definition
WQIA	Water quality impact assessment
WQRM	Water Quality Response Model.
WRP	Water recycling plant (wastewater treatment with recycling facility)
WSA	Western Sydney Airport
WSAA	Water Services Association of Australia
WSAGA	Western Sydney Aerotropolis Growth Area. Also known as Aerotropolis or Western Sydney Aerotropolis
WSAP	Western Sydney Aerotropolis Plan
WSI	Western Sydney International (Airport)
WSUD	Water-sensitive urban design
WWTP	Wastewater Treatment Plant

11 References

AAJV 2019, Western Sydney Aerotropolis South Creek Flood Study, prepared for Sydney Water

Advisian 2020, Wianamatta (South) Creek Catchment Flood Study – Existing conditions report, prepared for Infrastructure NSW

ANZECC & ARMCANZ 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Commonwealth of Australia, Canberra

ANZG 2018, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Commonwealth of Australia, Canberra

Aurecon Arup 2020, Upper South Creek Advanced Water Recycling Centre (AWRC) and Pipelines – Detailed Site Investigation, prepared for Sydney Water

Aurecon Arup 2022, Upper South Creek AWRC EIS Flood model validation using 1% AEP hydrographs from INSW, prepared for Sydney Water

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

Civil Aviation Safety Authority (CASA) 2019, Part 139 (Aerodromes) Manual of Standards

CT Environmental 2016, Iconic Species of the South Creek Catchment, prepared for Sydney Water

Department of Environment and Climate Change (DECC) 2007, Practical Consideration of Climate Change - Floodplain Risk Management Guideline, NSW Government

Department of Environment and Climate Change (DECC) 2009, NSW Interim Construction Noise Guideline (ICNG), NSW Government, Sydney

Department of Environment and Conservation (DEC) 2006, The Technical framework: Assessment and management of odour from stationary sources in NSW, NSW Government

Department of Environment, Climate Change and Water (DECCW) (now Heritage NSW) 2010a, Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW, NSW Government Sydney

Department of Environment, Climate Change and Water (DECCW) (now Heritage NSW) 2010b, Aboriginal cultural heritage consultation requirements for proponents, NSW Government, Sydney

Department of Infrastructure, Planning and Natural Resources (DIPNR) 2005, NSW Floodplain Development Manual, The management of flood liable land, NSW Government, Sydne

Department of Natural Resources (DNR) 1990, South Creek Flood Study, NSW Government

Department of Planning, Industry and Environment (DPIE) 2020a, Biodiversity Assessment Method 2020 Operational Manual – Stage 1, Environment, Energy and Science, Parramatta.

Department of Planning, Infrastructure and Environment (DPIE) 2020b, Environmental Management Plan Guideline – Guideline for Infrastructure Projects, NSW Government

Department of Planning, Industry and Environment (DPIE) 2021a, Aviation Safegarding Guidelines – Western Sydney Aerotropolis and surrounding areas, NSW Government

Department of Planning, Industry and Environment (DPIE) 2021b, Minimum requirements for building site groundwater investigations and reporting, NSW Government

Department of Planning, Industry and Environment (DPIE) 2021c, Recognising Country: Draft Guidelines for development in the Aerotropolis, NSW Government

Department of Planning, Industry and Environment (DPIE) 2021d, State significant infrastructure guidelines – preparing a submissions report, NSW Government, Sydney

Department of Planning, Industry and Environment (DPIE) 2021e, Western Sydney Aerotropolis Development Control Plan Phase 2 – Draft for exhibition, NSW Government

Department of Planning, Industry and Environment (DPIE) 2021f, Explanation of Intended Effect of amendment to Environmental Planning Instruments in relation to the Western Sydney Aerotropolis, NSW Govenment

Department of Primary Industries (DPI) 2012a, Guidelines for controlled activities on waterfront land, NSW Government, Sydney

Department of Primary Industries (DPI) 2012b, NSW Aquifer Interference Policy - NSW Government policy for the licensing and assessment of aquifer interference activities, NSW Government, Sydney

Department of Primary Industries (DPI) 2013, Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update), NSW Government, Sydney

Fryirs, K. 2017, River sensitivity: a lost foundation concept in fluvial geomorphology, Earth Processes and Landforms, Volume 42, Issue 1, pp 55-70

Fryirs, K. and Brierley, G. 2016, Assessing the geomorphic recovery potential of rivers :forecasting future trajectories of adjustment for use in management, WIREs Water 2016, 3, 727-748

Government Architect NSW 2017a, Better Placed - an integrated design policy for the built environment in NSW, NSW Government, Sydney

Government Architect NSW 2017b, Greener Places - an urban green infrastructure design framework, NSW Government, Sydney

Kermode, S., Vietz, G., Tippler, C., Russell, K., Fletcher, T., van der Sterran, M., Birtles, P. and Dean, M. 2020, Urban Streamflow Impact Assessment (USIA): a novel approach for protecting urbanising waterways and providing the justification for integrated water management, Australian Journal of Water Resource

Khan, S. and Fryirs, K. 2020, An Approach for assessing geomorphic river sensitivity across a catchment based on analysis of historical capacity for adjustment, Geomorphology, Volume 359

Landcom 2004, Managing Urban Stormwater Soils and Construction, Volume 1, 4th Ed, Landcom, NSW

National Airports Safeguarding Framework (NASF) 2018, developed by the National Airports Safeguarding Advisory Group (NASAG), Australia

National Health and Medical Research Council (NHMRC) 2008, Guidelines for Managing Risks in Recreational Water, Commonwealth of Australia, Canberra

National Institute of Water & Atmospheric (NIWA) Research New Zealand 2013, Updating nitrate toxicity effects on freshwater aquatic species

National Parks and Wildlife Service (NPWS) 2020, Developments adjacent to NPWS lands: Guidelines for consent and planning authorities, National Parks and Wildlife Service, Department of Planning Industry and Environment, Sydney, NSW

Natural Resources Access Regulator (NRAR) 2018, Guidelines for controlled activities on waterfront land—Riparian corridors, NSW Department of Industry, Sydney

NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC) 1998, Acid Sulfate Soils Management Manual

NSW Environment Protection Authority (EPA) 1995, Contaminated Sites – Sampling Design Guidelines

NSW Environmental Protection Authority (EPA) 2016, Modelling and Assessment of Air Pollutants in New South Wales, NSW Government, Sydney

NSW Environment Protection Authority (EPA) 2017, Noise Policy for Industry: Fact Sheet CCorrections for annoying noise characteristcs, NSW Government, Sydney

NSW Environment Protection Authority (EPA) 2019, Environmental Protection Licence (EPL) 372 Southern Suburbs Sewage Treatment System, includinbg Malabar WWTP, NSW Government, Sydney

NSW Environment Protection Authority (EPA) 2020, Draft Sampling Design Part 1 and Part 2 - Contaminated Land Guidelines

NSW Government 2017, Hawkesbury-Nepean Valley Flood Risk Management Strategy

Office of Environment and Heritage (OEH) 2011, Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW, NSW Government, Sydney

SMEC Australia 2021, Environmental Impact Statement Warragamba Dam Raising, prepared for WaterNSW

Sydney Water 2018, Parramatta River Masterplan – Water Quality Modelling

Sydney Water 2021a, Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report

Sydney Water 2021b, Upper South Creek Advanced Water Recycling Centre Environmental Impact Statement

Sydney Water 2022, Upper South Creek Advanced Water Recycling Centre Amendment Report

Tippler C. Reid D.J., Bush C., Dean M., Birtles P. and Belmer N. 2018, Setting Appropriate Goals for Urban Stream Restoration: A Case Study from Blacktown City Council.

Tippler C., Dean M., Birtles P., Davies P., Belmer N., Kermode S. 2016, Eco-servicing South Creek Catchment: A case study from Australia's largest urban growth precincts. Proceedings of the 8th Australian Stream Management Conference 31 July- 3 August 2016 Leura New South Wales

Urbis and Atlas Urban Economics 2021, Luddenham Village Discussion Paper, prepared for the NSW Government and Western Sydney Planning Partnership

Vietz G., Tippler C., Russell K., Kermode S., van der Sterran M., Fletcher T., Dean M. 2018, Development and application of the Urban Streamflow Impact Assessment (USIA) to inform stream protection and rehabilitation, Proceedings of the 9th Australian Stream Management Conference (2018) Hobart, Tasmania

Vietz G.J. and Rutherfurd I.D. (2018) Proceedings of the 9th Australian Stream Management Conference (2018) Hobart, Tasmania

Water Services Associated of Australia (WSAA) 2011, Water Supply Code of Australia Version 3.1, Sydney

Water Services Associated of Australia (WSAA) 2018, Sewerage Code of Australia (Sydney Water Edition 1 Version 4), Sydney

WaterNSW 2021, Guideline for Development Adjacent to the Upper Canal and Warragamba Pipelines, WaterNSW

Wave Consulting 2020, Integrated Water Management Strategy Wollondilly Shire Council, December 2020

Western Sydney Planning Partnership 2020a, Western Sydney Aerotropolis Plan, Western Sydney Planning Partnership, NSW

Western Sydney Planning Partnership 2020b, Draft Aerotropolis Precinct Plan, Western Sydney Planning Partnership, Sydney

WMA Water 2019, Hawkesbury-Nepean Valley Regional Flood Study

Wollondilly Shire Council 2020, Wollondilly 2040: A vision for the future of Wollondilly, Local Strategic Planning Statement, March 2020

WorleyParsons Services Pty Ltd 2015a, Updated Upper South Creek Flood Study. prepared for Penrith City Council in association with Liverpool, Blacktown and Fairfield City Councils

WorleyParsons Services Pty Ltd 2015b, Nepean River Flood Study. prepared for Camden City Council

SW103 03/22

For more info email multimedia@sydneywater.com.au