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27 October 2023 Ref: SWS230002.01

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Subject: Upper South Creek Advanced Water Recycling Centre Water Pollution Impact Assessment for Construction Stage Stormwater Discharges

Epic Environmental (Epic) has been engaged by John Holland Pty Ltd (JH) to complete a Water Pollution Impact Assessment (WPIA) and related services for the construction stage of Upper South Creek Advanced Water Recycling (AWRC) (addressed in this letter report) along with its treated water pipelines and ancillary infrastructure (herein referred to as the "Project"). Condition E124 of the development consent for the project (SSI 8609189) requires a WPIA if construction stage stormwater discharges are proposed, to inform licensing consistent with section 45 of the POEO Act (EPA, 1997).

This WPIA for construction stormwater discharges has been undertaken with specific reference to Landcom 2004 Managing Urban Stormwater: Soils and Construction ("Blue Book") (Landcom, 2004) and NSW EPA (2022) Fact Sheet: Water pollution discharge assessments dated 14 October 2022.

1 BACKGROUND

The AWRC site is located on Lot 211 DP 1272676 in Kemps Creek, adjacent to the proposed Western Sydney International (Nancy-Bird Walton) Airport and M12 Motorway in Western Sydney. The site is located within Liverpool City Council, while proposed brine and treated water pipelines are situated across five local government areas (LGAs): Wollondilly Shire, Penrith City, Liverpool City, Fairfield City, and Canterbury-Bankstown. This WPIA relates to the AWRC site only, as shown on Figure 1 and **Figure 2**.

JH has been appointed by Sydney Water to deliver the Stage 1 project works, including detailed design and construction for treating operational daily wastewater. Stage 1 works will comprise:

- 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 the treated water and brine 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)

During the construction phase, stormwater will be managed using erosion and sediment controls including the use of a sedimentation basin. The sedimentation basin will be utilised to capture and contain runoff, and where required facilitate sediment removal and water treatment. Discharge locations for construction stormwater are proposed for South Creek to the west of the AWRC. The discharge location is upgradient of manmade dams, and is considered a moderately disturbed ecosystems.

Epic understand that dewatering or treatment and discharge of groundwater is not proposed under the Stage 1 construction design.

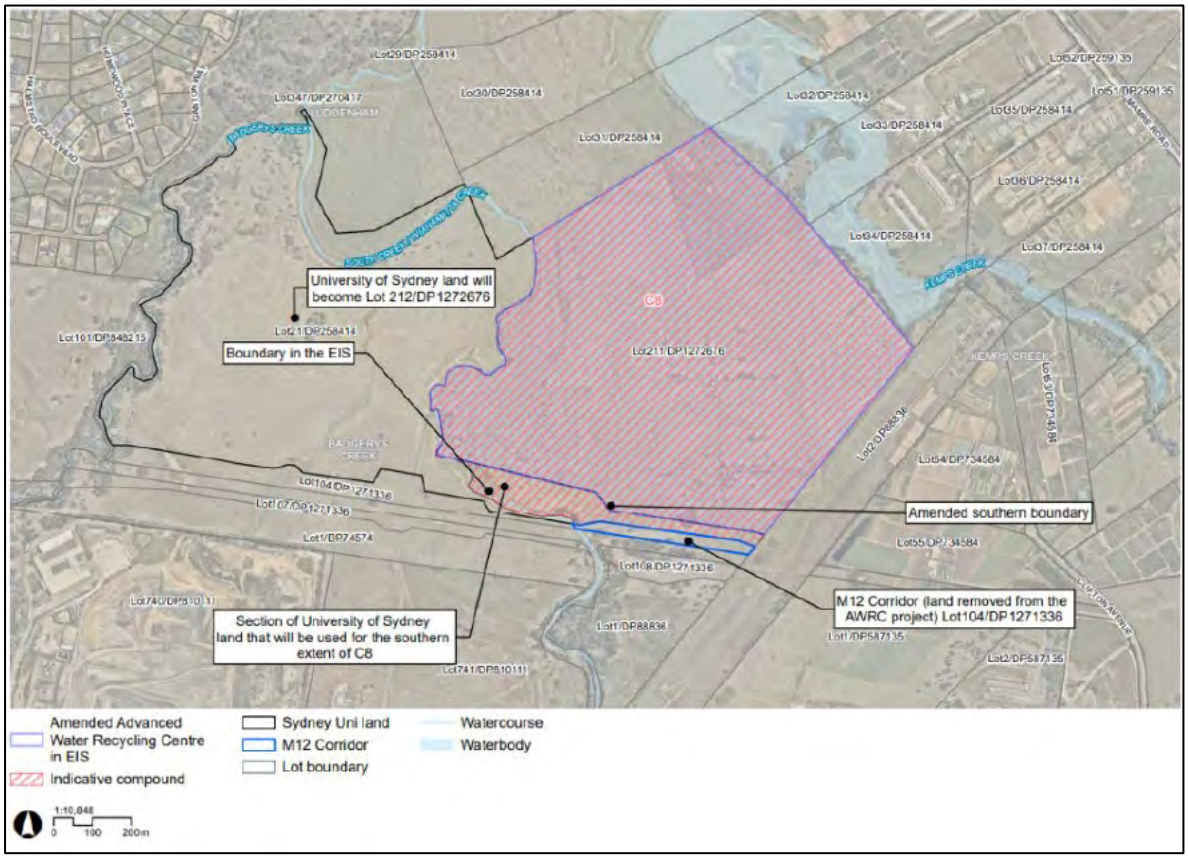

Figure 1. Site locality for the AWRC site (Source: USCP-JH-MPL-ENV-0008)

2 OBJECTIVES

The primary objective of this study is to provide an assessment of the proposed construction stage stormwater discharge and potential water quality impacts that may occur from releases of treated stormwater discharged during construction stages of the AWRC. This WPIA has been undertaken to address the project conditions of approval, specifically condition E124, as specified in **Section 2.2.**

This WPIA for construction stormwater discharges has been undertaken with specific reference to Landcom (2004) and NSW EPA (2022). Given the assessment relates to construction stormwater only, which will be discharged to a moderately disturbed ecosystem, the level of risk and level of assessment required is considered low.

2.1 Scope of Work

The following scope of work has been completed to address the objectives of the WPIA:

- Identification of the regulatory framework and guidelines governing the assessment and management of discharges to water, including:
  - Landcom 2004 Managing Urban Stormwater: Soils and construction (Blue Book)
  - Protection of the Environment Operations Act (1997)
  - New South Wales (NSW) Water Quality Objectives (WQOs)
  - ANZECC (2000) and ANZG (2018) Guidelines
- Review and summary of the catchment environment conditions in waterways that will receive stormwater discharge, including:
  - Geological and hydrological conditions

  - Baseline water quality, including concentrations of toxicants and physical / chemical stressors in surface water
- Review of assigned environmental values for the catchment and associated waterways with reference to the NSW Water Quality Objectives
- Identification of the project conceptual model for, including:
  - Stormwater runoff, collection, storage and anticipated influent water quality
  - Any possible water quality improvement methodology
  - Anticipated effects of construction activities, stormwater collection and storage on water quality
  - Proposed stormwater discharge regime from construction site to receiving waterways
- Proposed stormwater discharge criteria for all relevant analytes based on a combination of water quality targets and water quality outcomes
- Proposed adaptive management measures and contingency options for stormwater discharge

2.2 Conditions of Approval

Planning approval for the AWRC is addressed under the Stage 1 Planning Approval (SSI 8609189). Conditions of approval for the project include the following specific requirements for stormwater discharge:

*"**E124:** If construction stage stormwater discharges are proposed, a Water Pollution Impact Assessment will be required to inform licensing consistent with section 45 of the POEO Act. Any such assessment must be prepared in consultation with the EPA and be consistent with the National Water Quality Guidelines, with a level of detail commensurate with the potential water pollution risk."*

Figure 2. Indicative AWRC site arrangement (Source: USCP-JH-MPL-ENV-0008)

3 REGULATORY FRAMEWORK AND GUIDELINES

The main guidelines, specifications and policy documents relevant to this WPIA include:

- Landcom 2004 Guidelines in Managing Urban Stormwater: Soils and Construction (the Blue Book)
- NSW EPA 2022 Water pollution discharge assessments
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000 & ANZG 2018.)
- Protection of the Environment Operations Act (1997)
- New South Wales (NSW) Water Quality Objectives (WQOs)
- DPE 2022 Technical Guidance for Achieving Wianamatta-South Creek Stormwater Management Targets (DPE, 2022)

The project specifications and plans relevant to stormwater management are provided by JH by the time of reporting, and include:

- John Holland (2023) Draft Surface Water & Groundwater CEMP Sub-plan (Rev 03) (USCP-JH-MPL-ENV-0001)

4 EXISTING ENVIRONMENT

4.1 Climate – Rainfall and Evaporation

4.1.1 Historical records

A detailed assessment of the local climate for the USC AWRC is provided in Section 5.1.1 of Appendix K of the project EIS (Aurecon-Arup, 2021b). A box and whisker plot chart showing the range of total monthly rainfall and evaporation between 1971-2019, that was developed for Appendix K (Aurecon-Arup, 2021b) is shown in Figure 3 (below). This monthly breakdown, data suggests generally “wet season” from November to May” and “dry season” from June to October. Figure 5-2 also indicates that in all the months the average evaporation exceeds the average rainfall with December having the highest evaporation rate.

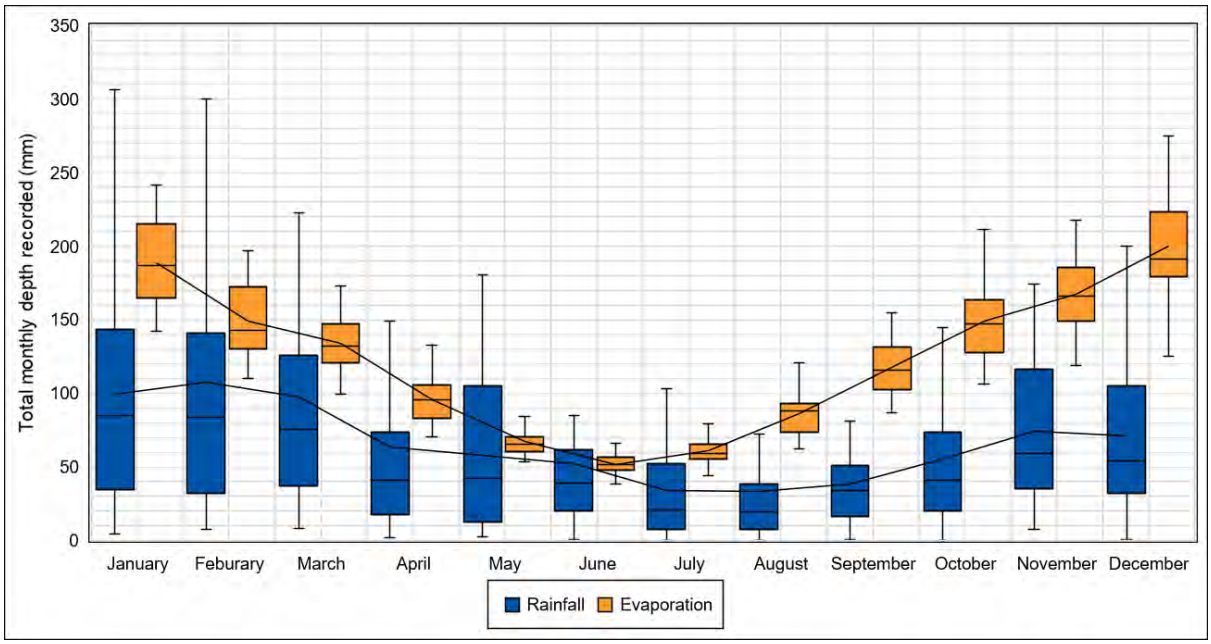

Figure 3. Range of total monthly rainfall and evaporation (1971-2019)

Notes: Whiskers show 10th and 90th percentiles. Boxes depict median values, upper and lower quartiles. Trend lines reflect monthly averages.

The mean annual rainfall (MAR) for the local areas Is equivalent to approximately 746 mm, with a mean annual evaporation of 1,456 mm (almost double the rainfall volume). It should be noted however that these values correspond with long term averages, and do not reflect conditions that may occur in response to regional and global climate variations (e.g., El-Nino / La-Nina oscillations). For this reason, minimum, maximum, and median rates of annual rainfall and evaporation are provided in **Table 1**. Under severe wet-weather conditions maximum rainfall may exceed evaporation by several hundred millimetres, while evaporation may be up to six times annual rainfall.

Table 1. Annual Rainfall and Evaporation Statistics

Statistics	Annual Rainfall (mm)	Annual Pan Evaporation (mm)
Mean	746	1456
Minimum	314	1257
Median	725	1445
Maximum	1725.5	1881

Design rainfall depths were obtained from the Bureau of Meteorology website for the AWRC site location (BOM, 2020). The storm depths associated with various annual exceedance probabilities (AEP's) for the 1-hour and the 24-hour duration events are indicated in **Table 2**. For the purpose of clarity it can be recognized that 1mm of rainfall per square metre of land is equivalent to 1 litre of water.

Table 2. Daily rainfall depths associated with different AEP storm events

AEP	1-hr rainfall depth (mm)	24-hr rainfall depth (mm)
0.5%	76.5	249
1%	70.1	229
2%	62.0	203
5%	51.9	169
10%	44.4	144
20%	37.0	119
50%	26.5	85.0

4.2 Land Use

The AWRC site is located within the Kemps Creek Precinct of the Western Sydney Aerotropolis growth area, which is currently undergoing rezoning on a regional scale. Future changes are expected to change the bulk of the rural and primary production zoned areas to commercial and industrial land uses.

4.3 Topography

The AWRC is located within a regional alluvial plain associated with Badgery's Creek, South Creek and Kemps Creek watercourses. The topography in this area is predominantly flat, with a gentle slope towards the north. Elevations across the AWRC generally range between about 35 to 40 mAHD.

4.4 Geology

The project is located within the Permo-Triassic Sydney basin. The underlying geology is shown in **Figure 4** and comprises areas of:

- **Anthropogenic Fill:**
  - Highly variable fill materials (includes topsoil, embankments, road pavements, landscaped areas)
- **Quaternary Alluvial Sediments:**
  - Loose, unconsolidated fine to medium grained sand, silt and clay
- **Bringelly Shale:**
  - Variable sedimentary rock types. Black and grey shales and sandstones with small scale bedding

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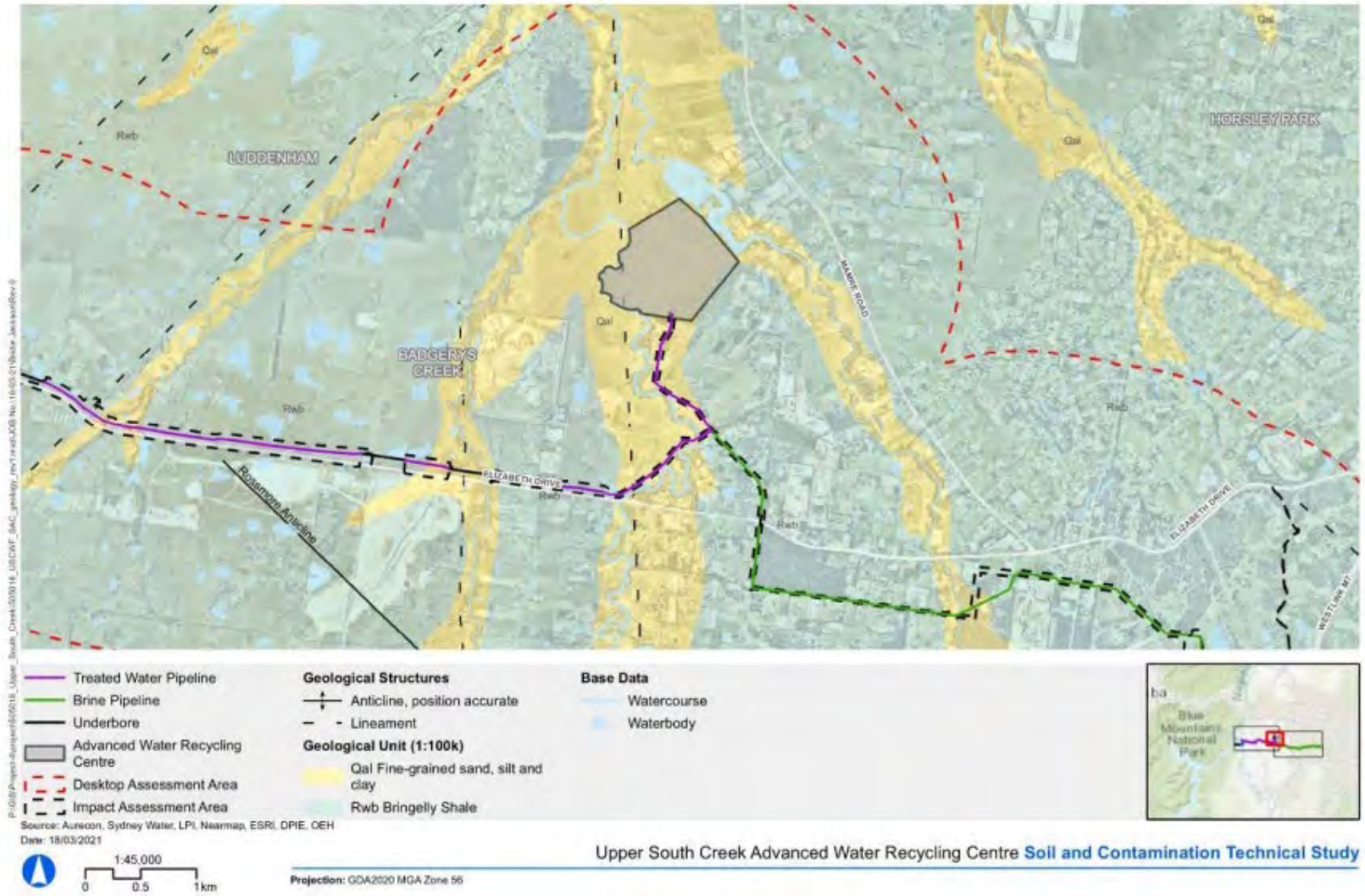

Figure 4. Regional Surface Geology – AWRC site (Aurecon Arup, 2021c)

4.5 Hydrology

The AWRC site is located in the Hawkesbury-Nepean Catchment, overlapping the Wianamatta-South Creek and Kemps Creek Sub-catchments (as shown in **Figure 3**). Runoff from this area naturally drains towards Drainage Line 1, where it ponds within a billabong and any excess spills over to South Creek via the connecting spillway channel. Site stormwater is proposed to be managed to prevent discharge to the east of the ridge, towards Drainage Line 2 and Kemps Creek. Flows through both sub-catchments have been modified due to extensive land clearing activities and progressive urban development.

Figure 5. Site Drainage (Source: Surface Water & Groundwater CEMP Sub-plan)

4.5.1 Winamatta-South Creek

Wianamatta-South Creek is a significant tributary of the Hawkesbury River. South Creek was renamed Wianamatta Creek on the 28 March 2003 by the Geographical Names Board of NSW. It was renamed after the Wianamatta Aboriginal Tribe local to Windsor but the name “South Creek” wasn’t dropped on the basis of the name was a long standing name and should not be lost in historical context (Enacademic, 2020).

The watercourse originates around Oran Park, flowing generally north, where it is joined by other tributaries such as Badgerys Creek and Kemps Creek before reaching its confluence with the Hawkesbury River, near Windsor. The creek descends 94 m over its 70 km course. Several farm dams and minor waterbodies exist within the Project area.

The South Creek sub-catchment covers around 620 km^2. The confluence of Kemps Creek and Badgerys Creek into South Creek is about three kilometres north of Elizabeth Drive. The South Creek catchment upstream of the confluence with Badgerys's Creek covers an area of approximately 96 km^2.

The channel width and flow velocity varies significantly within the stretch of the creek directly adjacent to the AWRC site as indicated in photos provided in Figure 6 taken along the river banks, looking downstream (Aurecon-Arup, 2021).

Figure 6. South Creek adjacent to AWRC site (photos taken looking downstream) (Aurecon-Arup, 2021c)

The hydrology of the Winamatta-South Creek sub-catchment has been significantly modified as a result of a land clearing and progressive urban development.

Flows through the Winamatta-South Creek sub-catchment can be generally sub-divided into four conditions: ephemeral, intermittent, perennial, and perennial with tidal influence. The main channel of South Creek is intermittent both upstream and downstream of the AWRC (to the confluence with Kemps Creek), whereby extended dry weather conditions can result in the creek becoming segregated into a number of standing pools.

Median flows recorded at stream flow gauges upstream and downstream of the AWRC are presented in **Table 3.** At the Elizabeth Drive gauge very low flows or zero flow conditions occur for a significant proportion of the streamflow record (i.e., <0.01 ML/day for approximately 46% of the record). Further downstream of the Great Western Highway site, flows less than 0.01 ML./day occur for less than 16% of the recorded data.

Table 3. Median flows at existing stream flow gauges near AWRC

Gauge Number	Location	Median
212320	South Creek at Elizabeth Drive, 1.7 km upstream of AWRC	0.26 ML/day
212048	South Creek at Great Western Highway, 14.3 km downstream of the AWRC	7.6 ML/day

A comparison of the flow duration curves for South Creek is provided in Figure 7, and shows the range of potential daily flow volumes with respect to the probability of exceedance. As shown in the graph, flows can range between 0.001 ML/d up to 100 ML/d at the 10% exceedance probability reflecting the range of rainfall conditions and AEPs that are observed in the South Creek sub-catchment

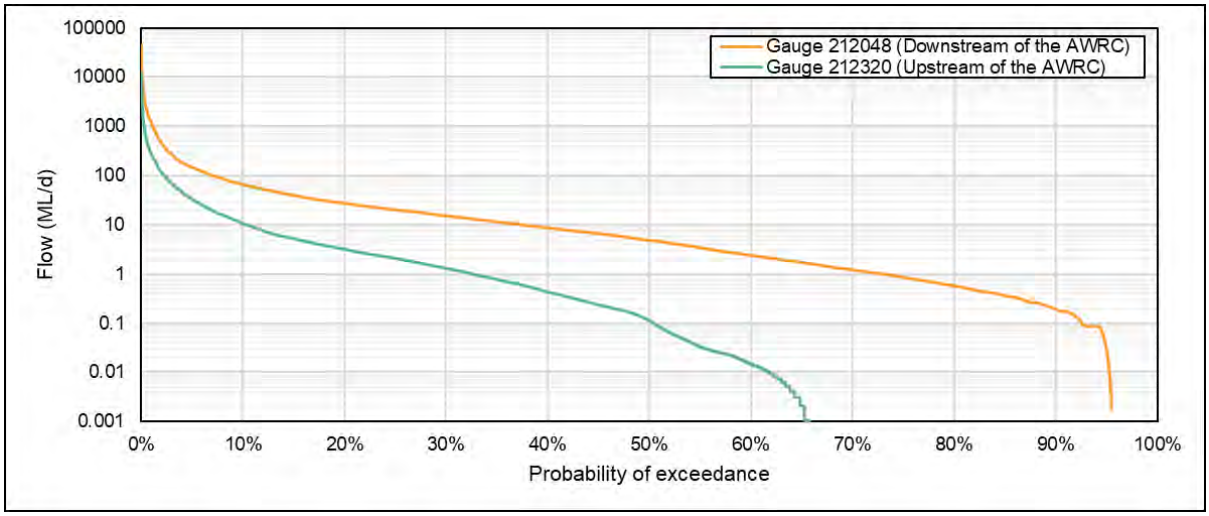

Figure 7. Comparison of the flow duration curves for gauge 212048 and 212320 (Aurecon-Arup, 2021c)

Results for flow modelling completed for South Creek as part of the project EIS are included in Figure 8, and demonstrate the daily flow rates for South Creek as a distribution across different calendar months.

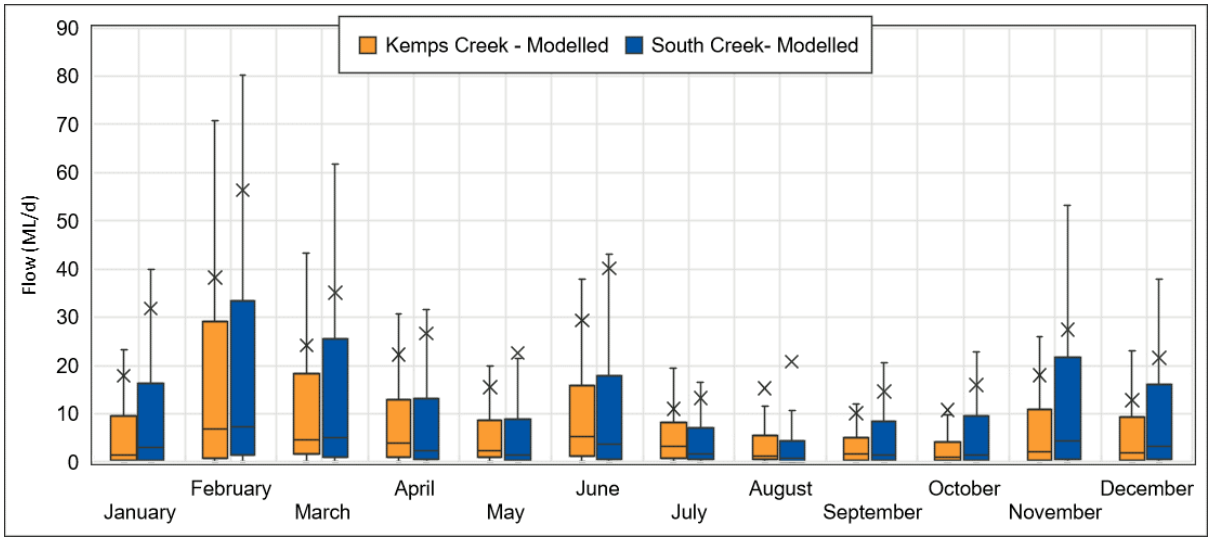

Figure 8. Flow distribution across different calendar months for South Creek and Kemps Creek(Aurecon-Arup, 2021c)

A search of the NSW Water Register indicated that there are nine water access licences (WALs) for the South Creek Catchment with a total share component of 313 ML/yr (under the category of unregulated river), used primarily for agricultural purposes including market gardens, dairy and pastures. The water taken from surface

water is likely to have reduced flows through the Wianamatta-South Creek sub-catchment resulting in modified flow conditions.

4.5.2 Kemps Creek

Kemps Creek is a tributary of South Creek and is a fourth order stream in the vicinity of the AWRC site. The creeks source is approximately 2 km east of Catherine Fields and it flows for about 17 km through the suburbs of Rossmore, Bringelly, Austral and Kemps Creek before discharging to South Creek just north of the AWRC site. The creek flows through a predominately semi-rural setting, although urbanisation has increased in recent years (Liverpool City Council, 2003).

Kemps Creek catchment has been known to experience flooding problems likely due to limited hydraulic capacity in the creek channels, filling activities on the floodplain and inadequate hydraulic capacity at culverts and bridges (Liverpool City Council, 2003). As a result of this, extensive earthworks have been undertaken in the catchment to control water including construction of dams to provide storage, construction of channels or banks to divert flow of water and widening the creek channel to reduce flood levels as well as the frequency and extent of inundation (Liverpool City Council, 2003). Land use within the Kemps Creek sub-catchment largely includes agriculture (grazing, market gardens, poultry), residential, commercial and extractive industries. Kemps Creek has a catchment area of approximately 59 km^2.

4.6 Surface Water Quality

The Baseline water quality has been established by the Sydney Water monitoring program as detailed in the Water Quality Study EIS Appendix F (Aurecon Arup, 2021a). Supplemental water quality data was obtained from several technical studies, including the M12 Motorway EIS (RMS, 2019), the Western Sydney Airport EIS (GHD, 2015), the Badgerys Creek Environmental Survey (SMEC, 2014) as well as the Second Sydney Airport study (PPK, 1997).

Median results for water quality monitoring undertaken for South Creek and Kemps Creek derived from the project EIS (Aurecon-Arup, 2021c) is presented in **Table 4**. The results show that: turbidity is generally higher in South Creek than Kemps Creek, with South Creek ranging from 41 to 82 NTU and Kemps Creek median around 24 NTU. Salinity is typically fresh in both creeks, there is a high dissolved oxygen content and slightly alkaline pH in both creeks, total nitrogen and total phosphorous concentrations are high, reflecting the agricultural land uses throughout the catchment.

Table 4. EIS monitoring water quality data – median concentrations for AWRC Site

Location	Turbidity (NTU)	Salinity (µS/cm)	DO (%sat)	pH	Total Nitrogen (mg/L)	Total Phosphorous (mg/L)
South Creek NS45 Upstream	41	1,203	73	7.4	1.67	0.21
South Creek NS44 Downstream	82	931	88	7.5	1.69	0.18
South Creek NS35 Downstream	68	928	80	7.5	1.73	0.14
Kemps Creek NS440 Upstream	24	1,341	77	7.5	2.27	0.61

95th percentile results for water quality monitoring undertaken for South Creek and Kemps Creek derived from the project EIS (Aurecon-Arup, 2021c) is presented in **Table 5.** The results show that: turbidity is generally higher in South Creek than Kemps Creek, with South Creek ranging from 130 to 225 NTU and Kemps Creek 95th percentile around 114 NTU. Salinity is typically fresh in both creeks, there is a high dissolved oxygen content and slightly alkaline pH in both creeks, total nitrogen and total phosphorous concentrations are high, reflecting the agricultural land uses throughout the catchment.

Table 5. EIS monitoring water quality data – 95th percentile concentrations for AWRC Site

Location	Turbidity (NTU)	Salinity (µS/cm)	DO (%sat)	pH	Total Nitrogen (mg/L)	Total Phosphorous (mg/L)
South Creek NS45 Upstream	130	1,268	98	7.6	2.58	0.36
South Creek NS44 Downstream	131	1,203	119	8.2	2.31	0.29
South Creek NS35 Downstream	225	1,171	91	7.6	2.53	0.24
Kemps Creek NS440 Upstream	114	2,660	94	7.7	6.99	0.85

Water quality data for streams adjacent to the AWRC site derived from previous studies including the M12 Motorway EIS (RMS, 2019), the Western Sydney Airport EIS (GHD, 2015), the Badgerys Creek Environmental Survey (SMEC, 2014) as well as the Second Sydney Airport study (PPK, 1997) are summarised in **Table 6**. The results show that: turbidity in South Creek may range from 7 to 82 NTU with Kemps Creek ranging between 11 and 12 NTU, water salinity is generally fresh, pH is neutral to slightly alkaline, dissolved oxygen content ranges between low and high, total nitrogen and total phosphorous are both significantly elevated.

Table 6. Available water quality data for the streams adjacent to the AWRC site (supplementary sources)

Location	Turbidity (NTU)	TSS (mg/L)	Salinity (µS/cm)	DO (%sat)	pH	Total Nitrogen (mg/L)	Total Phosphorous (mg/L)
South Creek: M12 Highway EIS (RMS, 2018) (M12-6)	14.3	16	2,640	80	8.5	1.40	<0.05
South Creek: Second Airport EIS (PPK, 1997-1999) (S1)	15 – 65	9 – 56	ND	83 – 105	7.0 – 7.2	0.49 – 1.60	0.01 – 0.14
South Creek: Second Airport EIS (PPK, 1997-1999) (S2)	7 – 82	5 – 19	ND	60 – 87	6.8 – 6.9	0.44 – 1.50	0.01 – 0.11
South Creek: Second Airport EIS (PPK, 1997-1999) (S3)	12 – 40	4 – 14	ND	39 – 79	6.9 – 7.4	0.8 – 1.50	0.05 – 0.50
Kemps Creek: Liverpool City Council (2017-2018)	11	ND	1,189	31	7.7	4.5	0.75
Kemps Creek: M12 Highway EIS (RMS, 2018) (M12-7)	12	10	1,500	36	7.3	6.6	0.60

As detailed in John Holland (2023) Surface Water & Groundwater CEMP Sub-plan, the creeks located in the project area are characterised by overall poor water quality with low DO, elevated EC and nutrient concentrations associated with run off from saline soils and agricultural land use within the catchment. The levels of pH and turbidity were generally within the guideline ranges, with some exceedances of upper limit turbidity presumably during low flow algal bloom events or rainfall events with high suspended matter captured from storm runoff. The historical representativeness of this data has not been evaluated and it has not been established if they represent a full range of hydrological conditions (i.e., zero, low, intermediate, and high flow events).

The water quality monitoring results for the local creeks indicate exceedances of the Draft Wianamatta-South Creek Waterway Health Objectives (DPE, 2022) across all indicators. Low order ephemeral creeks in this area often form disconnected 'chain-of-ponds' which do not flow for a large proportion of time. Low frequency-high magnitude rainfall events trigger flow due to initiation of overland flow pathways in the sub-catchments to the channels. These tend to occur in a short-wet season between November and March. Furthermore,

there is a sampling bias towards easy to access sampling locations at bridge crossings where pools have been widened to improve flood flow conveyance – even when these pools contain water, the majority of the creek channel may be dry and the resulting stagnation and evaporation processes have the potential to significantly alter water chemistry.

John Holland has undertaken baseline surface water quality monitoring for South Creek and Kemos Creek as part of the Surface Water Quality Construction Monitoring Program. The monitoring locations (summarized in **Table 7**) have been selected to identify potential water quality impacts on the receiving waterways arising from the construction activities.

The sampling sites have been selected outside of the construction footprint, up gradient and down gradient of the project. When the sample is collected on site, work health and safety issues must be taken into consideration in obtaining the sample. This is particularly important prior to and during high rainfall and flooding events. At relevant sampling locations, access will also be subject to landowners' consent for the purpose of obtaining samples.

A total of seven (7) surface water quality monitoring sites and one (1) surface water gauging site are established for the AWRC site, in addition to the baseline and ongoing monitoring at sites conducted under Sydney Water to provides baseline and operational data for the project. Two of the seven surface water monitoring sites at the AWRC site are nominated for the purpose of wet weather sampling in response to the event triggered sampling requirements. Field photographs of the AWRC construction stage monitoring sites are provided as an attachment to this technical letter.

Table 7. Surface Water Quality Monitoring Locations (AWRC)

Site Code	Site Description	Easting	Northing
SW01	AWRC site drainage line 1 located downgradient of the site.	33.85518	150.77018
SW02	AWRC site drainage line 2 located downgradient of the site.	33.85543	150.77852
SW03	AWRC site drainage line 3 located downgradient of the site.	33.85406	150.77011
SW04	Additional stormwater control facilities (e.g. sediment ponds) that drain directly to South Creek (to be confirmed based on construction plans) located adjacent the upgradient watershed boundary.	33.85966	150.76794
SW05	Additional stormwater control facilities (e.g. sediment ponds) that drain directly to Kemps Creek. (to be confirmed based on construction plans) located downgradient of the site.	33.85251	150.77414
SW06a	AWRC wet weather sampling only In receiving water above the confluence of site water discharge point (location is indicative and subject to accessibility and safety of sampler)	TBC	TBC
SW06b	AWRC wet weather sampling only In receiving water below the confluence of site water discharge point, but upstream of the AWRC site boundary (location is indicative and subject to accessibility and safety of sampler).	TBC	TBC
SW07	South Creek surveyed stream level gauging point to confirm groundwater flow direction if AWRC_MW04 groundwater drawdown criteria is exceeded.	TBC	TBC

The results from two (2x) rounds of surface water quality monitoring are available, comprising measurements of field turbidity, salinity as electrical conductivity, dissolved oxygen, pH, redox potential, temperature, and observed flow condition. The results are summarized in **Table 8**, and show that: turbidity ranges between 50 and 271 NTU, salinity ranges between 1,084 and 2,360 µS/cm (fresh), oxygen content is high, pH is slightly to moderately alkaline, and temperature varies between 11 and 15.7 °C.

Table 8. Median flows at existing stream flow gauges near AWRC

Site	Date	Turbidity (NTU)	Salinity (µS/cm)	DO (%)	pH	ORP (mv)	Temperature (oC)	Flow
SW01	19/07/2023	-	-	-	-	-	-	Dry
	25/08/2023	-	-	-	-	-	-	Dry
SW02	19/07/2023	-	-	-	-	-	-	Dry

	24/08/2023	-	-	-	-	-	-	Dry
SW03	19/07/2023	-	-	-	-	-	-	Dry
	25/08/2023	-	-	-	-	-	-	Dry
SW04	20/07/2023	60.7	1,084	87.1	7.95	28	11.7	No Flow
	25/08/2023	55.7	1,370	146.0	8.48	240	13.4	No Flow
SW05	20/07/2023	50.0	1,623	112.0	8.73	-18	11	No Flow
	25/08/2023	271.0	2,360	159.6	9.35	135	15.7	No Flow
SW06	20/07/2023	-	-	-	-	-	-	No Access
	25/08/2023	-	-	-	-	-	-	No Access

4.7 Water Quality Objectives

Water quality objectives (WQOs) relevant to the waterways affected by this this project and are detailed in Appendix K of the EIS (Aurecon Arup, 2021b). The values and uses adopted for South Creek and Kemps Creek sub-catchments include:

- Aquatic ecology
- Recreation and aesthetics
- Primary industries
- Drinking water (Nepean River only)

The following sections provide further detail about each of the water quality ob.

4.7.1 Aquatic ecosystems

The management goal of the aquatic ecosystems WQOs is to protect, maintain, and restore the ecological condition of aquatic ecosystems and their riparian zones overtime. Key water quality indicators and default trigger values are detailed in **Table 9**.

Table 9. Aquatic ecosystems trigger values

Indicator	Units	Trigger Value	
		Wianamatta-South Creek ANZECC / ANZG Default Guideline Values	DPE Values South Creek (NSW EPA Endorsed)/ Draft Aerotropolis Precinct Plan
Total nitrogen (TN)	mg/L	0.35 [1]	1.72 [2]
TN Loads	Kg/yr	Sackville Zone 2 – 126,100 [3,4]	-
Total phosphorus (TP)	mg/L	0.025 [1]	0.14 [2]
TP Loads	kg/yr	Sackville Zone 2 – 2,720 [3,4]	-
Oxides of Nitrogen	mg/L	0.040 [1]	0.66 [2]
Ammonium (NH_4+)	mg/L	0.020 [1]	0.08 [2]
Filterable reactive phosphorus (FRP)	mg/L	0.020 [1]	-
Chlorophyll a (Chl a)	mg/L	0.003 [1]	-
Dissolved oxygen (DO)	% Sat	85 – 110 [1]	43-75 [2]
pH	Units	6.5 – 8.01	6.2-7.6[2]
Conductivity	µS/cm	125-2,200 [1]	1,103 [2]
Toxicants	-	Refer to ANZG guidelines	Refer to ANZG guidelines
Turbidity	NTU	6-50 [1]	-
Total Suspended Solids	mg/L	ND	50

1. Indicators and metrics adopted from ANZECC (default trigger values) are for slightly disturbed lowland river ecosystems in south-east Australia (ANZECC 2000 and ANZG 2018)
2. These metrics are performance criteria presented in the Draft Aerotropolis Precinct Plan (Western Sydney Planning Partnership, November 2020)
3. Load limits taken from Table 7, Regulating nutrients from sewage treatment plants in the Lower Hawkesbury Nepean River catchment (EPA, 2019)
4. Limits adopted exclude loads from McGraths Hill and South Windsor (non-Sydney Water facilities)

4.7.2 Recreation and aesthetics

The management goals of the recreation and aesthetics WQOs are to maintain or improve water quality for recreational activities such as swimming, boating, and fishing, and to maintain or improve the aesthetic qualities of the waterways. Key water quality indicators and default trigger values are detailed in **Table 10**.

Table 10. Recreation and aesthetics

Indicator	Trigger Value/Criteria	
	Nepean & Warragamba Rivers	**Wianamatta-South Creek**
Recreational water quality: Primary Contact	Enterococci	95th percentile for intestinal enterococci/100 mL ≤ 40[2]
	Cyanobacteria	< 5000 cells/mL M. aeruginosa or biovolume equivalent of > 0.04 to <0.4 mm^3/L for the combined total of all cyanobacteria (Categories A & B)[2]
Recreational water quality: Secondary Contact	Enterococci	95th percentile for intestinal enterococci/100 mL > 40 and ≤ 200[2]
	Cyanobacteria	≥ 5000 to <50,000 cells/ mL M. aeruginosa or biovolume equivalent of ≥ 0.4 to <4 mm^3/L for the combined total of all cyanobacteria (Category C)[2]
Visual clarity and colour	Surface waters should be free from substances that produce undesirable colour, odour, tasting or foaming.[1]	
Surface films and debris	Surface waters should be free from floating debris, oil, grease and other objectionable matter[1]	
Nuisance organisms	Surface waters should be free from undesirable aquatic life, such as algal blooms, or dense growths of attached plants or insects[1].	

1. Indicators and metrics adopted from ANZECC (default trigger values) are for slightly disturbed lowland river ecosystems in south-east Australia (ANZECC 2000 and ANZG 2018)
2. Guidelines for managing risks in recreational water (NHMRC 2008)

4.7.3 Primary industries

The management goals of the primary industries WQOs are to protect the quality of water used for a broad range of irrigation activities and livestock drinking. Key water quality indicators and default trigger values are detailed in **Table 11**.

Table 11. Primary industries indicators

Indicator	Criteria	
	Nepean & Warragamba Rivers	**Wianamatta-South Creek**
Human Pathogens	Thermotolerant Coliforms <10 cfu/100 mL[1]	
Cyanobacteria	< 11,500 cells/mL Microcystis, <2.3 µ g/L microcystins[1]	

1. Indicators and metrics adopted from ANZECC (default trigger values) are for slightly disturbed lowland river ecosystems in south-east Australia (ANZECC 2000 and ANZG 2018)

4.7.4 Drinking water

The management goals of the drinking water WQOs are to maintain or improve the quality of raw drinking water extracted downstream. Key water quality indicators and default trigger values are detailed in **Table 12**.

Table 12. Drinking water quality indicators

Indicator	Criteria	
	Nepean & Warragamba Rivers	**Wianamatta-South Creek**
Microbial Water Quality – bacteria, viruses, protozoa & helminths; Cyanobacteria and their Toxins; Disinfection by-products – particularly NDMA;	Primarily bacteria and cyanobacteria[1]	Not applicable.

Indicator	Criteria	
	Nepean & Warragamba Rivers	Wianamatta-South Creek
Pesticides; Pharmaceuticals; Endocrine Disruptors; Radioactive Materials;		

1. Australian Drinking Water Guidelines 6 V3.5 (NHMRC, NRMMC 2011)

4.8 River Flow Objectives

The River Flow Objectives are the agreed high-level goals for surface water flow management. They identify the key elements of the flow regime that protect river health and water quality for ecosystems and human uses. The NSW Department of Planning, Industry and Environment (DPIE) have drafted numerical objectives to preserve the hydrologic condition of Wianamatta-South Creek (and its tributaries) to inform the planning of the Western Parkland City, detailed in Appendix K of the EIS (Aurecon Arup, 2021b). Flows objectives for waterways and water dependent ecosystems (WDEs) have been developed by DPIE through the application of the Risk Based Framework and provide numerical values that define the desired hydrologic regime for Wianamatta-South Creek. These criteria are detailed in **Table 13**.

Table 13. Wianamatta-South Creek waterway health (flow) criteria

Flow Variable	Unit	Performance Criteria	
		1-2 Order Streams	≥ 3rd Order Streams
Median Daily Flow Volume	L/ha/d	71.8 ± 22.0	1,095.0 ± 157.3
Mean Daily Flow Volume	L/ha/d	2,351.1 ± 604.6	5,542.2 ± 320.9
High Spell ≥ 90th Percentile Flow Volume	L/ha/d	2,048.4 ± 739.2	10,091.7 ± 769.7
High Spell - Frequency High Spell - Average Duration	number/y days/y	6.9 ± 0.4 6.1 ± 0.4	19.2 ± 1.0 2.2 ± 0.2
Freshes ≥ 75th and ≤ 90th Percentile Flow Volume	L/ha/d	327.1 to 2048.4	2,642.9 to 10,091.7
Freshes - Frequency Freshes - Average Duration	number/y days/y	4.0 ± 0.9 38.2 ± 5.8	24.6 ± 0.7 2.5 ± 0.1
Cease to Flow	proportion of time/y	0.34 ± 0.04	0.03 ± 0.007
Cease to Flow – Duration	days/y	36.8 ± 6	6 ± 1.1

5 DISCHARGE CHARACTERISATION

5.1 Construction Stage Activities

The key construction phase activities for the proposed AWRC site include the following:

- Clearing of vegetation and mulching at the proposed treatment plant site
- Demolition of existing house, if not repurposed during construction and operation
- Bulk earthworks. Detailed approach to this has not been finalised but a typical methodology would involve:
  - Grubbing
  - Removal and stockpiling of 200-300 mm of topsoil for re-use later (following chemical and geotechnical testing for suitability). An area of approximately 115,000 m2 would need to be stripped equating to a topsoil volume around 34,500 m3
  - Geotech investigation identified the underlying 200 mm of material below the topsoil is unsuitable for construction and is to be removed and disposed offsite
  - Cut and fill to bench levels with import of quality engineered fill as required and removal of any excess / poor quality material if it cannot be re-used on site elsewhere for landscaping purposes
  - Fill in layers of up to about 300 mm, which is compacted before the next layer is added. The fill depth on this site would generally increase from southeast to northwest up to a depth of about 2.5 m

  - Targeted dewatering of surficial local aquifer systems to required depths (refer to impacts assessed in the Groundwater Impact Assessment report)
- Excavation for construction of below surface infrastructure
- Installation of subfloor drainage, foundations and underground infrastructure
- Installation of aboveground civil works, mechanical and electrical plant and equipment
- General landscaping, planting out of WSUD elements and installation of stormwater harvesting and irrigation equipment
- Commissioning and testing

Water would be used during construction for a range of purposes including excavation, dust suppression, drilling, hydrostatic testing, materials preparation and use, and amenities for the construction workforce. Construction areas and access tracks would be watered to supress dust, with the frequency of watering dependent on wind and rainfall conditions. During construction, water would likely be sourced offsite from suitable mains reticulation so multiple tankers would be required.

5.2 Stormwater Discharges

During the construction phase, flood detention basins to be constructed as part of the operational design, will be utilised as sedimentations basins to capture and contain runoff and facilitate sediment removal. The high efficiency sediment basin (HES) provides suitable capacity to function as construction sediment basins for compliance with the Blue Book (Soils and Construction Guide Volume 1, 4th Edition for managing urban stormwater by the NSW government (Landcom, 2004)) guidelines.

Design schematics showing the location of the proposed construction stage sedimentation basin are provided as an attachment to this technical letter.

5.2.1 Stormwater Catchment Area and Discharge Volumes

The construction stage sedimentation basin for the AWRC site will capture surface runoff from a combined area of 118,000 square metres (11.8 hectares). The basin has a storage capacity of 4,400 m^3 for construction stage stormwater flows and is designed to store and treat water up to the 1 year ARI rainfall event. The outlet of the sedimentation basin is located at E 293805.794, S 6251296.380, and will drain to South Creek at E 293502.766, S 6251173.887 via the stormwater conveyance identified in the attached design plans and erosion sediment control plan.

5.2.2 Stormwater Treatment and Discharge Quality

An aluminium chloralhydrate based flocculant is recommended for flocculation of sediments in the sedimentation basin. The HES basin design has assumed a dose rate of 6-10L per 100m^3 which is consistent with standard dose rates for clay-based soils. Exposed soils will comprise Virgin Excavated Natural Material (VENM) of exposed Quaternary alluvial sediments and residual Bringelly Shale.

The HES will be able to meet the construction phase stormwater targets related to Total Suspended Solids (TSS) (50 mg/L or less) prior to each planned discharge following stormwater and runoff events from the construction areas.

6 IMPACT ASSESSMENT

The potential impacts associated with the construction phase activities of the Project are identified and assessed in the following sections, with consideration of the relevant reference design and CEMP.

6.1 River Flow

During construction phase, the potential impacts from stormwater discharge to the local stream flow include:

- Changes in volumes and rates of flow to the receiving creeks
- Worsening flood conditions (flow rates) downstream of the site

- Obstruction of surface drainage from the contributory sub catchments leading to unnatural dried channels downstream, if conducting works during periods when surface flow would usually be occurring

The significance of the above potential impacts is low based on the following rationale:

- The median flow rates through South Creek range from 0.26 ML/day (3 L/s) to 7.6 ML/day (88 L/s). Flow rates can increase up to 100 ML/d (1,157 L/s) through South Creek at the 10% exceedance probability.
- The sediment basin has been designed to manage stormwater events up to the 1 year average recurrence interval (ARI) (63.8% AEP), which is consistent with Blue Book guidelines, and will discharge at a rate of 0.38 m^3/s (380 L/s). The rate of discharge is within the conveyance capacity of South Creek.
- An Erosion and Sediment Control (ESC) Procedure has been established for the project and is detailed in Appendix G of the draft Surface Water & Groundwater CEMP Sub-plan (included as an attachment to this letter). Site-specific erosion and sediment control plans will be developed during construction phase based on the EPL requirement (Section 7.5 of the draft Surface Water & Groundwater CEMP Sub-plan).
- Section 7.1.1 of EIS Appendix K concludes the flow patterns from the site would not be significantly altered due to the flat nature of the existing site (0.4 to 0.6%) and the proposed reference design grades (0.8%). Impacts to flood flows downstream would not be significant during the bulk earthworks phase and flood detention would not be required until hard surfaces are established.

6.2 Water Quality

Water can accumulate in sediment basins and traps, excavations and other low-lying areas of site after rainfall or from groundwater inflows. Water can also accumulate from piling work and associated stockpile treatment and the management of saturated material. The water can be or become impacted by a range of pollutants including sediment, trace metals, oil, grease, hydrocarbons, chemicals, and concrete wastewater depending on the nature of the construction activities on the site. The water also has the potential to become acidic or basic depending on the presence of acid sulphate materials or cement.

During construction phase, the potential impacts from stormwater discharge to the local stream quality include:

- Increased turbidity
- Adverse changes to physico-chemical condition of the receiving waterway
- Introduction of pollutants including toxicants and nutrients

The significance of the above potential impacts is low based on the following rationale:

- Turbidity:
  - Results from baseline monitoring of South Creek have found that Turbidity typically ranges between 14 and 271 NTU, with median values between 41 and 82 NTU and 95th percentile values between 114 and 225 NTU. No data was collected to establish a correlation between NTU and TSS during the EIS investigations.
  - The proposed stormwater discharge limit for total suspended solids is 50 mg/L, which is consistent with the DPE technical guidance on Erosion and sediment control design principles for achieving Wianamatta–South Creek stormwater management targets.
  - There is no site specific correlation between TSS and turbidity that has been established for discharges from the site as empirical data is required for this to be undertaken. Assuming TSS to turbidity conversion ratios between 1.25 and 2.0, the expected turbidity from discharge may range between 62.5 NTU and 100 NTU, which are between the upper median and 95th percentile baseline values for South Creek respectively. Further testing will be required during construction stage activities to establish a site specific correlation.

- The proposed stormwater discharge limit for TSS is consistent with Landcom 2004 Guidelines in Managing Urban Stormwater: Soils and Construction (the Blue Book
- pH:
  - The results from baseline monitoring have found that pH in South Creek ranges between slightly acidic (pH 6.8) to moderately alkaline (pH 8.7 – 9.4).
  - The proposed stormwater discharge limits for pH are 6.5 to 8.5, which are within the natural ranges observed in South Creek and thus will not significantly affect water quality.
- Oil and Grease:
  - The target discharge criteria for oil and grease will be non-visible, as such there will be no significant impacts to water quality in South Creek arising from oil and grease.
- Pollutants including toxicants and nutrients:
  - Stormwater discharges are not expected to contain significantly elevated concentrations of toxicants as the exposed surface will comprise VENM of exposed Quaternary alluvial sediments and residual Bringelly Shale. There are no suitable advanced water treatment options for on-site management of stormwater associated with construction projects beyond the use of sedimentation basins.
  - An Erosion and Sediment Control (ESC) Procedure has been established for the project and is detailed in Appendix G of the draft Surface Water & Groundwater CEMP Sub-plan. Measures in this sub-plan will be taken to mitigate risks of introducing contaminants to receiving waterways from construction related activities.

Potential impacts of construction stormwater discharges on surface water quality will be mitigated in accordance with DPE 2022 and Landcom 2004 requirements. Treatment measures that will be implemented include:

- Flocculate sediment basins and/or traps to settle out sediment, with either gypsum or other approved flocculant
- Use pH buffering (lime to increase pH, acid to lower pH) to adjust pH levels to acceptable range where required
- Remove any oil, grease and hydrocarbons with oil absorbent materials (from spill kits) or oil/water separator

Continuous improvement of this plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

Based on the proposed water treatment management measures the resultant impact significance is considered low. The proposed discharge will not prevent the environmental values being achieved in the future.

7 PROPOSED ENVIRONMENT PROTECTION LICENCE POLLUTANT CONCENTRATION LIMITS

The stormwater runoff will be managed in accordance with the regulatory framework and guidelines described in **Section 3**. The proposed criteria adopted the environmental standards considered most appropriate for the construction water discharge, based on the receiving environments and the proposed construction activities. The proposed discharge / assessment criteria are discussed in the following sections.

7.1 Wianamatta – South Creek Stormwater Management Targets

Construction phase stormwater quality targets are provided for development sites >2,500 m^2 in DPE (2022). The targets are provided to strengthen provisions in Landcom 2004 for controlling sediment during the construction phase of the development and provide advice to achieve compliance.

Table 14. Construction phase stormwater quality targets (DPE, 2022)

Parameter	Target
Total suspended solids (TSS) and pH	All exposed areas greater than 2,500 m^2 are to be provided with sediment controls that are designed, implemented and maintained to a standard that would achieve treatment of at least 80% of the average annual runoff volume of the contributing catchment (i.e. 80% hydrological effectiveness) to 50 mg/L TSS or less, and pH in the range (6.5–8.5). No release of coarse sediment is permitted for any construction or building site. Sites less than 2,500 m^2 are required to comply with the requirements of the Blue Book.
Oil, litter and waste contaminants	No release of oil, litter or waste contaminants
Stabilisation	Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces are to be effectively stabilised including all drainage systems. An effectively stabilised surface is defined as one that does not or is not likely to result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation and water contamination.

7.2 Recommended Discharge Limits

Under the Protection of the Environment Operations Act 1997, there is a legal responsibility to ensure that runoff leaving a construction site (including water discharged from sediment basins after storm events) meets acceptable water-quality criteria. The parameters to be monitored and their assessment criteria are proposed in accordance with DPE (2022), as summarised below in **Table 15**.

Mixing zones have not been considered in this assessment as there is insufficient empirical data available to correlate flow rates with Turbidity in the South Creek sub-catchment and therein assess the impacts from discharge. However, the limits are consistent with DPE recommended and EPA endorsed criteria as per the Draft Aerotropolis Precinct Plan, for which extensive modelling and investigations have been undertaken. It should further be noted that the recommended limits reflect an upper limiting condition, and it is likely that turbidity in sediment basins will vary below this upper limiting value.

Table 15. Recommended numerical criteria for contaminants of concerns

Parameters	Recommended criteria (DPE 2022)
Total suspended solids (TSS)	50 mg/L
pH	6.5 – 8.5
Oil and grease	Visual assessment (not visible)

8 CLOSING

This WPIA has been completed in accordance with the regulatory framework and guidelines listed in **Section 2**. The assessment indicates that the proposed construction stage stormwater discharge are likely to have limited impacts to the receiving freshwater ecosystems. The criteria recommended in DPE (2022) is considered appropriate for monitoring and management of construction stage water discharges.

Kind regards

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