DOC22/325987 20 May 2022

Mr Nathan Heath
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Social and Other Infrastructure Assessments
Department of Planning and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

Upper South Creek Advanced Water Recycling Centre (SSI 8609189)
EPA Advice on Response to Submissions (RtS)

Dear Mr Heath

I am writing to you in reply to your invitation to the NSW Environment Protection Authority (EPA) to provide comment on the Response to Submissions (RtS) for the above project.

The EPA previously provided comments on the Environmental Impact Statement (EIS) for the project in late 2021 (ref No. DOC21/1042313, DOC21/1040063). Comments were also provided on the Amendment Report for the project in March 2022 (DOC22/245647). It is understood the proponent will provide a separate RtS for comments on the Amendment Report in the future.

The EPA has reviewed the following documents provided by Sydney Water in relation to the RtS:

- *Upper South Creek AWRC Submissions Report,* dated March 2022, prepared by Sydney Water (the RtS)
- *Appendix B – Updated Management Measures,* undated, prepared by Sydney Water (the Management Report)
- *Hawkesbury Nepean and South Creek TUFLOW FV and AED2 Model Calibration Report*, dated August 2021, prepared by Sydney Water (the Calibration Report)
- *South Creek STP Environmental Impact Assessment Peer Review of Water Quality Models,* dated 12 March 2021, prepared by Mr Brett Miller of the University of New South Wales (the Peer Review)
- *South Creek STP Environmental Impact Assessment Peer Review of Water Quality Models (updated),* dated 4 November 2021, prepared by Mr Brett Miller of the University of New South Wales (the Updated Peer Review)

The EPA's comments on the RtS are provided at **Appendix A**. The comments provided on effluent impacts to water quality were prepared in consultation with the Water, Wetlands and Coasts (WWC) Branch within the Department of Planning and Environment (DPE).

As outlined in these comments, the EPA has outstanding and significant concerns about the project, specifically in relation to the proposed wet weather discharges, both in terms of the justification for those discharges and the impacts on water quality of South Creek and the Nepean River. The EPA considers that these issues must be resolved prior to DPE determining the project.

If you have any questions about this request, please contact Daniel Burchmore on 9995 5995 or via email at daniel.burchmore@epa.nsw.gov.au.

Yours sincerely

JACINTA HANEMANN
Director Regulatory Operations

APPENDIX A

1. Water quality impacts of effluent discharge

As outlined in the EPA's response to the EIS, AWRC treated effluent discharges 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. During dry weather, all flows from the AWRC will be of an extremely high treatment standard.

However, the EPA has significant concerns regarding the environmental impacts of the following components of the proposal:

- The discharge of primary treated effluent into South Creek during wet weather.
- The discharge of tertiary treated effluent into the Nepean River during wet weather at the current discharge location.
- The adequacy of modelling for the water quality impacts.

Under the *Protection of Environment Operations Act 1997* (the Act), the EPA will be required to regulate the proposed AWRC under an environment protection licence (EPL). In exercising its licencing functions, the EPA must consider the environmental values of the waterways impacted by the AWRC and the practical measures that could be taken to restore or maintain the environmental values of these affected waterways[1].

Further information on each of these issues is provided below:

Discharge of primary treated effluent to South Creek

The EPA's response to the EIS raised concerns that the proposed discharges of primary treated effluent to South Creek from the AWRC were not adequately justified.

The modelling provided indicates the following issues in relation to South Creek primary treated discharges:

- Extensive bank attachment from the pollution plume will occur downstream of the release point will occur from the majority of the discharges.
- These discharges would, in many scenarios, fail to meet toxicity dilution requirements for ammonia and chlorine.
- Primary treated effluent would contain substantial nutrient concentrations (18 mg/L median concentration for total nitrogen) and pathogens (7,400 CFU/100 mL median concentration for enterococci).
- Analysis of other pollutants likely to present in primary treated effluent have not been undertaken. A wide range of other constituents (e.g., endocrine disruptors, heavy metals, other pathogens) found in primary treated effluent will also likely be discharged to the river system during these discharges.
- No assessment has been undertaken on pathogen impacts for recreational areas within South Creek. The discharge of effluent containing large concentrations of pathogens would present human health risks that could substantially limit recreational water use in South Creek in the future.

Furthermore, significant uncertainty remains regarding the impact of these discharges. Whilst residence times for nutrients, pathogens and other contaminants may potentially be low in South Creek under large rainfall/flow events, they are likely to remain in the Hawkesbury River for much longer periods of time (e.g., days; especially if released at the back end of the hydrograph).

The Water Quality Response Models (WQRMs) developed by Sydney Water for the AWRC discharges represent a significant undertaking to assess these impacts and uncertainties. In the RtS Report, Sydney Water stated that regardless of any uncertainties in these WQRMs, the following overarching outcomes are unlikely to change:

- *"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.*

[1] Section 45(f1) of the Protection of Environment Operations Act 1997

- *That the AWRC inputs are a small driver of change (and mostly beneficial) relative to the broader catchment pressures, and projected climate change impacts."*

Following review of the WQRMs and the Calibration Report on which the models were based, the EPA considers that the uncertainties in the WQRMs mean that all of these overarching outcomes cannot be properly justified. A detailed review of the inherent limitations with the WQRMs is provided below (see Limitations of WQRMs section). It should be noted that wet weather discharges to South Creek will be occurring at times of high nutrient loadings from other sources, including sewerage overflows and bypasses from other sewerage treatment plants within the catchment. The cumulative impact of the South Creek AWRC discharges during wet weather with other similar wet weather discharges from Sydney Water operations have not been well modelled or quantified in the assessment.

Given that these primary treated discharges are predicted to already have significant water quality issues, and there is inherent uncertainty that more significant water quality issues will not occur, the EPA recommends a more conservative approach be taken to AWRC discharges into South Creek. While there will always be difficulties in accurately projecting future water quality impacts, what can be managed more clearly are the *inputs* from the AWRC. The removal or significant reduction of primary treated discharges will remove a large input of minimally-treated effluent into the waterway.

The EPA recommends that the following approaches be examined in further depth by Sydney Water:

- **Re-modelling of primary treated discharge volumes**
- **Storage of some or all of the wet weather flows**
- **Increasing AWRC treatment capacity**
- **Consideration of UV treatment for primary treated flows**

Further information regarding these approaches is provided below:

Re-modelling of primary treated discharge volumes

It is acknowledged that the volume of primary treated discharged into South Creek from the AWRC is heavily dependent on stormwater infiltration into the sewer system. In relation to this, the following aspects of the project are noted:

- 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, and that this work may potentially reduce stormwater infiltration into the sewer network (and thus reduce the volume of primary discharges).
- High 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.

If Sydney Water is able to provide clearly defined and measurable agreements or works (including stormwater harvesting and infiltration management) that will further reduce the modelled volume of primary discharges to South Creek, these should be outlined and an estimated reduction in the volume of primary treated discharge included.

Storage of wet weather flows

In the RtS report, Sydney Water advised that storage of wet weather flows presents a significant challenge given the cost and impacts of installing additional large-scale infrastructure. Specifically, the RtS Report notes *"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.".*

If the figures provided in this statement are accurate, the EPA considers there are sufficient grounds for the development of this additional storage capacity. The ability to store and prevent the discharge of 165 ML/day of effluent on just one 'peak day' would appear to remove about 80% of the total yearly discharge of only primary treated effluent into South Creek[2]. Based on the modelled size of various

[2] Table 4-6 of Appendix F of the EIS indicates that the projected yearly volume of solely primary treated effluent into South Creek in a wet year is 206 ML

components of the proposed AWRC[3], the potential for storage to developed at an offsite location (where land and planning constraints may not be as significant), and the demonstrated footprint of other major storage tanks of EPA-regulated sites, the development of 165 ML storage is considered reasonable and feasible given the modelled and potential water quality impacts from these primary treated discharges.

Clarification should also be provided around the accuracy of the RtS statement above. The EIS indicates that up to 144 ML of flows can be discharged per day before primary treatment is required during severe wet weather[4]. Sydney Water should provide confirmation that the 165 ML/day figure refers to additional flows that could potentially enter the plant during the day above the existing 144 ML/day maximum non-primary treatment capacity, rather than the overall plant peak daily flow. If the RtS statement above is referring to the overall plant peak daily flow, the infrastructure required to store a peak day's flows would be substantially less than the 165 ML/day stated.

Increases to AWRC treatment capacity

In the RtS Report, Sydney Water noted difficulties with increasing the treatment capacity of the AWRC to provide a higher level of treatment to the proposed primary effluent discharges. The RtS Report states "*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."*

While there may be limitations to treating all discharges into South Creek at an advanced treated (reverse osmosis) standard, minimal consideration has been given to increasing the capacity of other treatment stages. Based on 2056 population projections, Sydney Water expects that the AWRC will ultimately require expansion to treat wastewater flows up to 100 ML/day and has set aside additional areas of the AWRC site for future capital works to meet this future capacity. Sydney Water should further consider fast-tracking any incremental capital works to increase the capacity of the secondary and tertiary treatment components of the AWRC in the future so that these works are incorporated into Stage 1 of the project. Improved secondary or tertiary treatment of the currently proposed primary discharges into South Creek may have a significant environmental benefit.

Use of UV treatment from primary treated discharge

Primary treated effluent discharged to South Creek will receive pathogen treatment via chlorination. In these circumstances, there will be a high chlorine chemical demand and usage, and uncertainty as to whether an adequate level of chlorination can be consistently provided to kill pathogens, and uncertainty as to the effects of variable chlorination levels on aquatic life and water quality. As outlined above, there are acknowledged toxicity issues with chlorine for primary discharges. **If primary treated wet weather discharges are to occur, it is strongly recommended that Sydney Water investigate and implement ultra-violet (UV) disinfection methods at the AWRC rather than use chlorine dosing/chlorination.**

Nepean River discharge location and impact assessment

In its response to the EIS, the EPA raised concerns that the assessment of mixing zone modelling for the Nepean River discharge was inadequate. Specifically, only some wet weather discharges were modelled (periods of more than 3 x ADWF into the plant).

In the RtS Report, Sydney Water stated that *"additional near field modelling of other release conditions during dry or mild to moderate wet weather conditions [in relation to the Nepean discharge] …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)."*

Further justification is needed for this statement. During partial and moderate wet weather events (1.3 – 3 x ADWF), tertiary treated effluent will be discharged into the Nepean River. This effluent contains multiple pollutants that exceed ANZG DGVs. While this discharge will be mixed with advanced (reverse osmosis) treated effluent, this does not necessarily mean that these moderate wet weather discharges will meet mixing zone toxicity requirements (especially given that tertiary treated discharges during extreme wet weather are modelled to have significant issues with respect to toxicity). Without this assessment, it is unclear as to the frequency and impact of discharge events in which toxicity impacts will be observed at the

[3] Figure 4-1 of the EIS

[4] Table 4-7 of the EIS – "Flow Scenarios for Stage 1 of the AWRC"

Nepean River discharge. **An assessment of near-field toxicity impacts should be undertaken for the Nepean River discharge for scenarios in which tertiary treated effluent is to be discharged (between 1.3 and 3 x ADWF) and discharge concentrations are above ANZG DGVs.**

Even without a more complete toxicity assessment of the Nepean River discharge under other scenarios, TN, TP and NOx in the tertiary effluent do not meet ANZG at the edge of the near field mixing zone (which is at least 50m) during extreme wet weather events. Based on this very basic assessment and the mixing zone results for the identified toxicants in the EIS, the discharge represents a risk to the protection of the environmental values in the Nepean River under extreme wet weather.

In the RtS report, Sydney Water have considered an alternative discharge configuration (three port diffuser) that provides adequate dilution of Nepean River discharges. While there are identified construction and operational issues associated with this alternative, if these issues can be overcome or mitigated it will significantly reduce the risk to the protection of the environmental values in the Nepean River under severe wet weather conditions and, most likely, also under other rainfall conditions

In the RtS Report, Sydney Water has also committed to investigating opportunities during detailed design to see if there are any feasible opportunities to improve dilution of wet weather releases. While the EPA is supportive of this commitment, further assessment of alternative discharge locations and configurations at this stage of the planning process is considered a more concrete mechanism to identify a more beneficial environmental outcome.

The EPA recommends that Sydney Water consider alternatives to the current proposed location and configuration of the discharges to the Nepean River. The following approaches should be examined in further depth by Sydney Water:

- **Expanded assessment of toxicity impacts for the current discharge location (as per above)**
- **Further assessment of alternative discharge locations**

Further information regarding some of these requirements are provided below:

<u>Further assessment of alternative discharge locations</u>

In the RtS Report, Sydney Water identifies several constraints regarding an alternative discharge location into the Nepean River from the AWRC:

“

- *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.*
- *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.”*

While the potential erosion issues with discharge points further upstream are acknowledged, the EPA considers that further assessment should be given to a discharge location downstream of Wallacia weir. Specifically, this assessment should:

- Outline further the construction issues associated with a downstream location
- Further clarify any recreational areas downstream that may be impacted (if any) and assess the impacts to these areas relative to the current discharge location.
- Model the toxicity impacts of this downstream discharge location compared to current discharge point (including justification that limited levels of dilution would occur relative to the current discharge point during extended dry weather).

Limitations of WQRMs

The WQRMs developed to assess the AWRC impacts have significant limitations and inherent uncertainties.

Conceptual and numerical catchment models such as the WQRMs are common tools in calculating the runoff dynamics, stream flow, water quality and ecosystem response for a given area or region. The model parameters are usually calibrated to try and obtain a good fit between observed and simulated outputs. However, since computer models are not a perfect representation of reality, the model results have an inherent level of uncertainty.

It is noted that the Peer Review of the WQRMs stated:

> *The 2021 calibration report relies heavily on information previously documented in the 2014 calibration report. However it is apparent that there has been ongoing development of the catchment, hydrodynamic and water quality models. This 2021 calibration report would benefit from having complete documentation of all assumptions, parameters, calibration and verification within a single report. Given the complexity of the system, the amount of development undertaken and the roadmap of future development, a single, stand-alone document would ensure that all model stakeholders and users of the model outputs are aware of the confidence, assumptions and limitations of the models.*
>
> *Modelling of South Creek and the Hawkesbury Nepean in separate hydrodynamic and water quality models has the advantages of greater modelling speed for scenarios in South Creek. However, the potential disjoint between the models has only discussed the implications to the Hawkesbury Nepean. The calibration report should explicitly state that any changed in water quality predicted by the Hawkesbury Nepean model cannot influence scenarios run in the South Creek model. The lower part of the South Creek model is in the tidal pool and with the disjoint there is no way that WQ in the lower South Creek can be influenced by water quality in the Hawkesbury Nepean, which might occur in the prototype.*
>
> *Statistical analysis of model results against data has not been presented. As such, quantitative terminology that infers statistical analysis such as "high correlation" should not be used in the discussion. While I agree that a visual inspection of model timeseries versus measurements will often provide greatest insight into processes, I recommend that statistical analysis also be considered to quantify which model regions and constituents can have the greatest confidence placed upon them. Ideally the statistical analysis would be completed separately for the calibration period and a validation period.*

This is considered a very useful summary of the modelling arrangements and issues for the South Creek and the Hawkesbury Nepean models. **Miller's Updated Peer Review of the WQRMs identified that many of these issues were addressed, but recommended that the statistical analysis of the calibration and verification in Section 4 of the Calibration Report should also report:**

- **The equations used for each of the four statistical measures.**
- **The number (n) of "samples" vs "model" data points that were used in each period, parameter and waterway zone.**
- **Definition of what quantitative measures comprised "poor", "acceptable" and "accurate".**
- **Referencing of statistical and modelling papers as to why these values were adopted.**

These recommendations are supported.

The Water, Wetlands and Coasts Science (WWCS) Branch at DPE have also been involved in reviewing these numerical models and their results in various capacities for over a decade (including reviewing the original Hawkesbury Nepean model reported by SKM 2014). Modelling such a diverse catchment as the Hawkesbury-Nepean is in reality a huge undertaking and the efforts of the modellers are duly acknowledged as being a significant contribution in this area. **Nevertheless, limitations exist with all such models, and a number of important points have emerged from various reviews where such models have been used previously.**

Sydney Water's response to recent modelling comments, provided via email on 5 March 2021 (Sydney Water, 2021), stated the following in relation to the Hawkesbury Nepean and Stonequarry Creek models:

- *"The Source model aims to capture the complex and varied processes within the catchment and is a 'mechanistic' model. There are multiple factors (known and unknown) that impact the flow gauge*

measurements. No single source of information is relied upon to the exclusion of other data. ***There are limitations for a mechanistic model to represent all the variable processes that occur across the catchment. The model is a simplified representation of reality."***

- "*The value of the calibrated model is in testing a range of management configurations (treatment, reuse, discharge) across many years of climate data, for current or future inflow conditions. In these cases, the comparison between scenarios is the most useful insight. Again, the individual concentration statistics are not predictive, but a scenario with higher modelled concentrations reflects mechanisms that are likely to occur in reality and result in higher concentrations if the scenario was implemented compared with an alternative lower concentration scenario*."

The above information identifies the following key limitations for the Hawkesbury Nepean, Stonequarry Creek and South Creek modelling:

1. When using models of this nature it is the relativities between model scenarios that are most informative (so qualitative comparisons such as one scenario is better than the other or potentially leads to lower impacts are more useful).
2. Statements about absolutes (e.g. percentage of time a guideline or level will be exceeded) are problematic because "*individual concentration statistics are not predictive"*.

Furthermore, as demonstrated in previous WWCS analyses/comments[5], depending on the site chosen, the models can sometimes consistently overestimate or underestimate the flow and concentration of nutrients or other important water quality variables. The provision of the new Calibration Report provides an opportunity to explore the recent calibration and validation of the South Creek and revised Hawkesbury Nepean models. The specific focus in the following sections are on areas where the model can be improved and should not be seen as an extreme criticism of the model or its overall approach.

<u>Hydrodynamic Model Assessment</u>

The Calibration Report states the following:

- *For both SC and HN WQRMs, the hydrodynamic performance of the models was evaluated for the periods July 2013-June 2014; and from July 2014-June 2015. These years are representative of a relatively dry year and a wet year respectively, based on decile analysis of rainfall over a 25-year period from 1994 through to 2019.*

- *For both the SC and HN WQRMs, water quality calibration was undertaken over the period July 2017-June 2018. This year was selected as it presented the most extensive and comprehensive dataset within both the river and creek. The period could therefore be used to constrain the parameter selection during the calibration process.*

- *Validation years for the SC and HN WQRMs included both the July 2013-June 2014 and July 2014-June 2015 years. As discussed previously, these periods were selected as representative dry and wet years, respectively. Due to more extensive availability of monitoring data, an additional validation year, July 2012-June 2013, was also run for the HN WQRM.*

- *The SC WQRM hydrodynamic evaluation consisted of comparison of model results against flow field data collected at the following gauges: South Creek at Great Western Highway, South Creek at Richmond Road and Eastern Creek at Riverstone.*

The first point to note here is that both models have been calibrated to only one years' data (July 2017-June 2018). Variability from year to year is to be expected, which means there will be uncertainty related to the calibrated parameters in these models. It is not always clear what these uncertainties are, but the calibration/validation report does help provide some insights into this variability.

The South Creek and Hawkesbury Nepean model has been validated for two years data (*July 2013-June 2014 and July 2014-June 2015 years)*. An additional validation year, *(July 2012-June 2013),* was also run for the HN WQRM. The point here is that validation occurred for two years in South Creek and three years for the broader Hawkesbury Nepean. Neither include the drought year of 2019 and so it remains unclear how well the model would predict the behaviour of the catchment flows and water quality at other times and the

[5] Warragamba EFlows Technical Review Group comments; Picton STP comments.

impact of the AWRC during extreme drought. Luckily during drought it is unlikely that wet weather discharges would occur, but the effect of discharges and benefits of the proposal during such times remains uncertain. An important step in reviewing the model is the assessment of how well the calibrated model predictions agreed with observed data during the two (or 3) validation periods.

Section 3.1.2 *Loss Nodes* of the calibration report discusses issues with the calibration of flow at the South Creek gauging station at the Great Western Highway (Stn 212048; Figure 3-3 below). The calibration report states:

> *Following the calibration process, it was identified that the baseflow at some locations in the South Creek Model was being overestimated. Focusing the calibration on the rainfall-runoff parameters that affect baseflow could not reproduce the observed baseflow (Figure 3-3). It is suspected that there are additional losses within the stream that have not been identified or accounted for.*
> *Losses were calculated through analysis of the observed and modelled flow duration curve without losses. Percentile flows were used to define the break points of the flow and the difference between the observed and modelled flow used as the loss volume for that flow volume. A greater resolution of points was used for low flows as this was where the greatest error between the modelled and observed flows occurred.*
>
> *The model has been calibrated without Loss Nodes in place, and then Loss Nodes added to account for the unknown losses of the system.*
>
> *Loss Nodes have been added immediately upstream of the following locations in the South Creek model:*
> • *212048*
> • *212049*
> • *212320*

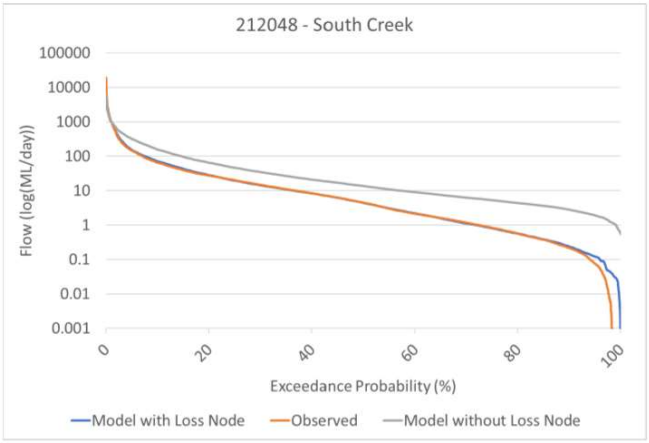
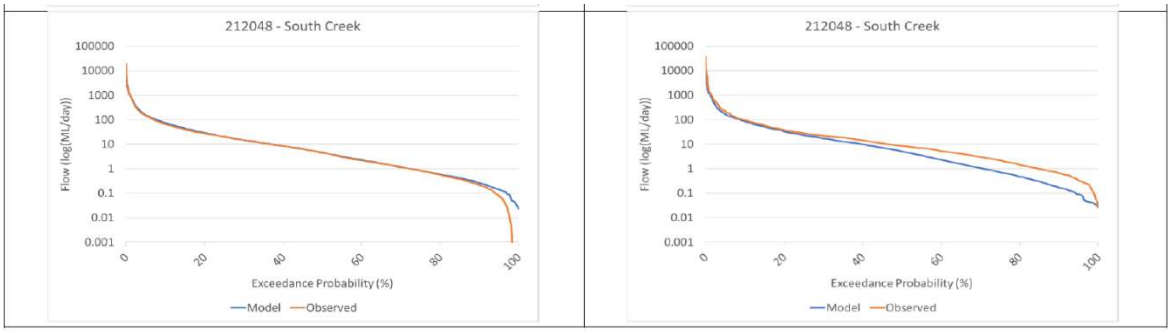


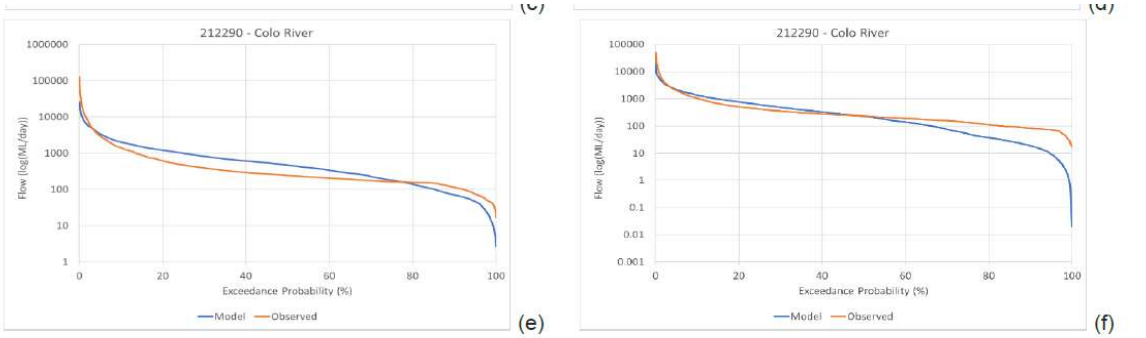
Figure 3-3 Example of Loss Node forcing at Stream Gauge 212048

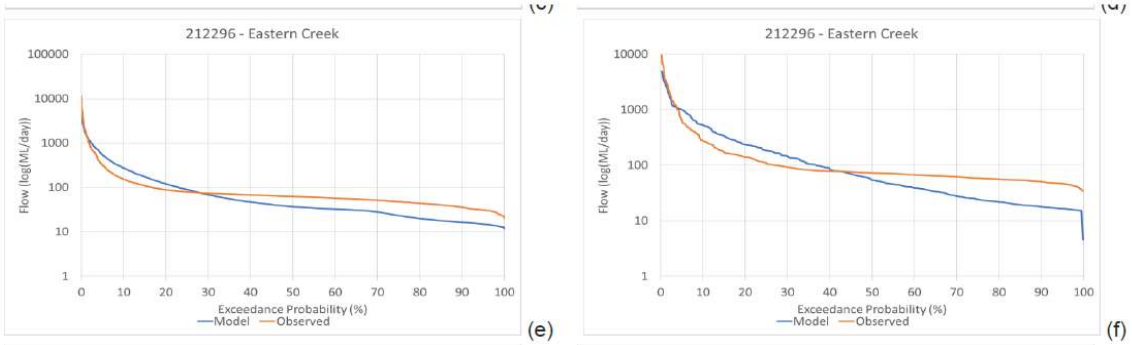
The level of adjustment to South Creek flows at gauge 212048 are fairly significant (up to 10 ML/day in some cases[6]). Since the calibration period was for one year (*July 2017-June 2018*), very limited information on 'flow losses' are available for other years, or how well the adjustment used here affects model output in other years. The calibration years (*July 2013-June 2014 and July 2014-June 2015 years)* suggest some deviation between modelled and predicted, particularly for the second time period (see Figure below). Again it would be nice to know the behaviour and effects of this flow loss adjustment in the 2019 drought year and at other gauging stations in South Creek (or other catchments). **More comprehensive assessment of this issue in other years and at other sites should be undertaken.**

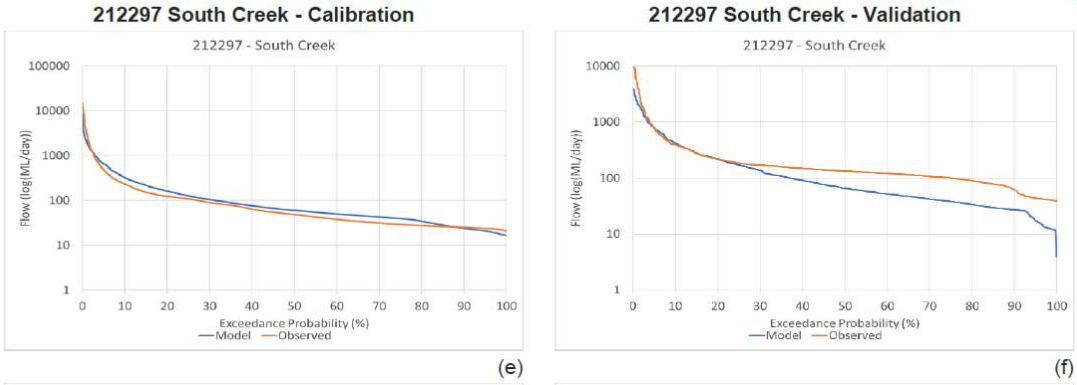
[6] An error (loss) equivalent to approximately 4 Olympic swimming pools. This is obviously not an insubstantial number and this issue needs significantly more study.



Other calibration/validation issues were found for the Colo River (212290; underestimation of low flows), Eastern Creek (212296; overestimation of high flows, underestimation of low flows) and South Creek (212297; underestimation of medium to low flows). No validation was available for the Eastern Creek gauge (567069) since all data were used in the calibration phase. It is unclear what effects the underestimation/overestimation of flow in model outputs have on various conclusions. Such effects will be minimised when relative comparison of one scenario are made to another (since they will cancel each other out), but it is quite difficult to say what this could mean in terms of absolute predictions, except that **over/underestimation of modelled flow can considerably increase the uncertainty of model predictions.**

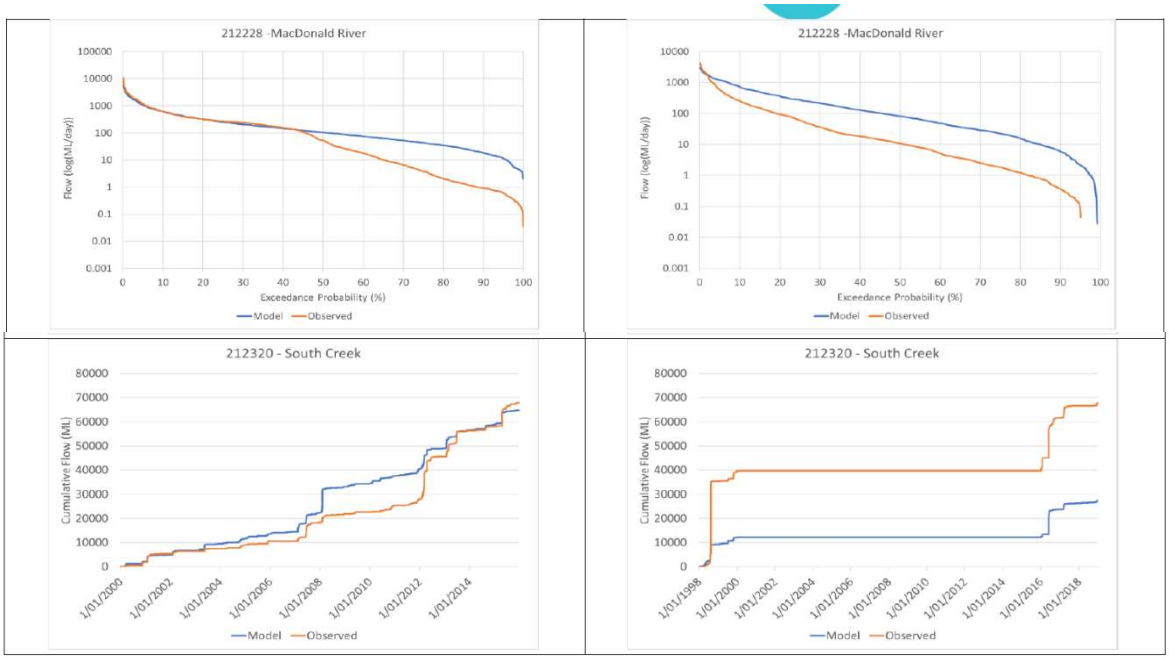






A detailed of the analysis of flow at other sites was unable to be achieved in the timeframe but some issues were noted in passing for flow in the MacDonald River (212228) and cumulative flow for Upper South Creek

(212320) - see below. Again, it is unclear what effects such underestimation/overestimation of modelled flows mean in terms of prediction.



Water Quality

As identified for flows above, depending on the site chosen, the models can sometimes consistently overestimate or underestimate the concentration of nutrients or other important water quality variables. The calibration report adopts a different approach when presenting water quality data (boxplots) than it does for flow (flow exceedance curves). Greater consistency and insight could be achieved if the water quality data were presented as concentration exceedance curves (similar to the flow exceedance curve). This is relatively simple to implement if one had access to the observed and model predicted data.

Again, a detailed analysis of water quality at various sites was unable to be achieved in the timeframe available but some issues (underestimation/overestimation of concentrations) were also noted in passing for TN at 212290 & 212291, enterococci at 212213, TP at 212290, TDS at 212290 & 212291, TP at 212213 & 2122131 (see below). In some cases, it appears that the revised model actually does worse (has a poorer agreement with observed data) than the original model. It would be good to explore the underlying reasons for this. Again, it is unclear what effects such underestimation/ overestimation of model concentrations mean in terms of prediction for individual sites.

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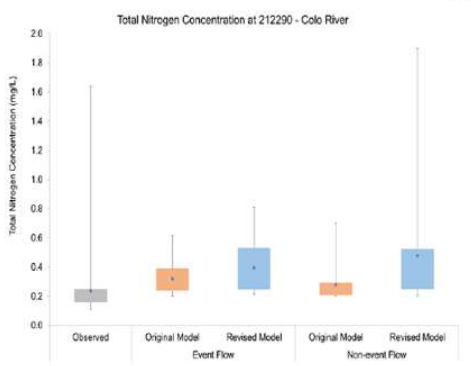
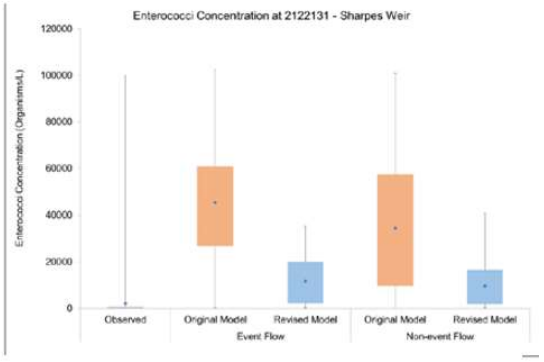
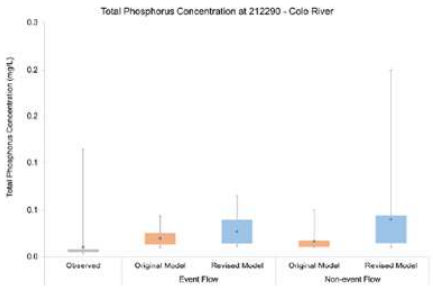
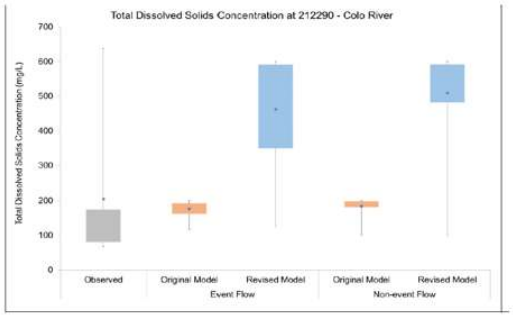
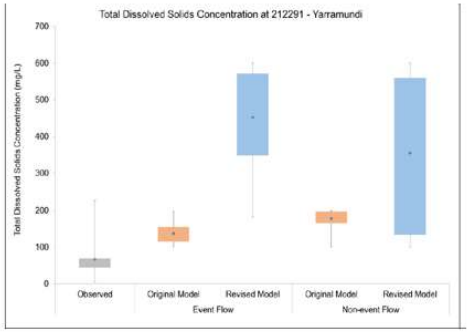




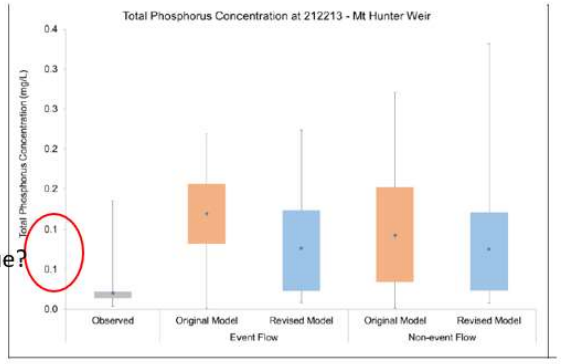


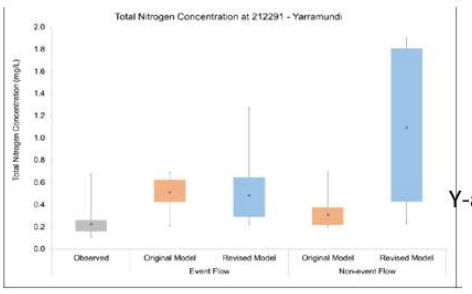
(m)





Y-axis issue?





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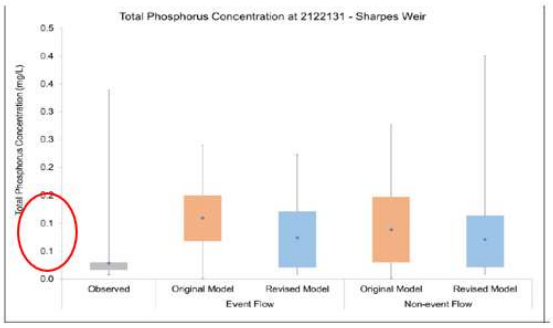

The statistical analysis for the calibration report focused on a range of indicators including salinity, temperature, nitrogen, phosphorus and total chlorophyll a. The statistical metrics applied included the following:

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

Tables 4-2 and Table 4-6 identified areas/sites of poor calibration where results need to be treated with caution. Chlorophyll a appears to be one of the poorest, but there also some issues with phosphorus (TP or

FRP) depending on the zone considered. It is unclear how 'acceptable performance' has been defined when the statistical bias metric can be greater than 100%.

Table 4-2. Validation summary statistics for key water quality attributes in the HN WQRM for the years 2012/2013

Zone	Salinity				Temperature				DO				TCHLA				TN				TP			
	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS
Zone_4_Box_2	-0.02	15.28	0.06	0.39	0.97	1.15	1.74	0.09	0.92	-19.89	1.94	0.21	0.37	-46.03	5.75	0.75	0.71	-30.71	0.28	0.41	0.61	72.09	0.03	1.05
Zone_3_Box_3	0.38	24.43	0.04	0.34	0.91	7.72	2.73	0.14	0.65	-20.96	2.34	0.25	-0.06	-69.9	11.25	1.24	0.67	-43.11	0.26	0.49	0.49	60.72	0.02	1.16
Zone_3_Box_4					0.98	-6.9	1.46	0.07	0.85	-10.52	1.14	0.13	-0.2	-78.27	10.7	1	0.87	-40.29	0.23	0.44	0.83	-7.61	0.01	0.44
Zone_3_Box_5	-0.55	16.78	0.04	0.32	0.97	-6.01	2.05	0.1	0.78	-11.42	1.43	0.16	0.17	-68.79	13.55	0.93	0.07	2.84	0.2	0.33	0.56	90.37	0.04	1.25
Zone_2a_Box_6	-0.06	26.27	0.04	0.38	0.98	7.53	1.9	0.1	0.7	-16.88	2.16	0.24	0.17	-69.5	18.33	0.97	0.08	2.4	0.31	0.51	-0.07	103.63	0.05	1.64
Zone_2b_Box_7	-0.15	-8.82	0.11	0.65	0.97	5.19	2.13	0.11	0.66	-16.9	2.07	0.25	0.33	-88.52	23.1	0.99	0.31	-4.39	0.27	0.35	0.28	30.05	0.03	0.76
Zone_2b_Box_8	0.43	137.2	0.72	4.83	0.97	6.09	2.07	0.1	0.83	-17.09	1.92	0.22	-0.03	-80.85	21.65	0.93	0.77	-28.55	0.26	0.38	0.82	-12.38	0.01	0.37
Zone_2b_Box_9	0.8	99.79	1.98	2.3	0.96	9.28	2.62	0.14	0.65	-22.5	2.53	0.3	0.08	-66.4	10.69	1.24	0.71	-15.28	0.15	0.4	0.33	52.28	0.02	1.22
Zone_1c	0.96	18.82	5.14	0.22	0.99	-0.31	0.62	0.03	0.62	-8.75	1.26	0.16	0.13	-76.39	38.27	3.15	0.69	-46.32	0.19	0.53	0.28	-15.99	0.01	0.45

Zone	NH4				NOx				FRP			
	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS
Zone_4_Box_2	0.46	-59.55	0.07	1.41	0.18	-35.71	0.23	0.66	0.31	119.53	0.02	1.97
Zone_3_Box_3	-0.03	-62.08	0.02	1.51	0.62	-53.08	0.16	0.7	0.32	130.44	0.01	2.39
Zone_3_Box_4	0.43	-35.05	0.01	0.85	0.83	-30.91	0.09	0.49	0.53	30.44	0.01	0.96
Zone_3_Box_5	0.3	87.73	0.03	1.57	-0.31	87.11	0.27	1.33	0.39	153.13	0.02	2.28
Zone_2a_Box_6	0.34	-45.59	0.02	1.03	0.17	22.53	0.19	0.91	0.03	184.61	0.02	2.55
Zone_2b_Box_7	0.35	-36.49	0.02	0.79	0.37	2.6	0.2	0.65	0.09	102.33	0.02	1.58
Zone_2b_Box_8	0.84	-40.27	0.03	1.66	0.45	7.05	0.2	0.93	0.88	12.42	0	0.4
Zone_2b_Box_9	0.57	-52.54	0.02	1.1	0.63	-12.09	0.1	0.76	0.47	29.17	0.01	1
Zone_1c	0.49	-81.45	0.02	1.42	0.61	-47.75	0.05	1.13	0.22	-12.96	0.01	0.51

Key

- Poor calibration result where results should be considered with caution
- Acceptable level of performance
- Accurate prediction.
- Zones with insufficient field data to report statistical measures

Table 4-6 Calibration and validation summary statistics for key water quality attributes in the SC WQRM for all calibration and validation years

Zone	Salinity				Temperature				DO				TCHLA				TN				TP			
	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS	R	BIAS (%)	RMS	NRMS
2013-2014 - Validation																								
Non Ephemeral	0.39	41.23	0.17	0.54	0.97	1.99	1.81	0.1					0.14	8.15	27.62	1.53	-0.11	-9.26	0.71	0.4	0.02	34.29	0.09	
Tidal	0.72	14.64	0.12	0.31	0.97	1.97	1.76	0.09	0.66	-8.34	2.02	0.34	0.45	-24.08	25.76	1.18	0.12	-12.21	0.78	0.33	0.44	-5.45	0.07	
2014-2015 - Validation																								
Non Ephemeral	-0.02	30.66	0.15	0.44	0.96	-1.03	2.4	0.13					0.66	158.55	14.75	3.5	-0.51	-29.35	1.46	0.63	0.07	9.91	0.11	
Tidal	-0.1	31.05	0.13	0.39	0.98	0.13	1.77	0.09	0.9	-23.76	1.66	0.28	0.54	1.77	12.34	1.06	0.31	-38.45	3.64	1.09	0.59	-28.12	0.11	
2017-2018 - Calibration																								
Non Ephemeral																								
Tidal	0.16	5.26	0.18	0.42	0.97	0.51	1.95	0.1	0.84	11.84	1.2	0.19	0.26	195.46	19.51	2.64	0.6	-2.55	1.02	0.36	0.42	42.7	0.05	

Key

- Poor calibration result where results should be considered with caution
- Acceptable level of performance
- Accurate prediction.
- Zones with insufficient field data to report statistical measures

Modelling Conclusions

There are a significant number of areas where the model would benefit from further calibration and validation. Models have been calibrated to only one years' data (July 2017-June 2018) and variability from year to year is to be expected, which means there will be uncertainty related to the calibrated parameters in these models. It is not always clear what these uncertainties are in predictions since absolute numbers are often stated rather than a range of flows/concentrations (or 95% confidence intervals).

It would be nice to know the behaviour and effects of flow loss adjustments for the 2019 drought year in South Creek (South Creek gauging station at the Great Western Highway Stn 212048), and for other gauging stations in South Creek, Eastern Creek, and other areas (if applied). Whilst some of these issues become less important when relative comparisons of one scenario are made to another (since these effects may cancel each other out), it is quite difficult to say exactly what this could mean in terms of absolute predictions, except that it is likely to significantly increase the uncertainty level in model predicted flows and

concentrations. Greater consistency and insight could be achieved if the water quality data were presented as concentration exceedance curves (similar to the flow exceedance curve).

2. Air Quality

The EPA's response to the EIS noted the need for further information to assess the impact of the project on air quality, in particular:

- Justification for the adopted emission rates
- Further description of proposed odour control measures
- Additional information on contingency measures for mitigating odour impacts
- Details about the proposed co-generation units.

The RtS addresses many of the information gaps outlined above. Sydney Water has provided additional information, in the RtS, regarding the proposed co-generation units. Based on this additional information, the EPA is concerned that the proposed co-generation technology is not aligned with best practice emission performance.

It has not been demonstrated that the proposed cogeneration equipment is consistent with best available technology (BAT). All new cogeneration in Sydney and the Illawarra should either be NOx neutral or achieve BAT emission performance (https://www.epa.nsw.gov.au/your-environment/air/air-nsw-overview/managing-air-quality).

The EPA considers a NOx emission standard of 250 mg/m3 is BAT for natural gas fired reciprocating internal combustion engines with a capacity to burn less than 7 mega joules per second of fuel in the Sydney and Wollongong Metropolitan Area and Wollondilly Local Government Area. It is noted that the proposed engines will be fired on bio-gas, however it is expected that the units should be capable of achieving an NOx emission performance better than the proposed 450 mg/m3.

The need to further improve on the modelled co-generation unit performance is supported by the modelling undertaken in the Air Quality Impact Assessment (AQIA) within the EIS:

- From section 8.2 of the AQIA, it is understood that incremental impacts of NOx are predicted to be 50 ug/m_3. These incremental impacts are considered significant.
- A robust cumulative assessment of NOx has not been performed. It has not been adequately demonstrated, under the 100 ML per day scenario, that the facility will comply with the EPA's impact assessment criteria at all current and likely future sensitive receptors.
- The predicted results of the modelling have not been presented in a table, as such it is unknown what the precited incremental and cumulative impacts are at all sensitive receptors.
- The adopted maximum background for NOx is 103 ug/m_3. Whilst this is the highest recorded background for the modelled year, the maximum measured over the 5-years (2015-2019) of data presented in Table 7 of the AQIA is 131 ug/m_3.
- No consideration of the 2021 Variation to the National Environment Protection (Ambient Air Quality) Measure where NO2 standards were significantly strengthened to reflect the most recent health evidence emerging about the health impacts of NO_2.

Given the above, the EPA recommends the proponent evaluate the feasibility of installing cogeneration engines that are consistent with Best Available Technology in regard to NOx emissions and advise whether the proposal will be amended to improve NOx emission rates below the currently modelled performance. Where a lower NOx emission technology is proposed, the expected change in NOx impacts from currently modelled should be discussed.

Should the adopted emission performance of 450 mg/m3, or marginally below 450 mg/m3, continue to be proposed, the EPA will require a more robust assessment of nitrogen oxides be performed in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants*. The assessment must:

- **Include a worst-case operating scenario for NO_2 impacts**

- **Present all predicted incremental and cumulative impacts of NO_2 for each modelled scenario at all existing and future receptors**
- **Consider the 2021 one hour and annual average NO_2 AAQ NEPM standards**

3. Noise and vibration

The EPA's comments on the EIS noted that the project is likely to have significant noise and vibration impacts on communities adjacent to works during the construction phase, and that all reasonable and feasible mitigation measures should be implemented prior to the commencement of these construction activities to address these impacts.

The RtS has generally addressed the EPA's comments on the EIS regarding noise and vibration impacts from the project in its current design.

4. Contaminated Land

In its response to the EIS, the EPA outlined a range of requirements regarding the assessment of contamination from the AWRC construction. Following review of the RtS Report, the EPA provides the below comments regarding contamination assessment.

Engagement of an EPA-accredited Site Auditor

In the RtS Report, Sydney Water did 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. The reasoning for this is that 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 EPA notes that there are areas of environmental interest which have been identified across the project footprint and there are areas (e.g. sites with former and current landfilling activities) which will likely require long-term environmental management plan/s to manage residual contamination. Appendix B of the submissions report include a commitment to review soil sampling and areas of environmental concern identified for the project as part of the Soils and Contaminated Land Impact Assessment (Aurecon Arup, 2021). However, it is not clear who will review the Sampling and Analysis Quality Plan (SAQP), the Construction and Environmental Management Plan (CEMP) and the unexpected finds protocol which will be prepared for the project.

Site auditors independently review work done by contaminated land consultants to ensure the work complies with current regulations and guidelines and meets the standard appropriate for the proposed land use. The purpose of the site auditor scheme is not just the oversight of complex contamination issues. Site auditing has an important role in decision-making by planning authorities as auditors can provide increased certainty to planning authorities on the nature and extent of contamination and the suitability of a site for a specific use, as well maintaining transparency and community confidence in the proposed works

The EPA disagrees with Sydney Water's position and maintains that a NSW EPA accredited site auditor should be engaged throughout the duration of works for this project to ensure that any work required in relation to contamination, including any unexpected contamination finds, is appropriately managed and so that there is confidence that the land within the project footprint would be suitable for the proposed use.

The EPA recommends that Sydney Water engage an EPA-accredited Site Auditor throughout the duration of works to ensure that any work required in relation to contamination is appropriately managed.

Sydney Water's justification for not having completed a SAQP

An SAQP was not provided as part of the submissions report because the Sydney Water considered that the SAQP is most appropriately done when a detailed engineering design has been prepared. Instead, Sydney Water revised management measure CLS01 in Appendix B to ensure that SAQP is prepared prior to any further sampling work being undertaken.

Given some intrusive site investigation has been conducted to inform the EIS and that Sydney Water committed in the RtS to submit SAQP to inform further sampling, the EPA considers it acceptable for the Sydney Water t to submit the SAQP as part of a condition of approval. To formalise this commitment, the EPA recommends that SAQP should be required for the SSI project as part of conditions of approval, should the project be approved in its current form.

5. Surface Water

As outlined in the RtS Report, trenching of Kemps Creek for the purposes of construction of the brine pipeline will no longer be undertaken as per the Amendment Report. As such, justification for trenching of the creek is no longer an issue.

The EPA further notes the proposed management measures to address the impacts of trenching across South Creek for the purposes of the construction of the treated water pipeline in Table 15-3 of the EIS, and the justification provided for these trenching impacts.