Planning, Industry & Environment

Our ref: DOC21/1099849
Your ref: SSD-8441

Mr Marcus Ray
Deputy Secretary
Planning and Assessment Group
Department of Planning, Industry and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

Attention: Erica van den Honert

Dear Mr Ray

Warragamba Dam Raising State Significant Infrastructure proposal (SSD-8441)

I refer to the request from Planning and Assessment of 28 September 2021 seeking advice from the Department of Planning, Industry and Environment – Environment, Energy and Science Group (EES) on the Environmental Impact Statement (EIS) for the Warragamba Dam Raising Project.

EES has reviewed the EIS dated 10 September 2021 prepared by SMEC for the proponent WaterNSW. The EES advice is attached to this letter and a summary of the main issues is presented below.

As you would be aware, in June 2020 the Department of Planning, Infrastructure and Environment (DPIE) provided comments to WaterNSW on the consistency of the draft EIS with the Planning Secretary's environmental assessment requirements (SEARs), which included comments on World Heritage and national park values, other heritage issues and offsets for impacts on values.

National Parks and Greater Blue Mountain World Heritage Area

The EIS states that the area impacted by the project is 0.03% of the World Heritage area, and therefore the project's impacts will not be significant. However, the diminution of values on any area of land with World Heritage values is potentially significant and should be adequately assessed.

EES does not consider the impacts of the project on the natural and cultural values of the national parks estate and Greater Blue Mountains World Heritage Area have been adequately assessed or justified. The EIS should clearly identify and assess, using appropriate frameworks and methods, the full range of expected impacts on parks.

Notably, the EIS makes incorrect assumptions about how to determine World Heritage values, and therefore how to evaluate impacts on those values. World Heritage values should be assessed against the Statement of Outstanding Universal Value, the listing criteria and integrity and management arrangements. The integrity of the World Heritage area includes Aboriginal cultural connection, wilderness, geology, geomorphology and water systems, and the fact the World Heritage area is surrounded by other public lands as part of the boundary integrity for the property.

Regarding Aboriginal cultural heritage, EES was not aware that the upstream impact area used for biodiversity assessment purposes would be applied to Aboriginal heritage assessment. The area

assessed for Aboriginal heritage impacts should be based on factors relevant to the Aboriginal cultural landscape and the context of Aboriginal heritage and cultural values. The EIS incorrectly identifies that Aboriginal heritage is not part of World Heritage values. Aboriginal heritage is part of the World Heritage values, as it is part of the integrity of the property. There is a risk that cultural values of high significance have not been identified, resulting in impacts on those values not being assessed. Clearer commitment to assessing and managing Aboriginal cultural heritage in consultation with relevant stakeholders is required.

There is insufficient analysis of World Heritage values related to biodiversity. The ecosystems of the World Heritage area are globally significant because they contain outstanding examples of the evolution and adaptation of the *Eucalyptus* genus and eucalypt-dominated vegetation. The evolutionary processes include the full range of interaction between eucalypts, understorey, fauna, environment and fire.

EES also notes that The Historic Heritage Information Management System (HHIMS) has not been referenced in the EIS. HHIMS constitutes the register that the National Parks and Wildlife Service (NPWS) is required to establish and maintain under section 170 of the *Heritage Act 1977*. This is a register of heritage items on national park estate. There are eight records in HHIMS in the potential inundation area and only one, Jooriland homestead, is referred to in the EIS.

Offset arrangements

I note that on 21 December 2020 the then Secretary of DPIE replied to WaterNSW's letter dated 11 November 2020 seeking to confirm if an additional and separate offset strategy for the impact of the Warragamba Dam Raising Project on national parks is required, in addition to that required by the Framework for Biodiversity Assessment (FBA). The DPIE Secretary's letter pointed out that, to satisfy the SEARs, the EIS must separately identify and account for all impacts of the proposal. It should: assess and document biodiversity impacts using the FBA; assess and document impacts to national parks; and do the same for all impacted environmental values.

The DPIE Secretary's letter also stated that the proposed package of offsets for the project can be documented in a single strategy or WaterNSW may choose to develop separate strategies for each impacted value. The critical requirement is that the strategy or strategies identify how each impact will be offset and clearly document any situations where the delivery of offsets overlaps.

WaterNSW needs to detail its approach to offsetting and the effectiveness of the offset measures so that the Department and the community can clearly understand and evaluate WaterNSW's approach.

It is anticipated some land-based offsets would be able to address impacts to both biodiversity and park values. For example, a parcel of land may contain suitable threatened species habitat to meet biodiversity offset requirements and may also be considered suitable for addition to the national parks system to offset the loss of park values. Similarly, some offset lands may also be capable of addressing impacts to other matters, such as World Heritage values and Aboriginal cultural heritage. It is also expected that there may need to be additional offsets for some values. For instance, not all land delivering biodiversity offsets may be appropriate for reservation as national park.

While the biodiversity offsets can be calculated using the FBA, identifying suitable offsets for impacted park values will require direct discussion with NPWS. Biodiversity offsets which relate to impacts on land reserved under the NPW Act must be delivered on land reserved under the National Parks and Wildlife Act 1974 (NPW Act). The only exception to this should be if it is not possible to deliver the offset on land reserved under the NPW Act

Biodiversity

Regarding the biodiversity assessments, WaterNSW will likely need to alter species and plant community types polygons for the upstream and construction areas, therefore EES cannot complete the *Environment Protection and Biodiversity Conservation Act 1999* bilateral assessment.

This will need to be done once a response to submissions report is prepared by WaterNSW. In addition, EES does not consider there to be adequate justification for not providing offsets for downstream impacts.

Climate Change Risk and Sustainability

It is unclear how potential climate change risks have been factored into the project design and operation. Technical assessment of these and other climate change risks, and any proposed adaptation measures, should be included as part of the process to inform the project design.

Priority 4 of the NSW Net Zero Plan Stage 1: 2020-2030 is for NSW government to lead by example. As a major infrastructure project, the project has the scale and opportunity to go beyond the minimum requirements set by NSW Government Resource Efficiency Policy and be an exemplar for other major infrastructure projects to minimise emissions towards net zero for both operations and construction.

Floodplain Risk Management

EES acknowledges that the International Panel on Climate Change Assessment Report 6 was not available when the Climate Change Risk Report (Appendix G) was prepared, but recommends it should now be considered to better understand the full range of climate change implications for the full design life of the project.

EES has also identified many matters in the assessment of flood risk management that need further consideration, corrections or additional information.

Hydrology and Aquatic Ecology

The project would result in approximately 284 kilometres of upstream waterways potentially being inundated up to the probable maximum flood level. Minimal assessment has been undertaken of the aquatic ecology in these inundation areas, despite them containing known locations of threatened species.

To achieve the best outcomes, EES is available to work with the Planning and Assessment Group and WaterNSW to identify and resolve the inadequacies in the assessments and progress the offset strategies.

Should you have any queries regarding this advice, please contact Ms Louisa Clark, Acting Director Greater Sydney Branch, Biodiversity and Conservation at louisa.clark@environment.nsw.gov.au or on 9585 6001.

Yours sincerely

Dean Knudson
Deputy Secretary Biodiversity, Conservation and Science
Environment, Energy and Science

17 December 2021

Encl.

Warragamba Dam Raising State Significant Infrastructure proposal (SSD-8441)

Department of Planning, Industry and Environment – Environment, Energy and Science Group Detailed Comments

Biodiversity Assessment – Upstream

General Comments

This advice is focused on the information and analysis contained in Appendix F1 of the EIS.

The assessment of avoid and minimise leans heavily on the Hawkesbury-Nepean Valley Flood Risk Management Strategy - Taskforce Options Assessment Report 2019. The biodiversity assessment report (BAR) has correctly identified that, once a decision has been made that a dam wall of a particular height is required to mitigate downstream flooding, the options of how to build and operate the proposal are limited. EES is not able to review the assessment and decision-making undertaken by the taskforce that led to the current proposal being selected.

The BAR for the upstream assessment has generally implemented the Framework for Biodiversity Assessment (FBA) as agreed in meetings between EES, PAG and WaterNSW in 2020. EES notes:

- The Biodiversity Assessment Method (BAM) has been applied to an agreed 'upstream impact area' based on a modelled likely maximum inundation level within a 20 year period, beyond that which would be likely to receive flooding in a 20 year period with the current dam wall.
- Total loss of biodiversity within the upstream impact area has been assumed.
- Species polygons have generally been identified by using the PCTs and IBRA subregions with which the species are associated and assuming the species was present in that entire area. This was required because surveys could not be conducted that would meet DPIE/FBA survey requirements.
- Comments on species assessments and polygons were sought from Accountable Officers in EES for each of the species assessed in the BAR. Those for which an Accountable Officer was not able to assist have been reviewed by other EES officers. There are several comments recommending modifications to the relevant species polygon. These are detailed in the threatened species comments below.
- Vegetation survey plots have been undertaken across the entire flooding zone between full supply level and the probable maximum flood (PMF). As a result, plots are outside the upstream impact area being used to calculate credits. This was previously agreed as it was considered that the vegetation in the study area was generally similar in condition.
- Due to inaccessible terrain, some surrogate plots have been used. These have included data at benchmark, which can only have resulted in an increased requirement for credits compared to completing all plots as required by the FBA. This has previously been agreed.
- The vegetation plot data has been reviewed and comments are provided below.
- Data entry has not been reviewed for any of the FBA calculators given the likely need to alter species and PCT polygons.
- Matters for further consideration have been identified correctly. The additional information required for these matters has been provided in accordance with the FBA. Generally, it is noted that, although an arbitrary method for calculating credit requirements has been used, the ability to determine actual impacts on native

vegetation and threatened entities, and thus provide definitive answers to many of the questions regarding further consideration, is limited. Some notes on the possible significance of impacts to these species are included below. EES will need to undertake further assessment of this aspect of the BAR to provide recommendations on additional or complementary offsets that may be required.

The Biodiversity Offset Strategy (BOS) has not identified offset sites and consequently has not determined whether the credit requirements will be met. EES notes the very large numbers of credits that will need to be retired. EES notes:

- The BOS correctly identifies the process for seeking credits, identifying supplementary measures and, where necessary, making a payment into the Biodiversity Conservation Fund for the construction impacts. It is proposed that this be undertaken prior to construction commencing. This is consistent with the Biodiversity offsets policy for major projects, for which the FBA was developed.
- The BOS discussion of the offsets for the upstream impacts is complicated by the need to also offset impacts to the national park estate, World Heritage and Aboriginal cultural heritage. The primary mechanism is purchase and dedication of land to the parks estate. This is consistent with the biodiversity offsetting principles of both NSW and Commonwealth legislation. While the process described in the BOS is logical there are two possible obstacles:
    - The proposal discusses obtaining and transferring land equivalent to or greater than the area being impacted. The likely biodiversity offset ratios mean that the area of land required could be several times that figure.
    - The proposal is to implement the BOS prior to project operation (ie prior to a flooding event occurring). The timing of this will, however, be subject to weather variabilities.

Threatened Species Comments

The following advice details required changes to species polygons. Where the species is a matter for further consideration (discussed in Appendix K of the BAR) under the FBA, some comments is provided on the possible local and regional significance of any impacts that may occur.

EES notes that while the information provided in Appendix K of the BAR is generally in accordance with the FBA, the lack of comprehensive surveys, both in the study area and in the surrounding region, mean that much of the consideration comments are uncertain.

Anthochaera Phrygia*

Plant Community Types (PCTs) HN553 and HN607 are not associated with this species in the Threatened Biodiversity Data Collection (TBDC). The credit requirements may have been over-estimated. The biodiversity offset strategy could include funding of actions from the national recovery plan for the species, such as the captive breeding program.

While possible, there is little evidence that large areas of alternative or additional habitat is available elsewhere locally. The large species polygon shown in Appendix B (Map B.82) is based on PCT associations and other habitat requirements may be absent from parts of this polygon.

The Project will cause temporary inundation of an area of habitat known to be used by 5-7% of the total known population of this critically endangered species. If this inundation does cause changes to the habitat that make it less suitable for Regent Honeyeaters, this could cause the loss of one of only a small number of breeding areas.

Ancistrachne maidenii*

This is one of the matters for further consideration species not detected during surveys. An area of habitat within the upstream impact area has been estimated to calculate credit requirements.

There is one record approximately 5 km from the dam wall (in Wollemi subregion), but no others locally. On that basis, if any impacts were to occur, then they would be significant in a local and regional context.

Bossiaea oligosperma*

PCTs HN527, HN536 and HN557 are not associated with this species in the TBDC but it is noted that records were found within HN536 and HN557 polygons during the surveys for the Project.

This vulnerable species is still a matter for further consideration as the Project has the potential to make it extinct in the Burragorang IBRA subregion. While a conservative estimate of 483 ha of habitat is to be impacted, it is noted that most of the local records are outside the upstream impact area and the PMF.

Callistemon linearifolius*

Offsets for this species have been calculated by assuming the presence of 1968 individuals, based on the PCTs it was found in during surveys. It is not clear how the number of individuals was calculated as no assumed density is given. The Proponent should provide the assumptions used to estimate the number of individuals for the credit calculations. It may be more appropriate to use an area-based calculation of credits.

This vulnerable species is still a matter for further consideration as the Project has the potential to make it extinct in the Burragorang IBRA subregion. While surveys have been limited, all six of the records for this species in the Burragorang IBRA subregion were found as a result of the surveys for this assessment. While only one of those records is within the Upstream Impact Area, the BAR still estimates that a large number of individuals are present in that area. The lack of surveys elsewhere in the catchment make it difficult to determine what proportion of the of the local population is likely to be inundated.

Callistemon megalongensis

Species polygon should include HN574. This species has also been recorded on 1st and 2nd order streams. The species polygon should include habitat associated with those streams.

Callistemon purpurascens

This species has been excluded on incorrect habitat assumptions. Additional records have been recently made. It is now known to occur on plateaus, as well as valleys. The habitats recorded include within streams on sedimentary rock; on alluvium/flood terraces; and sometimes on higher or wider terraces or on the toe of adjoining slopes. The recent discovery and potential for misidentification may contribute to lack of records in the study area. It co-occurs with *Callistemon megalongensis* and a reasonable interpretation would be that it be presumed present in the same species polygon as *C. megalongensis*.

Darwinia biflora

Table 7-3 should probably read 8.0 ha for this species, rather than 80.

Dillwynia tenuifolia*

The species polygon should include HN564 and HN566 in both the Wollemi and Burragorang subregions.

There are no records of this species from the upstream impact area and the nearest record is 6.5 km east of Warragamba Dam. While impacts are unlikely, they would be noteworthy as they would be impacting some of the few individuals that occur in the subregions.

Epacris purpurascens subsp. purpurascens*

Are the credits calculated using individuals (p.209) or hectares (p.242)? The use of individuals would require an explanation of the assumptions used to arrive at the number

used. As none were found, it may be more appropriate to use an area-based calculation of credits.

No specimens were found during surveys and the only record near the impact zone is from 1965 and within the area currently flooded when the current dam is at full supply level.

There are few other records near the study area. While impacts are unlikely, they would be noteworthy as they would be impacting some of the few individuals that occur in the subregions.

Epacris sparsa

There appears to be some confusion with the unit of impact used to calculate credits. Table 7-3 says two individuals, but Table 8-5 indicates 2 ha. This needs to be clarified. If individuals are used to calculate credits, then an explanation on how the number was derived is required.

Eucalyptus benthamii*

Significant records of this species occur within the Upstream Impact Area, particularly in the Kedumba Valley. Inundation of individuals is not the only concern; recruitment of the species is also likely to be affected by the Project as recruitment is particularly susceptible to changes in the flooding regime. As noted in the BAR, the CSIRO study of the effects of temporary inundation has only partial application to the Project.

The analysis in the Table K-4 (Appendix K – Matters for Further Consideration) states that impacts 'may occur' and are 'possible'. Such statements are not supported. Given the large proportion of the species population in the Project area, and the habitat in which the species occurs, it is considered that impacts will be likely.

Approximately 33% of the records in the Kedumba Valley are within the upstream impact area and over two thirds are within the PMF. If the species proves sensitive to temporary inundation, impacts are likely to be significant and important in terms of local and regional conservation of the species.

Eucalyptus glaucina*

This vulnerable species is a matter for further consideration as the records found during the surveys for this Project are a significant range extension. It has not been previously found south of the Hunter Valley. It is noted that the new records now place it in the Kanangra, Bungonia and Burragorang subregions. Based on those currently known records, the Project has the potential to make it extinct, in all those subregions

Most of the local records are within the upstream impact area, but this is an artifact of the area subject to limited targeted survey.

Euphrasia bowdeniae

There is a valid, though no longer extant, record for this species in the Burragorang sub-region (Mt Solitary). Consideration should be given to including the relevant PCTs from that sub-region in the species polygon.

Genoplesium baueri*

This is an endangered species with only one record within the Burragorang IBRA subregion which was not found during surveys. It is difficult to determine the likely impacts to this species (re. matters for further consideration) due to the lack of targeted surveys. Any impact could be significant in terms of local and regional conservation of the species.

Gyrostemon thesioides*

The BAR has excluded Kanangra, Wollemi and Bungonia IBRA subregions from the species polygon based on erroneous data in the TBDC (which will be corrected). The species polygon should be expanded to include the same PCTs in all four subregions.

It is difficult to determine the likely impacts to this species (re. matters for further consideration) due to the lack of targeted surveys. Any impact could be significant in terms of local and regional conservation of the species.

Hakea dohertyi*

Table 5-5 of the BAR associates this species with HN525, HN535, HN536 and HN557. Table 7-3 includes HN517, HN527, HN538, HN606, HN607 and HN557. The species polygon provided in GIS format, however, uses HN527, HN538 and HN557. Bionet associates the species with HN525, HN535 and HN536. It is recommended that the species polygon for this species be reconsidered.

While the known population likely to be inundated is small in comparison to that in the Kowmung Valley to the west, it is all of the records known from the Burragorang IBRA subregion (although some of the recorded locations would be inundated during a flood event without the Project proceeding). If the species is sensitive to inundation, the known population within the Burragorang subregion is likely to threatened with extinction.

As a result, conditions of approval for seed/propagule collection, ex-situ population establishment and translocation need to be considered for this species.

Haloragodendron lucasii

Bionet records in the Blue Mountains have been re-attributed from *H. lucasii* to *H. gibsonii*. As a result, this species need no longer be considered as likely to be present in the upstream impact area and no offsets are required.

Heleioporus australiacus

Heleioporus occupies home ranges up to 500-600 m from breeding ponds. The species polygon should, therefore, be changed to: 'All native vegetation within 600 m of 2nd and 3rd order streams on sandstone – in Burragorang, Wollemi, Kanangra IBRA subregions'.

Hibbertia puberula*

The impacts of the Project on the local population of this species are difficult to ascertain. The nearest local records are 15 km from the study area and local habitat can only be estimated by PCT associations.

The low number of local records means that any impact could be significant in terms of the local and regional conservation of the species.

Hygrocybe aurantipes* and *Hygrocybe reesiae

These species occupy similar habitat to *Hygrocybe anomala* var. *ianthinomarginata*. The species polygon should be the same as for that species.

Ixobrychus flavicollis

The TBDC does not list all the PCTs associated with this species. As a result, rather than PCT associations based on the TBDC, it would be more accurate to map the species polygon as all land within 40 metres of:

- freshwater wetlands or
- estuarine wetlands or
- other areas of permanent water, including permanent water courses.

Macropus parma

The TBDC states that this species' habitat cannot be predicted through PCTs. It is recommended that a survey or expert report is required to identify those parts of the study area that are likely to provide habitat.

Melaleuca deanei*

One individual of this species was detected incidentally during surveys approximately 3 km from the upstream impact area. No other records are known from the impact area or surrounding localities. If any impacts to this species do occur, they would be significant in terms of the local and regional conservation of the species as it is otherwise unknown from the Wollemi IBRA subregion.

Melaleuca groveana

Should Table 7-3 read six hectares for this species, rather than six individuals? If the latter, an explanation of how the number of individuals was determined should be provided.

Petaurus norfolcensis

Bionet also associates this species with HN553. This PCT should be added to the species polygon.

Phascogale tapoatafa

This species, like many species credit species, cannot necessarily be predicted based on the presence of any particular PCT. The occurrence of the brush-tailed phascogale is more closely aligned with an abundance of large hollows with small entrances and sparse ground and shrub cover.

The assessor should seek the advice of an expert to assist in the drafting of the species polygon/s for the brush-tailed phascogale. In addition, the species polygons should be based on the specific habitat requirements for this species. The TBDC encourages the use of an expert to determine the presence of suitable habitat for the brush-tailed phascogale, rather than relying on a survey.

Phyllota humifusa

The inclusion of this species is based on a record on the Bimlow tablelands. This has been recently been determined to be incorrectly identified – so the species could justifiably be excluded.

Pomaderris brunnea*

The report estimates the population within the Warragamba Special Area as possibly over 1000, which is a signification proportion of the total population of the species (most other populations are less than 100). Of the 51 records within the Special Area, 13 (approximately 25%) are within the upstream impact area and 50 are within the PMF.

With such a large proportion of the population subject to impacts, sourcing credits will be very difficult. If the species proves sensitive to temporary inundation, the known local population will be more vulnerable to extinction.

Rhizanthella slateri

Within sandstone derived habitats, *Rhizanthella slateri* has been recorded within dry woodlands at the bases of species including (but not limited to) *Corymbia gummifera*, *Eucalyptus piperita* and *Angophora costata*. The co-occurrence of *Allocasuarina* species can often benefit *Rhizanthella* by adding leaf litter and supressing ground and shrub cover competition.

It is recommended that HN566 and HN568 be included in the species polygon, as well as all four IBRA subregions - Bungonia, Burragorang, Kanangra and Wollemi.

Areas with high shrub and ground cover densities could be excluded from the species polygons, where these can be reliably mapped.

Rhodamnia rubescens*

The Scrub Turpentine is a ‘count’ species as opposed to an ‘area’ species. The impact to this species is referred to within the report as being 78ha. It is not clear how the 78ha impact area has been converted to a number of individuals for the purposes of calculating the species credit requirement. The current credit requirement is 3,878 species credits.

Scrub Turpentine is not included in the Biobanking Credit Calculator as this species has only recently been listed. To determine the credits for the Scrub Turpentine, *Acronychia littoralis* (Scented Acronychia) has been used as a surrogate in the calculations. The latter species has the highest offset multiplier that could be chosen under FBA, maximising the credit requirements. This is, therefore, acceptable.

Again, with no known local records, any impacts that do occur would be significant in a local and regional context.

It is likely that complementary offsets will be required for this species. Credits are difficult to generate on Biodiversity Stewardship sites due to the difficulty in controlling myrtle rust.

Solanum armourense*

The Project will impact on known records in the Bungonia IBRA subregion. There are 101 records in this subregion, of which 26 are within or near the upstream impact area. Nearly 50% of the records in the Bungonia IBRA subregion are outside the PMF. However, if the species is sensitive to temporary inundation, then the Project will reduce the local population substantially and increase its risk of extinction in the subregion.

Tetratheca glandulosa*

A vulnerable species that is a matter for further consideration as there are few records in the Wollemi and Burragorang subregions.

Like other, undetected species, determining the significance of the impact of the Project on this species is difficult. With so few records in these two subregions, any loss due to the Project will have substantial implications for the conservation of the species at local and regional scales.

Zieria involucrata

The species polygon should also include HN517, HN536, HN537 and HN538.

Zieria murphyi

There are records for this species near Penrose in the Burragorang sub-region. Consideration should be given to including the relevant PCTs from that sub-region in the species polygon.

Vegetation Plot Analysis Comments

DPIE obtained data from 93 BAR plots and applied it to a new DPIE on-line tool that compares new plot data against new Eastern NSW PCTs https://BioNet.shinyapps.io/vegplot/. The resulting Eastern NSW PCTs were then traced to identify current PCT relationships. PCT assignments were reviewed against an additional 105 plots located within the 550 m buffer area that are available in BioNet.

The analysis found:

- There was a high level of agreement between the PCTs identified in the BAR survey data and the plot data stored in BioNet and classified in the PCT classification source (Tozer et al 2010).
- 24 of the 93 BAR plots did not have strong matches to any PCT. This result does not preclude the assignment of these plots to a PCT but may suggest a less certain relationship.
- The BAR data did not present evidence for the presence of PCTs 1292 (HN607) or 1083 (HN566).
- The analysis suggests that PCT 1181 is present within the study area but not assessed in the BAR.
- The results of the PCT assignment evaluation found disagreement with the PCT assignments in the BAR for 20 plots.
- PCTs 1401 and 840 have a higher proportion of plots unassigned or in disagreement.
- There were a further seven plots for which the data did not support a PCT assignment using DPIE methods - plots US15, US60, US61, US71, US72, US76, US88. This was primarily due to low species numbers in these plots. Plots assigned by the BAR to PCT 840 were most problematic as there are few other BioNet plots assigned to this PCT in the Buffer area to provide additional supporting evidence. Resurvey of these plots would assist in clarifying the PCT mapping for the study area.

Table 1: Recommended amended PCT assignments for BAR plots

BAR Site Label	BAR Assigned PCT	Recommended Amended PCT
US1	1083	1081
US10	1083	1181
US11	1081	1181
US12	1081	1181
US2	1081	1181
US25	860	1401
US35	870	832
US49	870	832
US50	870	832
US6	1083	1081
US74	1401	832
US75	860	832
US79	877	871
US8	1083	1081
US80	1292	1105
US81	1292	941
US82	871	1246
US83	1292	941
US92	871	1284
US93	871	860

PCT mapping

14 BioNet plots intersect the vegetation mapping for the upstream impact area. Agreement between these plots and BAR PCT mapping suggests a map accuracy of above 80%. It provisionally suggests that the map forms a foundation for revisions to PCT assignments outlined in this review.

The BAR PCT map requires revision to include PCT 1181 and to review the amended PCTs assigned to both BAR and BioNet plots. For example, the extent of PCT 1401 is likely to be over-estimated and more likely encompass habitats occupied by PCTs 840, 871 or 832. A set of BioNet plots and their PCT assignments to assist with map revisions is provided in Table 2.

Table 2. Existing BioNet plot PCT assignments

Survey Name	Site Name	SCIVI	PCT Match	Lat	Long
WARRAGAMBA	BML03P2M	p5	PCT 860	-33.9099	150.3367
WARRAGAMBA	BML04P8M	p36	PCT 832	-33.8794	150.3295
WARRAGAMBA	BML05P7M	p36	PCT 832	-33.8743	150.3265
WARRAGAMBA	BML06C8V	p38	PCT 877	-33.8745	150.3213
WARRAGAMBA	BML09C2M	p36	PCT 832	-33.9119	150.3479
WARRAGAMBA	BML56A5F	p88	PCT 871	-33.9867	150.3751
WARRAGAMBA	BML57P1L	p88	PCT 871	-33.9818	150.3767
WARRAGAMBA	BML70P5L	p5	PCT 860	-33.9766	150.38
WARRAGAMBA	BML71P1M	p244	PCT 1246	-33.9793	150.3744
WARRAGAMBA	BML72A6V	p88	PCT 871	-33.981	150.3791
WARRAGAMBA	BML73A7V	p88	PCT 871	-33.9716	150.3829
WARRAGAMBA	BML74C8U	p35	PCT 840	-33.9224	150.3462
WARRAGAMBA	BML75A7V	p36	PCT 832	-33.926	150.3489
WARRAGAMBA	BML76D5L	p38	PCT 877	-33.9313	150.3276
WARRAGAMBA	BML77D7M	p36	PCT 832	-33.9317	150.326
WARRAGAMBA	BML78A1F	p31	PCT 941	-33.9355	150.3309
WARRAGAMBA	BML79P3M	p244	PCT 1246	-33.8942	150.3958
WARRAGAMBA	BML80P6V	p40	PCT 875	-33.8923	150.3949
WARRAGAMBA	BML81P1M	p88	PCT 871	-33.8995	150.3907
WARRAGAMBA	BML82P5M	p5	PCT 860	-33.9072	150.3954
WARRAGAMBA	BML83P7L	p5	PCT 860	-33.9302	150.3579
WARRAGAMBA	BML84N8R	p5	PCT 860	-33.9324	150.359
WARRAGAMBA	BML87A5F	p31	PCT 941	-33.9266	150.3568
WARRAGAMBA	BML88P7R	p5	PCT 860	-33.924	150.3675
WARRAGAMBA	BML89P1M	p5	PCT 860	-33.9319	150.372
WARRAGAMBA	BML90N5M	p5	PCT 860	-33.9278	150.3748
WARRAGAMBA	BML91N3M	p244	PCT 1246	-33.9289	150.376
WARRAGAMBA	BML92A6V	p88	PCT 871	-33.9325	150.3736
WARRAGAMBA	BML98P1M	p88	PCT 871	-33.9607	150.4151
WARRAGAMBA	BMLA1P3L	p88	PCT 871	-33.9612	150.4205
WARRAGAMBA	BMLA2P7U	p88	PCT 871	-33.9673	150.4123
WARRAGAMBA	BMLA3P4L	p36	PCT 832	-33.975	150.4279
SCA_DT	BUR39P6M	p36	PCT 832	-34.0897	150.4233
SCA_DT	BUR41P4M	#N/A	PCT 862	-34.071	150.4231
SCA_DT	BUR46P4H	p40	PCT 875	-34.0577	150.4319
SCA_DT	BUR48P2M	p244	PCT 1246	-34.0915	150.4285
WARRAGAMBA	BUR60P7U	p88	PCT 871	-34.0167	150.3841
WARRAGAMBA	BUR61P5M	p5	PCT 860	-34.0933	150.3695
WARRAGAMBA	BUR62P3M	p88	PCT 871	-34.0903	150.3673

Survey Name	Site Name	SCIVI	PCT Match	Lat	Long
WARRAGAMBA	BUR64A0F	p88	PCT 871	-34.0953	150.3658
WARRAGAMBA	BUR65P5C	p5	PCT 860	-34.097	150.3652
WARRAGAMBA	BUR66A0F	p88	PCT 871	-34.1038	150.3516
WARRAGAMBA	BUR67P7L	p35	PCT 840	-34.1187	150.3115
WARRAGAMBA	BUR71P3M	p88	PCT 871	-34.1123	150.3183
BURRA	BURRA01	p88	PCT 871	-34.1197	150.387
BURRA	BURRA02	p88	PCT 871	-34.0891	150.4313
BURRA	BURRA03	p102	PCT 1284	-34.1099	150.435
WARRAGAMBA	JMS97A5F	p31	PCT 941	-33.837	150.3589
RBG_KAT	JMS57M8L	p6	PCT 862	-33.8376	150.3503
WARRAGAMBA	JMS95P6L	p5	PCT 860	-33.8651	150.3517
WARRAGAMBA	JMS96P5M	p6	PCT 862	-33.847	150.3552
WARRAGAMBA	JMS98P1L	p5	PCT 860	-33.8342	150.3476
WARRAGAMBA	JMS99P8S	p88	PCT 871	-33.8342	150.3479
WARRAGAMBA	JMSA1P3L	p6	PCT 862	-33.8339	150.3494
WARRAGAMBA	JMSA5P3V	p88	PCT 871	-33.8385	150.3253
WARRAGAMBA	JMSB8D8M	p36	PCT 832	-33.8628	150.2611
WARRAGAMBA	JMSB9D3M	p88	PCT 871	-33.8661	150.2555
WARRAGAMBA	JMSD8C7M	p202	PCT 1401	-33.8574	150.3399
WARRAGAMBA	JNL54D1L	p40	PCT 875	-33.867	150.2498
NATTAI	NATTAI01	p88	PCT 871	-34.1385	150.4222
NATTAI	NATTAI09	p202	PCT 1401	-34.1873	150.3046
WARRAGAMBA	NTT20P7M	p202	PCT 1401	-34.1481	150.4283
WARRAGAMBA	NTT21P5V	p88	PCT 871	-34.1439	150.4349
WARRAGAMBA	NTT49P5U	p144	PCT 1086	-34.1385	150.4285
WARRAGAMBA	NTT51A7F	p31	PCT 941	-34.1595	150.4454
WARRAGAMBA	NTT56P7M	p202	PCT 1401	-34.146	150.4423
WARRAGAMBA	NTT57P5F	p32	PCT 1105	-34.1356	150.4551
WARRAGAMBA	NTT84P7R	p202	PCT 1401	-34.1906	150.3127
WARRAGAMBA	NTT85P7L	p202	PCT 1401	-34.1257	150.3709
WARRAGAMBA	NTT86P5M	p5	PCT 860	-34.1797	150.3332
WARRAGAMBA	NTT87P7F	p31	PCT 941	-34.1925	150.322
WARRAGAMBA	NTTA8D4C	p202	PCT 1401	-34.1907	150.301
SCA_DT	NTTA9H2M	p33	PCT 835	-34.1318	150.452
SCA_DT	NTTB2P2L	p40	PCT 875	-34.1417	150.4253
SCA_DT	NTTB3P2M	p5	PCT 860	-34.1398	150.4431
WARRAGAMBA	WRG01N2L	p142	PCT 1181	-33.8789	150.5866
WARRAGAMBA	WRG02N8L	p142	PCT 1181	-33.8817	150.5807
WARRAGAMBA	WRG04H5U	p142	PCT 1181	-33.8971	150.5387
WARRAGAMBA	WRG05N7C	p146	PCT 1081	-33.8953	150.5429
WARRAGAMBA	WRG06H1M	p146	PCT 1081	-33.8904	150.5723
Wollondilly 2017 FF	WOLJS027	#N/A	PCT 941	-34.124	150.4576
Wollondilly 2017 FF	WOLJS028	#N/A	PCT 1284	-34.1223	150.4569
Wollondilly 2017 FF	WOLJS029	#N/A	PCT 832	-34.1009	150.3944
Wollondilly 2017 FF	WOLJS030	#N/A	PCT 832	-34.091	150.4093
Wollondilly 2017 FF	WOLJS032	#N/A	PCT 832	-34.1383	150.4577
Wollondilly 2017 FF	WOLJS041	#N/A	PCT 871	-34.1642	150.4448
Wollondilly 2017 FF	WOLJS042	#N/A	PCT 941	-34.1342	150.453
Wollondilly 2017 FF	WOlJS043	#N/A	PCT 860	-34.1459	150.4243
Wollondilly 2017 FF	WOLJS044	#N/A	PCT 832	-34.1605	150.445
WARRAGAMBA	JMSA2A7S	p31	PCT 941	-33.8233	150.358
KEDUMBA	KEDUMB06	p88	PCT 871	-33.8602	150.3506

Survey Name	Site Name	SCIVI	PCT Match	Lat	Long
KEDUMBA	KEDUMB07	p202	PCT 1401	-33.8611	150.3506
KEDUMBA	KEDUMB08	p5	PCT 860	-33.8864	150.3552
KEDUMBA	KEDUMB09	p6	PCT 862	-33.8892	150.3595
KEDUMBA	KEDUMB10	p6	PCT 862	-33.8468	150.3565
KEDUMBA	KEDUMB11	p31	PCT 941	-33.8468	150.3586
KEDUMBA	KEDUMB12	p6	PCT 862	-33.8369	150.36
KEDUMBA	KEDUMB13	p31	PCT 941	-33.836	150.36
KEDUMBA	KEDUMB16	p202	PCT 1401	-33.8465	150.3424
KEDUMBA	KEDUMB23	p38	PCT 877	-33.8751	150.335
KEDUMBA	KEDUMB24	p5	PCT 860	-33.8751	150.334
BURRA	BURRA04	p144	PCT 1086	-34.062	150.431
WARRAGAMBA	NTT50P1M	p244	PCT 1246	-34.1402	150.4363
KEDUMBA	KEDUMB05	p31	PCT 941	-33.8226	150.3637
KEDUMBA	KEDUMB15	p6	PCT 862	-33.8465	150.3446

TEC identification and mapping

Plot data was evaluated to determine the presence of PCTs in the study area. It is agreed that there are two threatened ecological communities present:

1. *River-Flat Eucalypt Forest on Coastal Floodplains (RFEF) listed as Endangered under the BC Act and Critically Endangered under the EPBC Act*
   - DPIE agrees with areas mapped as RFEF in large areas of alluvium where the plot data, existing mapping and substrate mapping agree.
   - BioNet plot data (BML78, BML75, BML87, BUR66 and NTT57) indicates that RFEF also occurs where there a small, unmapped, alluvial deposits.
   - Plots assigned to PCT 1292 and situated on alluvial soils should be included in this TEC.
2. *White Box Yellow Box Blakely's Red Gum Woodland listed as Critically Endangered under the BC Act and Critically Endangered under the EPBC Act*
   - The BAR interpretation of the distribution of this TEC is likely to be precautionary.
   - Not all areas assigned to PCT 840 may meet the definition of the TEC (Paragraph 4.11 Final Determination).
   - There is a low likelihood that PCT 1401 is related to the TEC. This appears to be an error in the BioNet vegetation classification database.

White Box Yellow Box Blakely's Red Gum Woodland – Further Consideration

Table 7-11 provides the information required by 9.2.4.2 of the FBA (Matters for further consideration) for this critically endangered ecological community (CEEC). It is noted that the requirement under 9.2.4.2(b) was unable to be provided due to the large size of the study area and a modification has been implemented. This modification is acceptable.

With that modification and noting that the area of the CEEC in the upstream impact area may have been over-estimated, it is considered that the information has been provided in accordance with the FBA.

No recommendations on additional or supplementary offsets can be formulated at this stage.

Biodiversity Assessment – Downstream

EES comments on the assessment against the Downstream Assessment Requirements (Attachment B of SEARs)

This advice is focused on the information and analysis contained in Chapter 9 and Appendix F2 of the EIS.

Assessment requirement	Comments
1. A field survey of the potentially impacted areas downstream should be conducted and documented in accordance with relevant guidelines, including: • the Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (DECCW, 2009) • Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004), and; • Threatened species survey and assessment guideline information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm. If a proposed survey method is likely to vary significantly from the above methods, the proponent should discuss the proposed method with OEH prior to undertaking the assessment, to determine whether OEH considers that it is appropriate. Recent (less than five years old) surveys and assessments may be used. However, previous surveys should not be used if they have: • been undertaken in seasons, weather conditions or following extensive disturbance events when the subject species are unlikely to be detected or present, or	• No surveys were carried out for amphibians, despite 3 species in likelihood of occurrence table listed as being high or recorded (i.e. Giant Burrowing Frog, Green and Golden Bell Frog (GGBF), Red-Crowned Toadlet). However, EES considers this is of low concern as no GGBF have been recorded since 1977 and the other threatened frogs are unlikely to be impacted. • Surveys for bats were *'at least two nights'* at sites. As such, surveys for bats were not in accordance with the threatened bat survey guidelines, which state a minimum 4 nights is required for acoustic detection for all species where ultrasonic call detection is being used. • Survey locations were very limited and not randomly distributed across the subject area. Also, many of the flora plot locations and fauna survey locations were not within the survey area. This creates a risk that threatened species and their habitats will be impacted without adequate assessment. • Much of the plot data (in Appendix C of Appendix F2) does not include dates or recorders. • The method used for the preparation of the likelihood of occurrence table is not a standard method. Typically, all species recorded or known within a 5 or 10 km radius of the site are recorded in the table. However, for the EIS, firstly all entities within a 2 km buffer were selected, then entities were removed if no suitable habitat was present, then entities were removed if there were no nearby records, and finally the table was developed for the remaining species. This may have resulted in species not being adequately assessed. • As noted in Appendix F2, surveys were not carried out in the recommended survey period for *Dillwynia tenuifolia* or *Epacris purpurascens* var. *purpurascens*. • The likelihood of occurrence table lists 40 flora species as having a high or moderate likelihood of occurrence, but only 2 species were targeted during

Assessment requirement	Comments
• utilised methods, survey sampling intensities, timeframes or baits that are not the most appropriate for detecting the target subject species unless these differences can be clearly demonstrated to have had an insignificant impact upon the outcomes of the surveys. If a previous survey is used, any additional species listed under the *Biodiversity Conservation Act 2016* since the previous survey took place, must be surveyed for.	surveys. All species with a high or moderate likelihood should have been targeted. This may result in threatened species being impacted without adequate assessment. • Appendix F2 is inconsistent in stating how many flora species were targeted during surveys. Section 5.4.2 states targeted surveys were carried out for 2 flora species, but section 4.2.5 states targeted surveys were carried out for 10 species.
2. Determining the list of potential threatened species for the site must be done in accordance with the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004) and the Guidelines for Threatened Species Assessment (Department of Planning, July 2005). The OEH Threatened Species website and the *Atlas of NSW Wildlife* database must be the primary information sources for the list of threatened species present. The BioBanking Threatened Species Database, the Vegetation Types databases and other data sources (e.g. PlantNET, Online Zoological Collections of Australian Museums, previous or nearby surveys etc.) may also be used to compile the list.	• Several fauna species were not considered despite recent records in the locality (e.g. Eastern Osprey, Ruff, Red-necked Stint, Pacific Golden Plover, Wood Sandpiper and Marsh Sandpiper). • There are a number of species with many records, which should have be listed as 'recorded' but were not (though it is acknowledged that amending them to 'recorded' would not change their assessment): *Marsdenia viridiflora, Micromyrtus blakelyi, M. minutiflora, Persoonia hirsuta, Pimelea spicata*, Pectoral Sandpiper
3. The assessment should contain the following information as a minimum: (a) The requirements set out in the *Guidelines for Threatened Species Assessment* (Department of Planning, July 2005). (b) Description and geo-referenced mapping of study area (and spatial data files), e.g. overlays on topographic maps, satellite images and /or aerial photos, including details of map datum, projection and zone, all survey locations, vegetation	• Section 1.6 of the Appendix F2 advises it was agreed with the OEH that the 10% AEP event downstream extent would comprise the targeted survey area for the downstream assessment. EES considers no such agreement was made. • Section 1.6 also advises it was agreed with the OEH that the survey and assessment of the downstream area would be truncated to the confluence of the Hawkesbury and Colo Rivers. EES considers no such agreement was made. • Except for PCT 725, none of the other vegetation condition classes in Appendix B of Appendix F2 for the PCT match the condition classes listed in

Assessment requirement	Comments
communities (including classification and method used to classify), key habitat features and reported locations of threatened species, populations and ecological communities present in the subject site and study area. (c) Description of survey methods used, including timing, location and weather conditions. (d) Details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the assessment. (e) Identification of national and state listed threatened biota known or likely to occur and their conservation status. (f) Description of the likely impacts of the proposal on downstream biodiversity and wildlife corridors, including direct, indirect, construction and operation impacts. Wherever possible, quantify these impacts such as the amount of each vegetation community or species habitat to be cleared or impacted, or any fragmentation of a wildlife corridor. (g) Identification of the avoidance, mitigation and management measures that will be put in place as part of the proposal to avoid or minimise impacts, including details about alternative options considered and how long-term management arrangements will be guaranteed. (h) Description of the residual impacts of the proposal. If the proposal cannot adequately avoid or mitigate impacts on downstream biodiversity, then a biodiversity offset package is expected (see the requirements for this at point 6 below). (i) Provision of specific Statement of Commitments relating to biodiversity.	Table 5-1 for that PCT e.g., for PCT 1106, Table 5-1 states there are four condition zones: moderate/good, moderate/good _good, moderate/good _med and moderate/good _low, but Appendix B states the condition classes are moderate/good _good, moderate/good _med, moderate/good _low and moderate/good _derived. • Table 5-2 in Appendix F2 indicates some large areas of PCTs were not surveyed (e.g. all of PCT 1067 [despite 3.62 ha occurring in the survey area] and over 200 ha of the critically endangered ecological community (CEEC) Cumberland Plain Woodland (PCT 849) [i.e. all of PCT 849 apart from the 'Moderate/good low' vegetation zone area]). This creates a risk that some PCTs have been misidentified. • The description on weather conditions during surveys is too broad to be instructive i.e. 'temperatures higher than average'. No specific detail is provided about the weather conditions on the days of survey. • The SEARs include the requirement for a *'description of the likely impacts on biodiversity'* and section 6.1 of Appendix F2 contains an 'impact and risk assessment methodology'. It is noted that an impact risk assessment has been done as well as an assessment of significance for many species. But there is no 'impact assessment' as such. • Section 6 only discusses 'impacts', there is no distinction made between which are direct or indirect. The SEARs specifically require assessments of direct and indirect impacts. • The SEARs also require that 'where possible', impacts are quantified, but this has not been done and there is no justification provided on why it could not be done. Although it is noted there is some quantification of impacts for some species in the assessments of significance. • Section 6.4.1 advises PCTs listed as CEECs under the *Biodiversity Conservation Act 2016* were assigned a high-risk rating (in Table 6-4). This rating should also have been applied to PCTs listed as CEECs under the *Environment Protection and Biodiversity Conservation Act 1999*. • The SEARs require an assessment of the likely impacts on wildlife corridors. This is addressed in a few paragraphs in section 6.8, but the discussion is very broad and is mostly a general discussion of how corridors can be affected

Assessment requirement	Comments
	rather than any assessment of the impacts of the Project. There is no identification of biodiversity links and corridors in the study area. There is no assessment of whether any specific areas are at higher risk, or any assessment of the degree to which corridors will be affected. • There is inadequate justification for the assigned consequences of impacts. Table 6-3 states, for example, advises in relation to the potential impacts of a reduced flooding extent in wetland and floodplain vegetation communities and habitats that: *The gradual nature of change would be difficult to measure and to accurately differentiate the impact of the Project from broader changes within the catchment*. However, it does not follow that if changes are difficult to measure, they are therefore not significant. EES also disagrees with other comments in this table such as: o that the consequences of bank erosion, which the EIS lists as likely, would be minor. o that the consequences of displacement of habitat for fauna dependent on riparian or wetland habitats would be only moderate. o that the reduction in flooding extent in wetland and floodplain vegetation communities and habitats would only be of medium consequence. o that the consequences of the increased duration of inundation in wetland and floodplain vegetation communities and habitats would be insignificant, as these areas are currently subject to wet periods and flooding events. However, the Project will result in changes to the frequency and duration of these flood events. • Table 6-5 lists that the impact risk to threatened flora species are all medium or low, except for critically endangered species. However, EES considers the impacts on some riparian species are likely to be high particularly *Eucalyptus benthamii* and *Pomaderris brunnea.* • The outcomes of all the assessments of significance in Table 6-7 are that a significant impact is only 'unlikely' or 'potential'. No species are assessed as being likely to be significantly impacted. It is not adequate to conclude that a 'potential' significant impact is likely: the assessment should be definitive on this matter. It is noted that for a number of threatened communities listed in Table 6-7, the result for 4 out of 5 of the applicable assessment criteria is that a

Assessment requirement	Comments
	negative impact is likely for that criterion, however the overall conclusion is only 'potential'. Such outcomes are not adequately justified. • For the assessment of impacts on GDEs, the EIS argues that while the frequency of overbank flooding would be reduced in some areas, during flood mitigation zone (FMZ) discharge there would be higher levels and an increased flow, which would replenish aquifers, mitigating impacts. There are many assumptions in this statements that are not adequately justified. • The mitigation measures proposed are inadequate. Only one is proposed, as described in Table 7-1: that an operational protocol for FMZ be developed to minimise potential impacts on downstream native vegetation from inundation. The objectives of the protocol also include reducing impacts on life and property. Therefore, EES considers the protocol is unlikely to provide much mitigation for biodiversity impacts as the protocol objectives for reducing impacts on life and property are always likely to be more important than objectives around biodiversity impact. • There are no mitigation measures proposed for a reduction in flooding extent.
4. Where an offsets package is proposed by a proponent for any downstream impacts to biodiversity this package should: (a) Meet OEH's *Principles for the use of biodiversity offsets in NSW*, which are available at: www.environment.nsw.gov.au/biocertification/offsets.htm. (b) Identify the conservation mechanisms to be used to ensure the long-term protection and management of the offset sites. (c) Include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features and/or impact mitigation measures	• An offsets package is not proposed. • The section 7.2 requirement to offset states: *As outlined in Section 2(h) of Attachment B (of the SEARs), where the Project cannot adequately avoid or mitigate impacts on downstream biodiversity, such that there are no residual impacts from the Project, then a biodiversity offset package should be considered.* However, this wording is incorrect. The SEARs state that a biodiversity offset package is expected. • Section 7.2 also states that: *For the purposes of this assessment, residual impacts are those which will likely have a 'significant impact' on threatened biota as determined by the assessment of significance.* However, this is inconsistent with the SEARs, which state that any residual impacts must be offset not just the significant ones. • Also, section 7.2 justifies that no offsets will be provided for downstream impacts because there is a high level of uncertainty with respect to quantifying and qualifying the nature and scale of impacts. EES does not consider this to be adequate justification for not providing offsets.

Assessment requirement	Comments
(including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.	• Similarly, section 7.2 does not recommend any monitoring as *'it is unlikely that monitoring would be able to differentiate between potential impacts resulting from the Project and from other downstream factors.'* EES does not agree with this statement and considers monitoring an important tool to inform ongoing management of the dam to reduce impacts.
5. Where appropriate, likely impacts (both direct and indirect) on any downstream OEH estate reserved under the *National Parks and Wildlife Act 1974* should be considered. Refer to the Guidelines for developments adjoining land managed by the Office of Environment and Heritage (OEH, 2013).	• Section 6.9 advises that Scheyville and Cattai National Parks would experience the greatest reductions in flooding extents but would experience a longer duration of low-level flooding due to the discharge of water from the FMZ. Section 6.9 also states that: *The actual areas affected relative to the overall areas of these national parks would be very small* but there are no figures provided to quantify this. This section also advises the reduction in flood extent, depth and duration will not cause significant biodiversity impacts but there is nothing further to justify this claim. These national parks contain regionally significant remnants of CEECs, endangered ecological communities and threatened species. The Guidelines for developments adjoining national parks estate, which were supposed to be referenced but were not, make it clear that developments should seek to avoid (and then minimise and mitigate) any direct or indirect adverse impacts on reserved lands.

Biodiversity Downstream - Bilateral Assessment

Assessment of EPBC Act-listed threatened species and communities

This document discusses the assessment of downstream impacts only and references to the EIS are in relation to EIS Appendix F5: Matters of National Environment Significance (MNES) – Biodiversity unless stated otherwise.

1. Identification of MNES – Biodiversity

(a) Confirmation that all the EPBC Act-listed threatened species and communities that occur on the Warragamba Dam Raising Project (the Project) site, or in the vicinity are identified.

There are a number of records in Bionet of the following migratory species in the Project area, but they have not been considered in Appendix F5: Red-necked Stint, Ruff, Pacific Golden Plover, Wood Sandpiper; Marsh Sandpiper. It is noted that none of these species are listed in Attachment 1 of SEARs (that lists which EPBC Act-listed species must be considered).

Attachment 1 of the SEARs lists a number of species to be considered in the EIS. All species and TECs listed as downstream only have been considered in the EIS. The species and TECs not listed as downstream only are considered in the upstream bilateral assessment.

(b) Comments on whether the Framework for Biodiversity Assessment (FBA) has been applied to all EPBC Act-listed threatened species and communities that occur on the Project site or in the vicinity.

The FBA has not been applied in relation to this EIS, as the FBA cannot adequately assess overland flow impacts. In the absence of a methodology, the adequacy of the EIS has been assessed against the survey and assessment requirements in the SEARs.

The EIS has addressed all EPBC Act-listed species except those identified in 1(a).

(c) Comments on whether the EPBC Act-listed species that are not addressed by the FBA have been assessed in accordance with the SEARs.

The species listed in 1(a) have not been addressed in the EIS. The SEARs require that the EIS determine the list of potential threatened species for the site using databases such as Bionet. Given that there are records for the species listed in 1(a) in Bionet, then it can be concluded these species have not been addressed in accordance with the SEARs.

Table 7-3 lists EPBC Act-listed fauna species identified as potentially occurring in the Project area. Table 7-13 lists EPBC Act-listed fauna species recorded within the downstream study area or identified from database searches. Table 8-3 provides a likelihood of occurrence of threatened species.

(d) Verification that the proponent has expressed a statement about the potential impact i.e. likely significant, low risk of impact, not occurring, for each listed threatened species and community protected by the EPBC Act referred to in 1(a).

The EIS makes no mention of the species listed in 1(a).

Table 10-1 lists the results of the assessments of significant impact for 94 species and communities. Of these, 63 species/TECs are considered likely to be significantly impacted (i.e. 67%), and 31 are considered unlikely to be significantly impacted. It is noted there is no determination on whether it is the upstream, downstream or construction site impacts that are causing the significant impact.

Threatened species and TECs recorded in the study area or identified from database searches are detailed in Tables 7-12, 7-13 and 7-15. An assessment of significance has been completed for all of these, except *Lasiopetalum joyceae*. There are 2 records of this species in the affected downstream area in Bionet, so an assessment of significance should have been completed.

(e) Where further information from the proponent is critical to the assessment of MNES.

EES considers further information from the proponent is critical to the assessment on MNES. The inadequacies regarding the analysis of impacts, avoidance, mitigation and offsetting are outlined elsewhere in this document, along with the further information required.

The adequacy of vegetation mapping has been separately assessed.

2. Assessment of the relevant impacts

(a) Verification that:

(i) the nature and extent of all the relevant impacts has been described – YES

(ii) measures to avoid and mitigate have been described – YES

(iii) an appropriate offset for any residual adverse significant impact has been determined – NO

- The nature and extent of all relevant impacts is described in Chapter 12 of the EIS.
- The measures to avoid impacts have been described in Chapter 4 of the EIS.
- There are no measures proposed to mitigate impacts, except for a statement that environmental management plans will be prepared.
- There are no offsets proposed for downstream impacts. The EIS states that *'development of the operational protocol for the FMZ would seek to minimise potential impacts on downstream vegetation from temporary inundation subject to meeting operational priorities for protection of life and property'.*

(b) Information not provided for any relevant EPBC Act-listed species and communities.

The information provided for EPBC Act-listed species and communities, is the same as that provided for BC Act-listed species and communities.

(c) Comments on listed threatened species and communities which the proponent claims the impact will be 'not significant' in accordance with the *EPBC Act Significant Impact Guidelines*.

The Commonwealth referral document does not specify which entities the Commonwealth considers may be significantly affected by the Project. Rather, the referral says (page 16) that *'the downstream impacts are not well detailed within the referral and will require detailed analysis in the assessment documentation'.*

EES does not agree with the following conclusions in the EIS that the impact will not be significant:

- Turpentine-Ironbark Forest of the Sydney Basin Bioregion: In response to the criteria – will the action cause a substantial change in species composition of an occurrence of an ecological community, the EIS concedes that gradual alterations to the structure of the community may occur over an extended dry period. However, the EIS then states that this would not result in complete loss of the TEC, and therefore, the Project is unlikely to have an adverse effect on the composition of the ecological community. However, the complete loss of the TEC is not relevant to this criterion. Given the critically endangered status of this TEC, EES considers the Project may

have a significant impact on this TEC, given potential changes in species composition.

- Swift parrot: The EIS states the Project will likely modify, destroy, remove or decrease the availability or quality of habitat of an estimated 761 ha of suitable or potential foraging habitat. However, it says that given the nature of the predicted impact of the Project, it is unlikely the action will lead to a long-term decrease in population size. EES does not consider this to be adequately justification. Given the large scale of the predicted impact to foraging habitat, EES considers that there may be a significant impact on this critically endangered species.
- Grey-headed Flying-fox (GHFF): The EIS states that three GHFF camps are known from the downstream impact area, none of which are listed as Nationally Important camps. The EIS acknowledges the Project would require removal of critical foraging habitat, which may result in a long-term decrease of the size of an important population. The Project may remove or modify an estimated 3,827 ha of foraging habitat. The EIS also acknowledges the Project could affect habitat critical to the survival of the species and that the species may decline as a result of the Project. However, the EIS argues that because significant areas of foraging habitat would remain at the local and regional scale, the impacts are not significant. EES considers this argument is unconvincing given the proposed removal or modification to a large area of foraging habitat and given the acknowledgement that the Project is likely to affect critical habitats and lead to species declines.

(d) References where specific lists or tables are detailed in the EIS

- Table 7-1: List of EPBC Act-listed EECs mapped within the Project study area.
- Table 7-2: List of EPBC Act-listed flora species potentially present within the Project study area.
- Table 7-3: List of EPBC Act-listed fauna species potentially present within the Project study area.
- Table 7-6: PCTS within the downstream study area boundary and the existing 10% AEP event.
- Table 7-12: List of threatened flora recorded in downstream study area.
- Table 7-13: List of threatened fauna recorded in downstream study area.
- Table 7-17: List of EPBC Act-listed TECs associated with PCTs – downstream study area.
- Table 8-2: Likelihood of occurrence of TECs in Project study area.
- Table 8-3: Likelihood of occurrence of threatened species.
- Table 8-4: Likelihood of occurrence of migratory species.

Table 1: Impact Summary Relevant EPBC Act – listed Ecological Communities (refer to section 3)

A	B	C	D	E		F	G
EPBC Act -listed EEC	**Y/N**	**PCTs**	**Y/N/Comment**	**Ha**	**Credits**	**Comment**	**Relevant page numbers in the EIS**
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion*	Y	PCT958	Y	0	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 90, Table 7-17
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Y	PCT 725	Y	0.12	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
Cumberland Plain Shale Woodlands and Shale/Gravel Transition Forest	Y	PCT724 PCT849 PCT 850	Y	338.04	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
River-flat Eucalypt forest on coastal floodplains of southern NSW and eastern Victoria	Y	PCT835 PCT1504 PT1106	Y	460.78	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Y	PCT395	Y	360.56	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Y	PCT1183 PCT1284	Y	48.92	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
Western Sydney Dry Rainforest and Moist Woodland on Shale	Y	PCT877 PCT830	Y	9.22	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17
Nomination for Melaleuca dominated Temperate Swamp Sclerophyll Forests on Coastal Floodplains of Eastern Australia (Endangered)	Y	PCT1718	Y	4.08	0	Figures for impact is the extent of EEC within 1 in 10 chance in a year flood	Page 91, Table 7-17

* Note only those TECs listed in the EIS as significantly impacted downstream are included in Table 1.

Table 2: Impact Summary Relevant EPBC Act-listed species (refer to Section 4)

A	B	C	D	E		F	G
Threatened species (listed under the EPBC Act)	**Credit Type (SC/EC)**	**Record PCTs associated with ecosystem credits**	**Y/N/Comment**	**Ha (total species habitat)**	**Credits (total species habitat)**	**Comment**	**Relevant page numbers in the EIS and Appendices**
Allocasuarina glareicola[†]	SC	PCT 724, PCT 725, PCT 883, PCT 1067, PCT 1081	Y	28.75	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Pages 177-178; Table 12-1, Pages 139-140
Darwinia biflora	SC	PCT1081, PCT181, PCT1328	Y	30.27	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Table 12-1, Pages 139-140
Micromyrtus minutiflora	SC	PCT724, PCT725, PCT1067	Y	30.17	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Table 12-1, Pages 139-140
Persoonia hirsuta	SC	PCT83, PCT1081, PCT1181, PCT1183, PCT1327, PCT1328, PCT1395	Y	459.98	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Table 12-1, Pages 139-140
Persoonia nutans	SC	PCT724, PCT725, PCT883, PCT958, PCT1395, PCT1067	Y	44.99	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Table 12-1, Pages 139-140
Pimelea spicata	SC	PCT830, PCT835, PCT89, PCT850	Y	71.47	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Table 12-1, Pages 139-140
Pultenaea parviflora	SC	PCT724, PCT725, PCT883	Y	45.82	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Pages 323-324; Table 12-1, Pages 139-140
Zieria involucrata	SC	PCT1504, PCT1181, PCT1183, PCT1284, PCT1328, PCT1292, PCT1557	Y	58.17	0	Figure quoted for impact is the number of hectares between the existing and with project 10% AEPs	Pages 347-348; Table 12-1, Pages 139-140

[†] Note: only those species listed in the referral doc for consideration and listed in the EIS as significantly impacted downstream have been included in Table 2.

3. Avoid, mitigate and offset

(a) Comment on whether the EIS identifies measures to avoid and minimise impacts on the relevant EPBC Act-listed threatened species and communities

The measures to avoid and minimise impacts have been described in Chapter 4 of the EIS. They are also discussed in section 13.1 and Table 13-1 of Appendix F5. There are no specific gaps in relation to the discussion on Commonwealth matters compared to state listed entities.

(b) Comment on the adequacy and feasibility of measures to avoid and minimise impacts. Identify inadequacies where further efforts could be made to avoid and minimise impacts on Commonwealth matters.

The sections of the EIS that discuss avoidance and mitigation measures are listed above.

The SEARs require the EIS includes discussion of how long-term management arrangements will be guaranteed. There is only one mitigation measure proposed, that an *'operational protocol for the FMZ'* would be developed, which would *'seek to minimise potential impacts on downstream vegetation from temporary inundation subject to meeting operational priorities for protection of life and property'*. The main EIS volume (Chapter 29, section 29.3) states that this operational protocol would need to be developed during the detailed design of the Project and in consultation with relevant stakeholders up and downstream of the dam. There is no more detail provided in the EIS on the operational protocol.

It is noted that Table 29-17 of the EIS states that the operational protocol will *'need to balance the multiple objectives from the FMZ, upstream inundation, environmental flows and downstream riverine requirements. The outcome will be to minimise as much as possible the inundation durations in upstream areas and reduce downstream flooding'*. Therefore, it appears that while the aim of the operational protocol may be partly to reduce biodiversity impacts downstream, there are also other priorities that will be taken into account in the operational protocol, which may mean biodiversity is given a lower priority compared to these other factors. As such, EES does not consider the EIS provides any tangible mitigation measures for biodiversity. In addition, EES considers the EIS does not provide detail on how long-term management arrangements will be guaranteed, as required by the SEARs.

4. Offsetting

Verification that:

(i) An appropriate offset for any residual adverse significant impact has been determined – NO

(ii) Proposed offsets for EECs provide a like for like outcome – NO

(iii) Proposed offsets have been determined using the FBA – NO

The SEARs (Attachment A – guidelines for EPBC Act assessment) require that *'where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy'*. Appendix F5 lists 63 species that the EIS considers are likely to be significantly impacted by the Project, however, no offsets are proposed. This includes a number of the species that listed in the referral documents as impacted downstream only. There are also no comments on why offsets are not proposed.

5. Comment on whether the information and data relied upon for the assessment have been appropriately referenced in the EIS.

The data sources used in the EIS are listed in Table 6-1 and included the PMST, SPRAT profiles, NSW Bionet threatened species records and profiles, Bionet vegetation classification, Biodiversity Values Map, Atlas of Groundwater Dependent Ecosystems, Directory of Important Wetlands and Mitchell Landscapes layer. EES supports the use of all these data sources as being the most accurate and reliable data sources available.

Biodiversity Assessment – Construction Area

The comments in this section are primarily based on the information and analysis contained in Appendix F3 of the EIS.

Agreed modifications to the Framework for Biodiversity Assessment (FBA)

Under the Secretary's Environmental Assessment Requirements EES can agree to approaches for assessing biodiversity impacts different to the FBA.

In pre-exhibition discussions between Planning and Assessment Group, EES, the Commonwealth Department of Agriculture Water and Environment and WaterNSW, the following modifications to the FBA were agreed:

- Surrogate plots could be used where insufficient plots were not able to be surveyed on the construction area site. Except where noted below, this has been implemented acceptably.
- Plots outside of the construction area site could be used. Except where noted below, this has been implemented acceptably.
- Assumed presence be used, based on PCT associations, to develop species polygons for the purposes of calculating species credit requirements for offsets.

PCT and TEC mapping

Nine of the 12 plots conducted for this assessment (not including surrogate plots but including those off site) were provided to Vegetation Classification and Ecology as part of the assessment for the upstream BAR (the plots were in the same dataset). These were analysed as part of that work and it is recommended the following plots have their PCT assignments amended:

BAR Site Label	BAR Assigned PCT	Recommended Amended PCT
US1	1083	1081
US10	1083	1181
US11	1081	1181
US12	1081	1181
US2	1081	1181
US6	1083	1081
US8	1083	1081

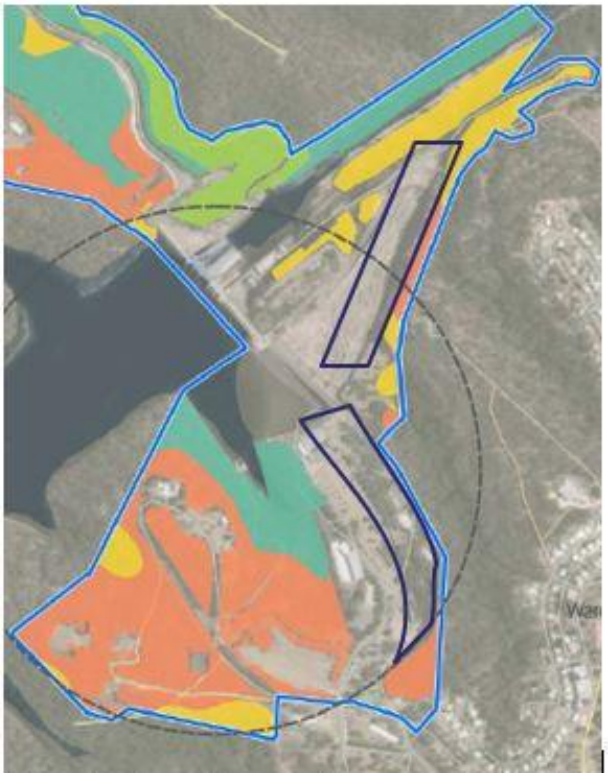
These re-assignments would also mean that Vegetation Zones 1 and 2 are now assessed using plots from more than one PCT.

It is also recommended that:

1. Data from Plots US3-5 be analysed using the Plot to PCT Assignment Tool to determine if alternative PCTs should be assigned to these plots.
2. Mapping of PCTs be revised based on the recommended plot PCT assignments.
3. Where vegetation zones no longer have sufficient plot data to meet FBA requirements, additional plot surveys be undertaken.

Only surrogate plots have been used for Vegetation Zone 5 due to site access limitations. This was discussed in meetings with WaterNSW and is considered appropriate. However, the revision of the PCT identification and mapping may mean that surrogate data for an alternative PCT needs to be used.

Figure 4-2 of the BAR shows apparent vegetation within the development site that is not mapped as native vegetation nor as a PCT (see below). It is recommended the assessor clarify whether the vegetation is native, whether it will be cleared as part of the development and, if so, assign PCTs and include it in the assessment of impacts.



EES notes the BAR advice that '*WaterNSW has recently carried out approved vegetation clearing around built structures for the purposes of asset protection in relation to bushfire risk. This clearing has reduced the area of vegetation mapped by SMEC by 0.15 hectares'* (section 3.6, page 25). It is recommended this area be identified on a map to assist in clarifying the assessment.

Threatened Species Assessment

Large-eared Pied Bat is only a species credit species when caves and other suitable habitat is present. These have been determined to not be present. There is, therefore, no need to provide a species polygon and calculated species credits for this species.

The Common Planigale has previously been recorded from the site. Because the species was not recaptured with additional survey effort, this species is now considered by the assessor to be absent. The species is known to be notoriously difficult to detect, even when known to be present. In addition, the assessor has used Elliott trapping to target the species planigale which is considered an ineffective technique for detecting. Given some of the survey methods employed are unsuitable and the species has been recorded on site previously, the Common Planigale should be included within the list of the species assumed to be present within the development site. A species polygon should therefore be provided and credits calculated.

Vegetation Zone 5 has not had any threatened species polygons associated with it. Further detail on past disturbance is required before this can be accepted, especially for fauna.

Indirect impacts on retained Shale Sandstone Transition Forest (SSTF) through temporary inundation or flooding are not discussed. Further information should be provided to demonstrate whether such impacts are likely and, if so, whether that could alter abiotic factors critical to the long-term survival of the retained SSTF vegetation.

Targeted surveys would increase the certainty around the assessment of threatened species that are matters for further consideration.

Offsets calculated by the FBA are not necessarily a measure that contributes to the recovery of a species or a Threatened Ecological Community. As these entities are matters for consideration that are of particular concern, additional offsets or other measures will need to be considered in any conditions of approval. These include implementing actions from the Save Our Species database both on site (as part of the Construction Environmental Management Plan and ongoing management) and funding those actions at other sites.

Other matters

The development footprint in Figure 7-1 is a series of disconnected vegetation patches within the larger development site. There has been no reference to access roads on the plan of the development footprint. The assessor should clarify whether these are connected by an existing road network. If not, any additional clearing for roads should be assessed as part of the BAR.

Biodiversity – Upstream and Construction Area Bilateral Preliminary Assessment

This advice is a preliminary assessment of upstream and construction area impacts only and references to the EIS are in relation to EIS Appendix F5: Matters of National Environment Significance (MNES) – Biodiversity unless stated otherwise. A final assessment will be provided following a review of the proponent's response to EES's upstream and construction area biodiversity advice.

1. Identification of MNES – Biodiversity

Table 6-1 of the MNES - Biodiversity report specifies the databases that have been used to identify potential biodiversity MNES.

The Project Assessment Notes supplied by Department of Agriculture Water and Environment (then DEE) list the upstream and construction area impacts:

- Two threatened flora species (*Eucalyptus benthamii* and *Hakea dohertyi*) are considered likely to be significantly affected by the proposal.
- Thirteen other threatened flora species may also be impacted.
- Three threatened fauna species (Regent Honeyeater (*Anthochaera phrygia*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Large-eared Pied Bat (*Chalinolobus dwyeri*)) are considered likely to be significantly affected by the proposal.
- Fourteen other threatened fauna species may also be impacted.
- Two threatened ecological communities (White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (WBYBBRGGW) and Shale Sandstone Transition Forest of the Sydney Basin Bioregion (SSTF)) are considered likely to be significantly affected by the proposal.
- Seven other threatened ecological communities may also be impacted.

The MNES – Biodiversity report (Tables 8-2, 8-3 and, 8-4)[1] has assessed the likelihood of occurrence of:

- 20 threatened ecological communities (TECs)
- 100 threatened flora species
- 37 threatened fauna species.

The report has used all primary data sources to identify likely species. These include:

- DAWE Protected Matters Search Tool
- DAWE Directory of Important Wetlands in Australia
- DAWE Species Profiles and Threats Database
- DPIE Bionet
- DPIE Threatened Biodiversity Profile Search
- DPIE Bionet Vegetation Classification

Persoonia mollis subsp. *revoluta* (EPBC – vulnerable) was found in the construction area during the surveys for the proposal. It was listed on the EPBC Act in June 2021 and is not assessed. Under section 158A of the EPBC Act, new listings that happen after a controlled action decision do not apply to the assessment or further approval process decisions. The controlled action decision for this proposal predates the listing of this species so it is not required to be assessed.

DPIE is not aware of any other EPBC-listed species that should have been considered in the assessment.

[1] These tables discuss the likelihood of occurrence of these entities in all three areas of assessment for the proposal – upstream, construction area and downstream. This review of the MNES assessment is intended to address only the upstream and construction area assessments noting that some entities are common to all assessment areas.

2. Assessment of the relevant impacts

The FBA, as modified by agreement, has been applied to all species and TECs that occur, or are assumed to occur, in the upstream and construction assessment areas. BARs for these assessments have been reviewed separately. There are several recommendations for changes to the assessment as a result of that review. These relate primarily to mapping of PCTs (and, consequently, TECs) and species polygons.

The SEARs Attachment A, the Commonwealth requirements, address migratory species that are not NSW threatened species and SEARs Attachment B, the assessment requirements for the Downstream EIS. No migratory species (that aren't also threatened species) are noted in the referral documents.

Migratory species are addressed in 7.7, 8.3, 10, 11.2 and 12.2.4 of the MNES Report. It is concluded that the proposal is not likely to have a significant impact on any migratory species. It is considered that the assessment of migratory species is in accordance with the SEARs.

As the biodiversity assessment reports (BARs) have assumed species presence for most threatened species reviewed (for the purposes of credit calculations), the definitive assessment of impacts has been difficult. The MNES report has described the types of potential impacts and their extents.

3. Avoid, mitigate and offset

A review of avoidance and mitigation for the two BARs has been conducted separately. In summary, once the decision to raise the dam wall to reduce downstream flooding was made, there is little scope for avoiding impacts, apart from avoiding direct impacts in the construction area.

4. Offsetting

The credit requirements for offsets have been identified in accordance with the FBA with the following caveats:

- There are several recommendations for modifications to those BARs, including identification and mapping of PCTs and consequently mapping of species polygons. These modifications will necessarily alter the amount of credits required.
- No review of the FBA calculator files has been possible, so data entry has not been reviewed.

No offset sites have been identified. The BOS has recommended a process for their future identification. EES notes that given the quantum of credit requirements identified in the BARs, sourcing the necessary credits may be difficult.

Hydrological Assessment and Aquatic Ecology

General Comments

If the Project is approved, approximately 284 kilometres of upstream rivers, streams and creek will potentially be inundated in a probable maximum flood (PMF) event. Very little attention has been paid to the aquatic ecology in these inundation areas, despite them containing known locations of threatened/endangered or protected species. The likely impacts to these streams are not minor. These areas may become similar to the current full supply level (FSL) for Warragamba Dam.

Assessing and predicting the actual downstream impacts specific to the changed flow regime because of raising the dam wall will be difficult if not impossible task. The installation of infrastructure to enable the release of downstream environmental flows is included in the Project. However, the exact nature of these environmental flows remains ambiguous and are not clearly articulated in the EIS.

Upstream Hydrological Impacts

Whilst the EIS suggests that some inundation areas will be temporary and this will be dependent on individual flood events and dam levels, temporary inundation effects and their consequences could be long-lasting if not permanent. This is most easily demonstrated using satellite imagery, aerial photographs, and location specific photographs at the upper end of the current FSL for Warragamba Dam (see Figures 1 to 3). This occurs due to several important physical processes:

- Temporary inundation floods riffle, pool and glide morphologies, rendering such areas unsuitable for many habitat specialists (e.g. riffle dwelling insects; fish that use riffles for spawning/egg laying such as the Macquarie Perch).
- Temporary inundation can kill vegetation not adapted to inundation (i.e. most Australian terrestrial species, including most eucalypt species).
- Wave action scours and erodes unconsolidated sediment in the upper reaches and on the banks.
- At high storage levels, sediment washing in from the upstream catchment settles out and smothers the bottom substrate (potentially causing large detrital layers and sand slugs in the river in the upper most reaches where inundation occurs).

All these effects are readily apparent at the upstream end of the current FSL but have not been appropriately recognised or assessed in the EIS (see Aquatic Ecology Section below). The succession of shoreline communities on previous river margins depends not only on the interplay between erosion and sedimentation of substrates and invasion and extinction of organisms, but also on the duration, timing, and frequency of regulated water levels.

Figure 1. Nattai River near the upper end of the current FSL for Warragamba Dam.

Figure 2. Tonalli River and Byrnes Creek near the upper end of the current FSL for Warragamba Dam (Wollondilly River arm).

Photograph 3-1. Clear delineation of remnant vegetation above FSL – taken in November 2017 when dam was at approximately 86% capacity (WaterNSW 2017).

Photograph 3-2. Colonised Casuarina cunninghamiana *with drowned specimens below the FSL – taken in November 2017 when dam was at approximately 86% capacity (WaterNSW 2017).*

Figure 3. Effects of Warragamba Dam at the current FSL. Note bare ground and dead vegetation.

It is notable that these long-lasting and most likely permanent impacts are readily observable, even though the inundation to the current FSL is also temporary (Figure 4).

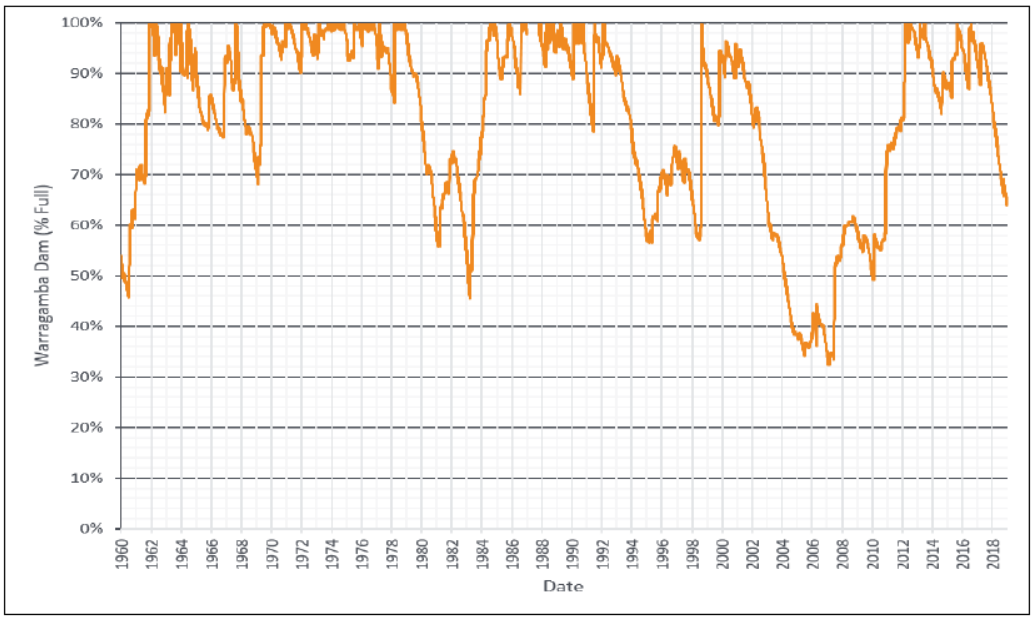


Figure 3-11 Warragamba Dam historical levels – Percentage Full (Source: WaterNSW)

Figure 4. Historical dam levels indicating current FSL experiences temporary inundation.

It is difficult to gain a clear statement regarding potential impacts of inundation to upstream riverine systems, but the EIS Appendix F1-L Part 2a and 2b Hydrological features reports show maps of the individual streams in relation to:

- The existing FSL.
- The upstream impact area.[1]
- The "study area" which appears to align with the PMF[2] level.

It is noted that the extent of inundation is heavily influenced by the modelling of catchment processes, rainfall and dam levels. The downstream ecological assessment suggests that:

> *For major rainfall events, the FMZ would capture the initial inflows until the capacity was reached and would then spill over the spillways. As the downstream levels would be higher, there is the opportunity to initially discharge water from the FMZ at a higher rate without increasing the extent of flooding (that is, piggyback releases). Generally, these higher discharge rates would occur for approximately two to three days before the FMZ discharge rate would be reduced to the same discharge rate as for minor flood releases, namely about 1,150 cubic metres per second or around 100 gigalitres per day.*

It remains unclear what many of the assumptions are that underlie the model, in particular the modelled time until capacity is reached and subsequent release rates from Warragamba Dam during periods of extreme flooding. Such assumptions are likely to affect both the upstream impact area and the PMF level and the height and duration of inundation.

Based on the EIS Appendix F1-L Part 2a and 2b Hydrological features reports approximately 284 kilometres of upstream rivers, streams and creeks could potentially be inundated by the proposed raising of Warragamba Dam wall[3]. This includes approximately:

- 9 kilometres of 8th order streams (Strahler categorisation), specifically the Wollondilly River.
- 16 kilometres of 7th order streams (Coxs River, Kowmung River, Nattai River).
- 10.7 kilometres of 6th order streams (Jooriland River, Kedumba River, Little River, Werriberri Ck).
- 24 kilometres of 5th order streams.
- 15 kilometres of 4th order streams.
- 32 kilometres of 3rd order streams.
- 64 kilometres of 2nd order streams.
- 113 kilometres of 1st order streams.

The inundation of these rivers is neither minor nor a temporary impact.

Wollondilly River

The Wollondilly River is the largest river entering Warragamba Dam. It rises about 7 kilometres east of Crookwell and initially flows south and then east through Goulburn, where

[1] The Project adopted a defined 'survey area' which, for the purposes of this assessment, is the 1 in a 100 chance in a year event plus nine percent climate change (that is, a nine percent increase in rainfall under a climate change scenario). The survey area was delineated with input from the former Department of the Environment and Energy (DoEE) 3 prior to surveys commencing. It should be noted that 'survey area' is not a defined concept within the FBA. Subsequently, the DoEE agreed that impact assessment should be up to the 1 in 100 chance in a year flood extent.

[2] For the EIS assessment, the PMF (no climate change) with Project is the study area.

[3] Based on PMF mapping (which could potentially become the 'new' FSL for Warragamba Dam).

it is joined by the Mulwaree River. At Towrang the river turns north-east to a point near Bullio, where it is joined by the Wingecarribee River. From here the Wollondilly River takes a wide detour to the north-west to Barrallier, before eventually regaining its north-easterly course into Lake Burragorang. The Wollondilly River is the largest individual inflow into Lake Burragorang supply accounting for approximately 36% of the reservoir's annual inflow. The Wollondilly River is an 8th order stream (Strahler categorisation) when it joins Warragamba Dam, downstream of Murphys Crossing. The location of FSL, upstream impact area and PMF are illustrated in Figure 5.

There is approximately 9.15 kilometres of river length mapped above Murphys Crossing to the 'new' PMF level for the Wollondilly River. Flooding to this level will submerge Murphys Crossing (the major eastern access point to Yerranderie) and much of the road that leads to it. Flooding could also submerge the gauge on the Wollondilly River at Joorilands. The historic Joorilands Shearing Shed would also be inundated under the 'new' PMF.

There is approximately 4.75 kilometres of river length above Murphys Crossing to the 'impact' level mapped for the Wollondilly River. Flooding to this level will still submerge Murphys Crossing (the major eastern access point to Yerranderie) and much of the road that leads to it.

It is noted that the FSL is mapped as extending well above Murphys Crossing, but it is more likely that it is downstream of the crossing based on anecdotal and on-ground observations.

Depth-duration curves in *Chapter 15: Flooding and Hydrology* were examined for four cross-sections on the Wollondilly River:

- Location 2 (WOLLONDILLY_US_6720) approximate location of the Project PMF event.
- Location 3 (WOLLONDILLY_US_8933) represents the approximate location of the Project for the 1% AEP event (upstream of the Jooriland gauge).
- Location 4 (WOLLONDILLY_3380) upstream of Murphys Crossing.
- Location 5 (WOLLONDILLY_15000) located within Lake Burragorang.

The EIS findings were:

- Increases in the depth and duration of temporary inundation were suggested to be less than half a metre and half a day respectively for the two upstream most cross-sections, the exception being the PMF event for Location 3 (WOLLONDILLY_US_8993) where the increase in depth was about 1.1 metres.
- At Location 4 (WOLLONDILLY_3380) increases in depth were less than half a metre for all events up to the 1% AEP; for the PMF event the increase in depth is about 4.3 metres.
- At Location 4 (WOLLONDILLY_3380) increases in inundation was less than half a day up to the 1% AEP event, then increasing up to 3.6 days for the 1% AEP event.
- At Location 5 (WOLLONDILLY_15000) there was a clear increase in depths and durations for inundation, broadly mirroring those at the dam wall for respective flood events.

On 1 November 2021 WaterNSW sought to reduce the levels in Warragamba Dam to 1m below full supply (see below). It was stated that this would take approximately 5 days assuming 'no further rain'. Under extreme flooding events with large flows continuing to enter Warragamba Dam from the catchments, it would likely take much longer. It is difficult to reconcile the suggested inundation levels and duration above (e.g. 0.5m height and half day

duration) with the practicalities and timing of drawdown stated for Warragamba Dam for the November 2021 release.

Unexplained assumptions are likely driving predictions of the extent and duration of inundation in the EIS and these model predictions need validation.

Flood impacts like the current FSL impacts may occur up to the full PMF level in the Wollondilly River - an extension of flood effects to about 9.15 kilometres of river length (see Figure 5).

Mon
01
Nov

Warragamba Dam Drawdown

Mon 01 Nov 21 4:06:40 PM (a day ago)

From 8.00am tomorrow morning, WaterNSW will be operating the gates manually to reduce the water level to 1m below full supply as per standard operating protocol.

Assuming no further rainfall, the drawdown should be complete within 5 days.

River users may notice a small increase in river heights over this period.

http://www.ewn.com.au/alerts/warragamba-dam-drawdown-2021-11-01-050700-520724.weather?utm_source=520724&utm_medium=rss&utm_term=alert&utm_content=fullurl&utm_campaign=alerts

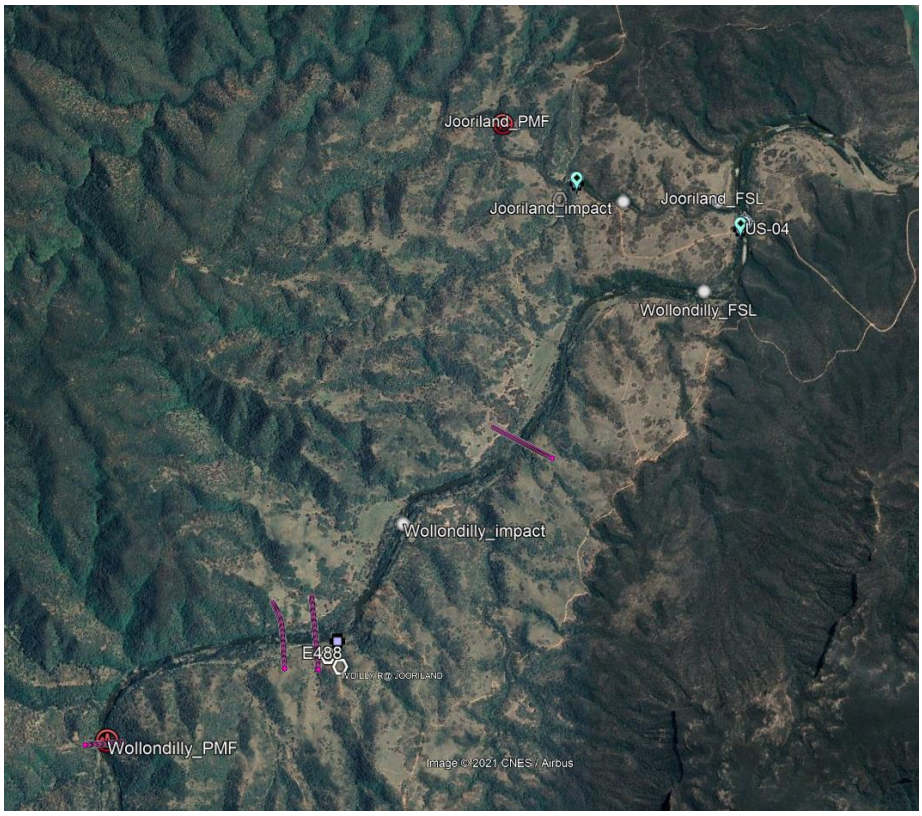


Figure 5. Wollondilly and Jooriland River: Existing FSL, Impact extent and PMF inundation.

Jooriland River

The Jooriland River is a 6th order stream (Strahler categorisation) that joins the Wollondilly River downstream of Murphys Crossing. The FSL for Warragamba Dam is located close to the junction of Jooriland River with the Wollondilly River and raising the dam wall will impact an important river that has previously remained largely unimpacted by the dam. Very little information is provided on the ecology of Jooriland River or how it may be impacted, particularly in the predicted inundation zone.

There is approximately 3.1 kilometres of river length mapped above the Jooriland River junction with the Wollondilly River that is inside the 'new' PMF level. No details were provided in the EIS on inundation levels or duration for Jooriland River. Inundation impacts could occur up to the PMF level in the Jooriland River - an extension of inundation impacts to approximately 3.1 kilometres of river length (see Figure 5).

Tonalli River

The Tonalli River is a 5th order stream (Strahler categorisation) that joins the Wollondilly River arm of Warragamba Dam, downstream of Byrnes Creek. The lower reaches of the Tonalli River are within the existing Warragamba Dam FSL and impacts of inundation in these areas are obvious (Figure 2). The upper catchment of the Tonalli River drains areas around the old mining town of Yerranderie and there have been previous studies undertaken on heavy metal pollution within the Tonalli River. Very little information is provided on the ecology of the Tonalli River or how it may be impacted, particularly in the predicted inundation zone.

No details were provided in the EIS on inundation level or duration for the Tonalli River. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in the Tonalli River - an extension of inundation impacts to approximately 4.5 kilometres of river length (see Figure 6).

Figure 6. Tonalli River: Existing FSL, Impact extent and PMF inundation.

Nattai River

The Nattai River is in the Southern Highlands and has a catchment area of 446 km^2. It is a 7th order stream (Strahler categorisation) when it joins Warragamba Dam, downstream of Little River. The town of Mittagong and the surrounding villages of Colo Vale, Braemar and Hilltop are located at the far upstream (southern) end of the catchment. Large areas of the catchment are within the Jellore State Forest, Nattai and Bargo State Conservation Areas and Nattai National Park, which forms part of the Greater Blue Mountains World Heritage Area (GBMWHA). The existing FSL is above the junction of Nattai River with Little River. Impacts are readily observable up to the existing FSL (Figure 1). Very little information is provided on the ecology of the Nattai River or how it may be impacted by yet further inundation.

Depth-duration curves were examined for four cross-sections on the Nattai River:

- Location 9 (NATTAI_US_8700) the approximate location of the PMF event.
- Location 10 (NATTAI_US_11066) about 2.4 kilometres downstream of NATTAI_US_8700 and the approximate location of the Project 1% AEP event.
- Location 11 (NATTAI_1880) about 2.6 kilometres downstream of cross-section NATTAI_US_11066.
- Location 12 (NATTAI_5680) a further 3.8 kilometres downstream where the Nattai River broadens out into Lake Burragorang.

Predicted changes along the Nattai River include:

- Increases in the depth and duration of inundation for cross-sections NATTAI_US_8700 and NATTAI_US_11066 of less than half a metre and half a day respectively for all events with the exception of the PMF event for NATTAI_US_11066, which would increase inundation levels by about 7.8 metres.
- Increases in the depth and duration of inundation are more noticeable at cross-section NATTAI_1880, particularly for the 5% AEP and rarer events.
- At NATTAI_5680, there is also a clear increase in depths and durations for inundation for all events.

This indicates that there will be significant inundation occurring in the Nattai River. There is approximately 5.1 kilometres of river length mapped above the FSL that is inside the 'new' PMF level for the Nattai River (see Figure 7). The upper end of the PMF appears to coincide with the *Eel Hole* cited as a resting place of *Gurangatch* in the Aboriginal creation story of the area[4]. Inundation impacts like the existing impacts of the current FSL may occur up to the PMF in the Nattai River.

[4] 'The Eel Hole' refers to a large waterhole just downstream of the junction of the Nattai River and Whitegum Creek (1905 Parish Map). Eel-holes were associated with the resting places of Gurangatch. Gundungurra Aboriginal Heritage Association 2018. Submission 72 to Inquiry into Water NSW Amendment (Warragamba Dam) Bill 2018 3 October 2018

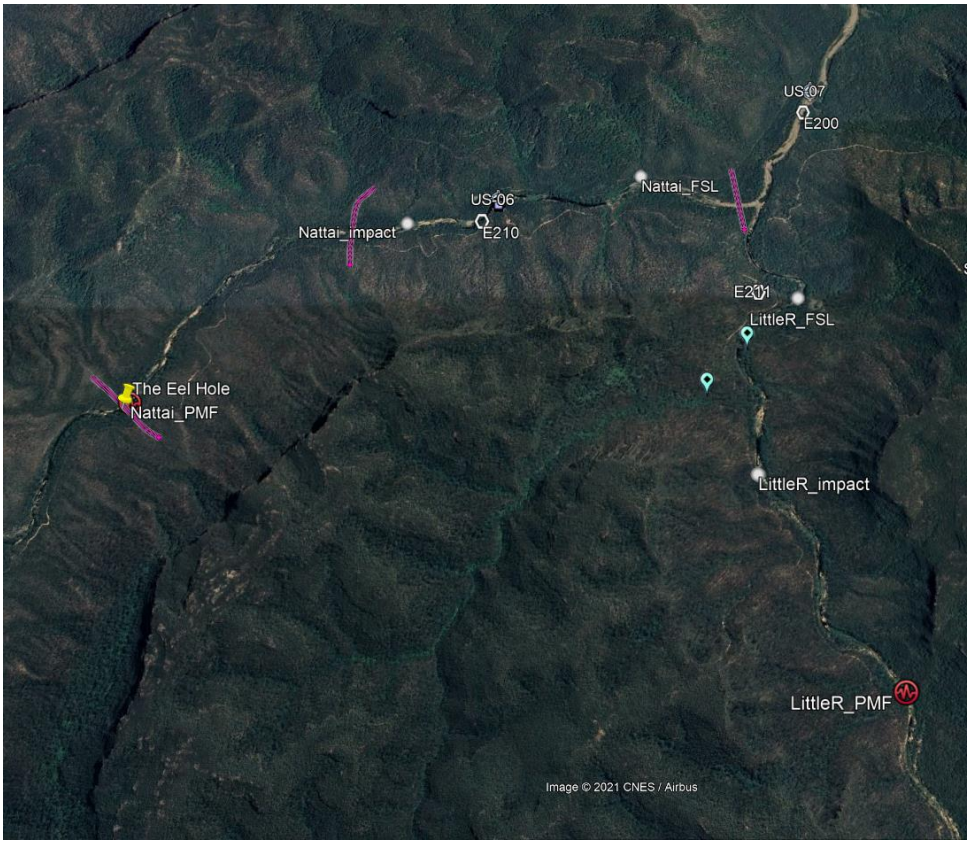


Figure 7. Nattai and Little River: Existing FSL, Impact extent and PMF inundation.

Little River

The Little River is a 6th order stream (Strahler categorisation) when it joins the Nattai River near the Nattai Bridge crossing. It is largely pristine with approximately 90% of the Little River catchment lying within the restricted Special Areas for Warragamba Dam. There are two small areas of peri-urban development on the south-east border of the catchment (Balmoral Village and Buxton). Because of its relatively pristine nature, it has been used previously for studies into natural riverine processes and nutrient studies (UWS 2001). The existing FSL is a short distance upstream of the junction of the Little River with the Nattai River. The EIS mapping appears to overestimate the exact FSL position in the Little River, but impacts are readily observable up to FSL (Figures 1 and 2). Very little information is provided on the ecology of the near-pristine Little River or how it may be impacted by yet further inundation.

There is approximately 2.6 kilometres of river length mapped above the FSL that is inside the ‘new’ PMF level for Little River. No details were provided in the EIS on inundation level or duration for the Little River. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in the Little River - an extension of inundation impacts to approximately 2.6 kilometres of river length (see Figure 7).

Werriberri Creek

Werriberri Creek flows into Lake Burragorang approximately 5 km upstream of the water supply offtake at Warragamba Dam. The townships of The Oaks, Belimbla Park and Oakdale are all located within the upper Werriberri Creek catchment. The lower end of Werriberri Creek is within the existing FSL of Warragamba Dam. Werriberri Creek is a 6th order stream (Strahler categorisation) when it joins Warragamba Dam but is a 5th order stream approximately 900m upstream of FSL. Very little information is provided on the

ecology of Werriberri Creek or how it may be impacted, particularly in the predicted inundation zone.

There is approximately 1.4 kilometres of river length mapped above the FSL that is inside the ‘new’ PMF level for Werriberri Creek. No details were provided in the EIS on inundation level or duration for Werriberri Creek. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Werriberri Creek, an extension of inundation impacts to approximately 1.4 kilometres of stream length (see Figure 8).

Figure 8. Werriberri Creek: Existing FSL, Impact extent and PMF inundation.

Green Wattle Creek

Green Wattle Creek is a 5th order stream (Strahler categorisation) that joins Warragamba Dam upstream of the Wollondilly River arm of the reservoir[5]. The lower reaches of Green Wattle Creek are within the existing Warragamba Dam FSL and impacts of inundation in these areas are obvious (Figures 1 and 2). The majority of Green Wattle Creek is in a near pristine state inside the Blue Mountains National Park and part of GBMWHA. Very little information is provided on the ecology of Green Wattle Creek or how it may be impacted, particularly in the predicted inundation zone.

There is approximately 4.65 kilometres of river length mapped above the FSL that is inside the ‘new’ PMF level for Green Wattle Creek. No details were provided in the EIS on inundation level or duration for Green Wattle Creek. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Green Wattle Creek, an extension of inundation impacts to approximately 4.65 kilometres of stream length (Figure 9).

[5] There is also a 3rd order Green Wattle Creek that joins the Wollondilly River arm of Warragamba Dam near Bob Higgins Creek. A further 900m of this creek will be inundated by the dam wall raising project.

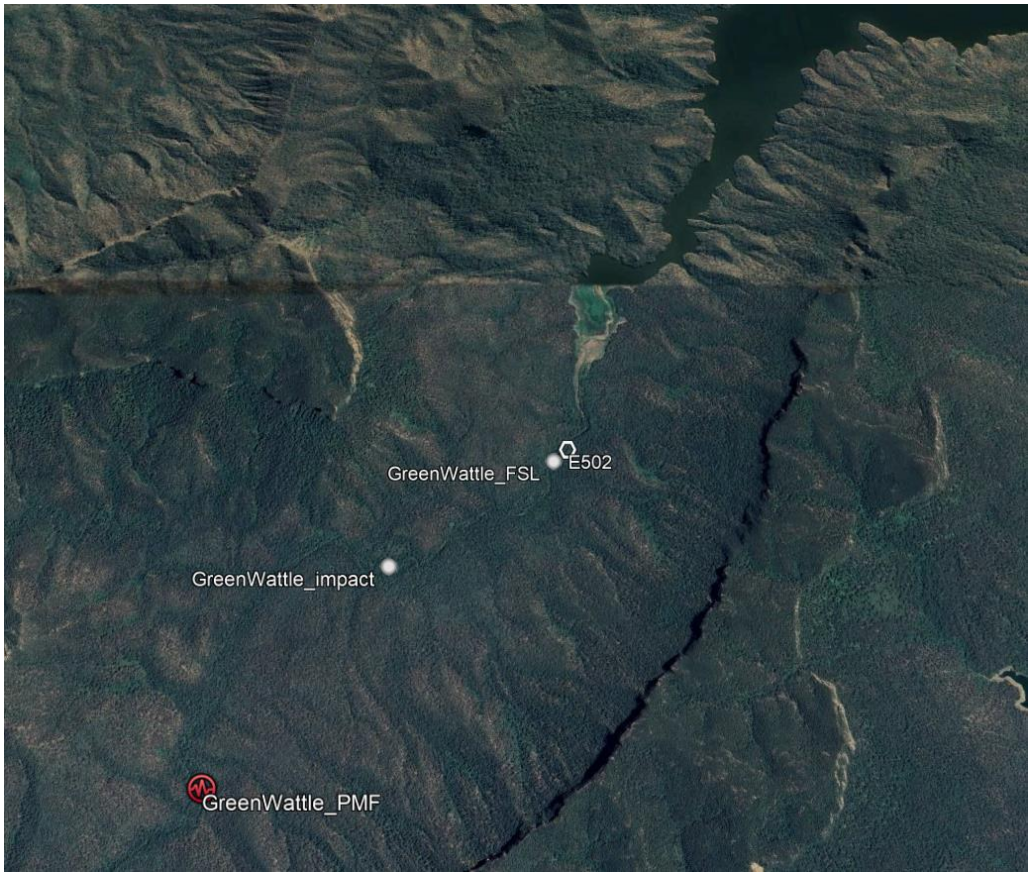


Figure 9. Green Wattle Creek: Existing FSL, Impact extent and PMF inundation.

Butchers Creek

Butchers Creek is a 5th order stream (Strahler categorisation) that joins Warragamba Dam upstream of the Wollondilly River arm of the Dam and upstream of Green Wattle Creek. The majority of Butchers Creek is in a near pristine state inside the Blue Mountains National Park and part of GBMWHA. The lower reaches of Butchers Creek are within the existing Warragamba Dam FSL and impacts of inundation in these areas occurs (Figures 1 and 2). Very little information is provided on the ecology of Butchers Creek or how it may be impacted, particularly in the predicted inundation zone.

There is approximately 3.75 kilometres of river length mapped above the FSL that is inside the 'new' PMF level for Butchers Creek. No details were provided in the EIS on inundation level or duration for Butchers Creek. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Butchers Creek - an extension of inundation impacts to approximately 3.75 kilometres of stream length (see Figure 10).

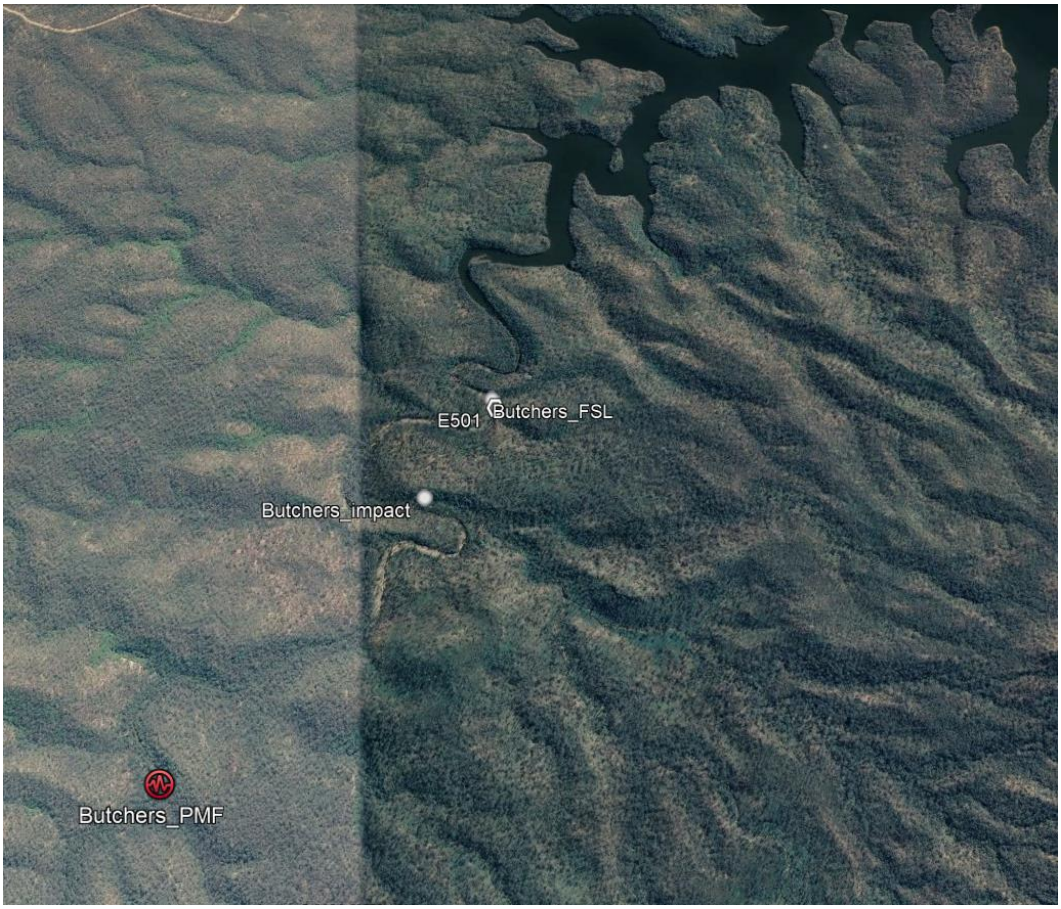


Figure 10. Butchers Creek: Existing FSL, Impact extent and PMF inundation.

Kedumba River

Kedumba Creek rises on the eastern side of Walford Park, Katoomba and flows generally south over the Katoomba Cascades, Katoomba Falls, and off the Blue Mountains Range, becoming the Kedumba River below the Three Sisters inside the Blue Mountains National Park and part of the GBMWHA. It then flows through the Jamison and Kedumba valleys within the Blue Mountains National Park, before reaching its confluence with the Coxs River within Lake Burragorang. The Kedumba River is a 6th order stream (Strahler categorisation) where it joins Lake Burragorang and is a 5th order stream upstream of the Reedy Creek confluence.

The lower reaches of Kedumba River are within the existing Warragamba Dam FSL and impacts of inundation in these areas is visible in satellite imagery (see Figure 11). Very little information is provided on the ecology of Kedumba River or how it may be impacted, particularly in the predicted inundation zone. The former Office of Environment and Heritage (OEH) has recorded the endangered Adams Emerald Dragonfly within the Kedumba River catchment[6] (in Reedy Creek).

[6] But this is not identified in the EIS despite being in the published scientific literature.

Figure 11. Effects of inundation in the lower Kedumba River.

There is approximately 6.4 kilometres of river length mapped above the FSL that is inside the ‘new’ PMF level for the Kedumba River. No details were provided in the EIS on inundation level or duration for Kedumba River. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Kedumba River (see Figure 12). Only the Coxs River and Wollondilly River are likely to have a larger inundation impact zone than the Kedumba River.

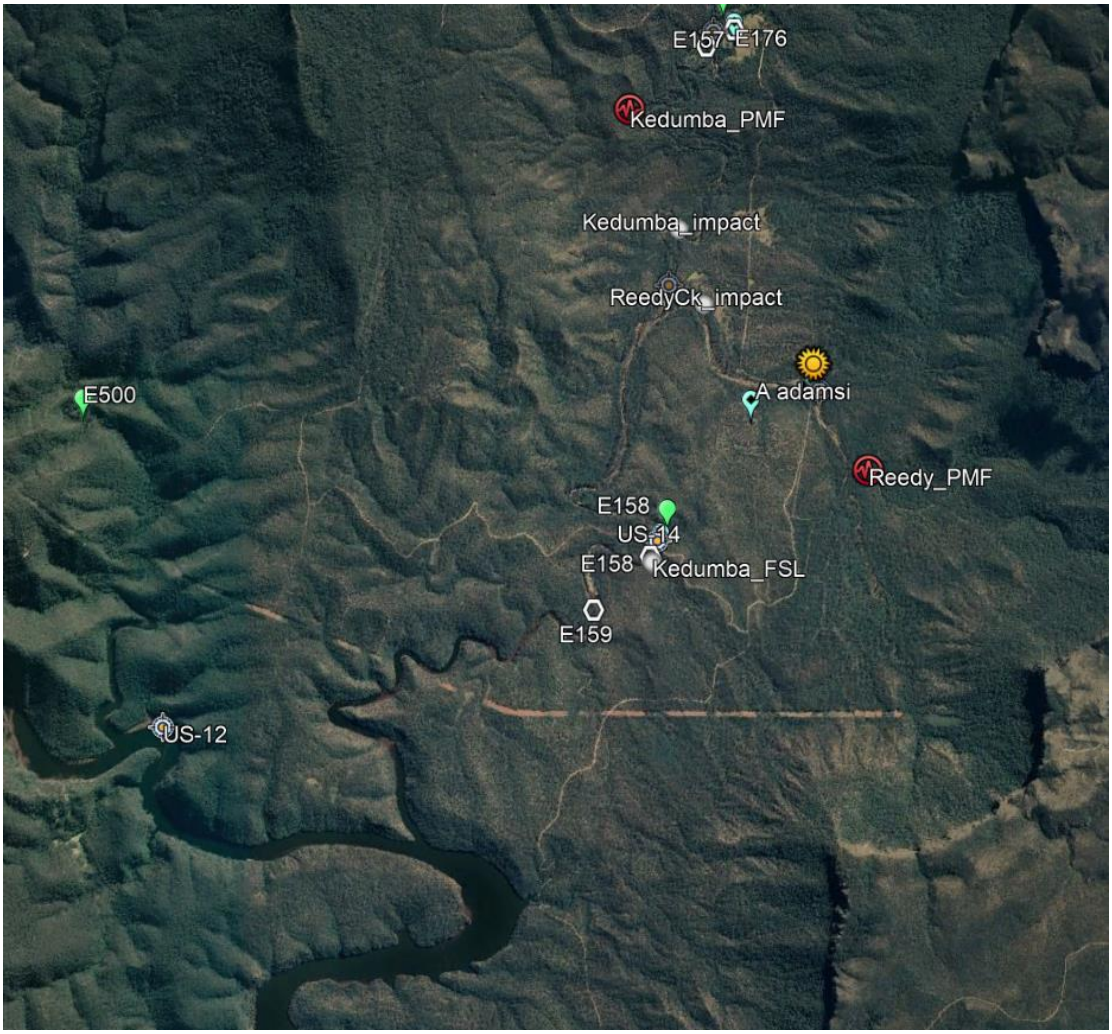


Figure 12. Kedumba River and Reedy Creek: Existing FSL, Impact extent and PMF inundation.

Reedy Creek

The Reedy Creek catchment is located approximately 7 km south of Wentworth Falls, in the Kedumba Valley inside the Blue Mountains National Park and part of the GBMWHA. Reedy Creek is a 5th order (Strahler categorisation) tributary of the Kedumba River. The Kings Tableland Road skirts the eastern boundary of the Reedy Creek and an unsealed road crosses the Creek upstream of its junction with Spring Creek. Because of its relatively pristine nature, Reedy Creek has been used previously for studies into natural riverine processes and nutrient studies (UWS 2001). OEH recorded the endangered Adams Emerald Dragonfly within Reedy Creek; however, this is not identified in the EIS despite being in the published scientific literature (Theischinger et al 2011). This location may be flooded by PMF events.

There is approximately 2.3 kilometres of river length mapped above the FSL that is inside the 'new' PMF level for Reedy Creek. No details were provided in the EIS on inundation level or duration for Reedy Creek. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Reedy Creek - an extension of inundation impacts to approximately 2.3 kilometres of stream length (see Figure 12).

Cedar Creek

Cedar Creek headwaters are in swamps on the Narrowneck Plateau inside the Blue Mountains National Park and part of the GBMWHA. Cedar Creek initially flows east before

turning south draining the valley in between the Narrowneck Plateau and Ruined Castle - Mt Solitary. The lower reaches of Cedar Creek are within the existing Warragamba Dam FSL and Cedar Creek is a 5th order stream (Strahler categorisation) where it joins Lake Burragorang. Apart from these areas of inundation, the Cedar Creek catchment is largely pristine. Very little information is provided on the ecology of Cedar Creek or how it may be impacted, particularly in the predicted inundation zone.

There is approximately 3.4 kilometres of stream length mapped above the FSL that is inside the 'new' PMF level for Cedar Creek, located approximately 900m downstream of the Berrima Inga Creek confluence. No details were provided in the EIS on inundation level or duration for Cedar Creek. Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in Cedar Creek - an extension of inundation impacts to approximately 3.4 kilometres of stream length (see Figure 13).

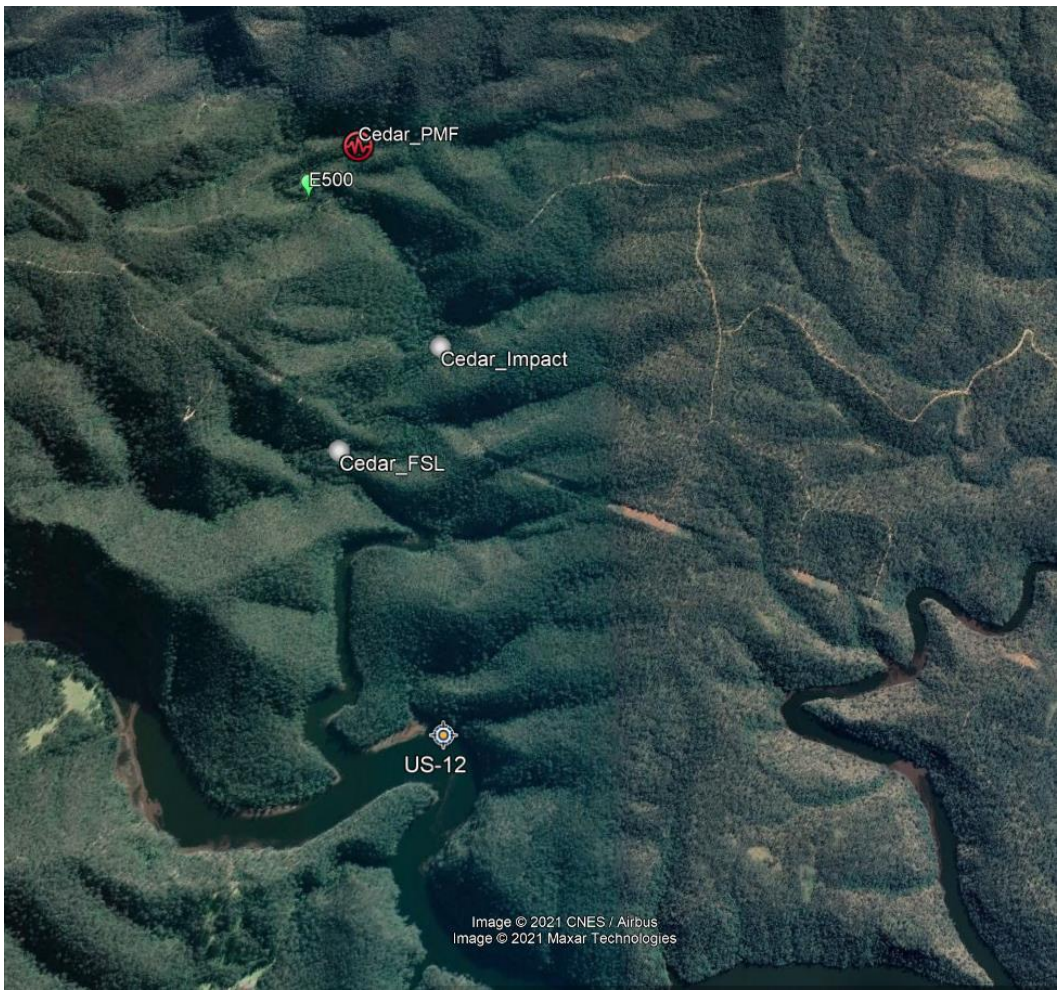


Figure 13. Cedar Creek: Existing FSL, Impact extent and PMF inundation.

Kowmung River

Approximately 70% of the Kowmung River catchment is protected within the Blue Mountains and Kanangra Boyd National Parks, part of the GBMWHA Area. Most of the 80-kilometre stretch of the Kowmung River lies within Kanangra-Boyd National Park, with the lower reaches of the river (approximately 15 km) occurring within the Blue Mountains National Park. The Kowmung River is fed by the tributaries of Tuglow and Hollanders Rivers and Browns Creek. The headwaters of these tributary rivers are in State forests, much of them characterised by pine plantations which are under an active harvesting regime.

The Kowmung River is in mostly near intact condition and is a declared wild river under the *National Parks and Wildlife Act 1974* (NPW Act). Under the NPW Act, wild rivers are to be managed to ensure restoration (where possible) and maintenance of the natural biological, hydrological and geomorphological processes associated with wild rivers and their catchments. The Kowmung River is a 7th order stream (Strahler categorisation) where it joins the Coxs River.

The FSL for Warragamba Dam extends up the Coxs River to about the confluence with the Kowmung River. The Kowmung River itself however is not impacted. There is approximately 4.7 kilometres of stream length mapped above the FSL that is inside the 'new' PMF level for the Kowmung River.

Depth-duration curves were examined for two cross-sections on the Kowmung River:

- Location 15 (KOWMUNG_10130) the approximate location of the Project PMF event.
- Location 14 (KOWMUNG_13130) about three kilometres further downstream and represents the approximate location of the 1% AEP event.

Predicted changes along the Kowmung River include:

- Increases in the depth and duration of inundation for cross-section Location 15 (KOWMUNG_10130) are less than half a metre and half a day respectively for all events.
- Increases in the depth of inundation for Location 14 (KOWMUNG_13130) are less than half a metre up to the 1% AEP event, and about 4.3 metres for the PMF event.
- Increases in the duration of inundation for Location 14 (KOWMUNG_13130) are less than half a day up to the 5% AEP event, increasing slightly – up to two days – for the rarer events.

Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in the Kowmung River - an extension of inundation impacts to approximately 4.7 kilometres of river length (see Figure 14).

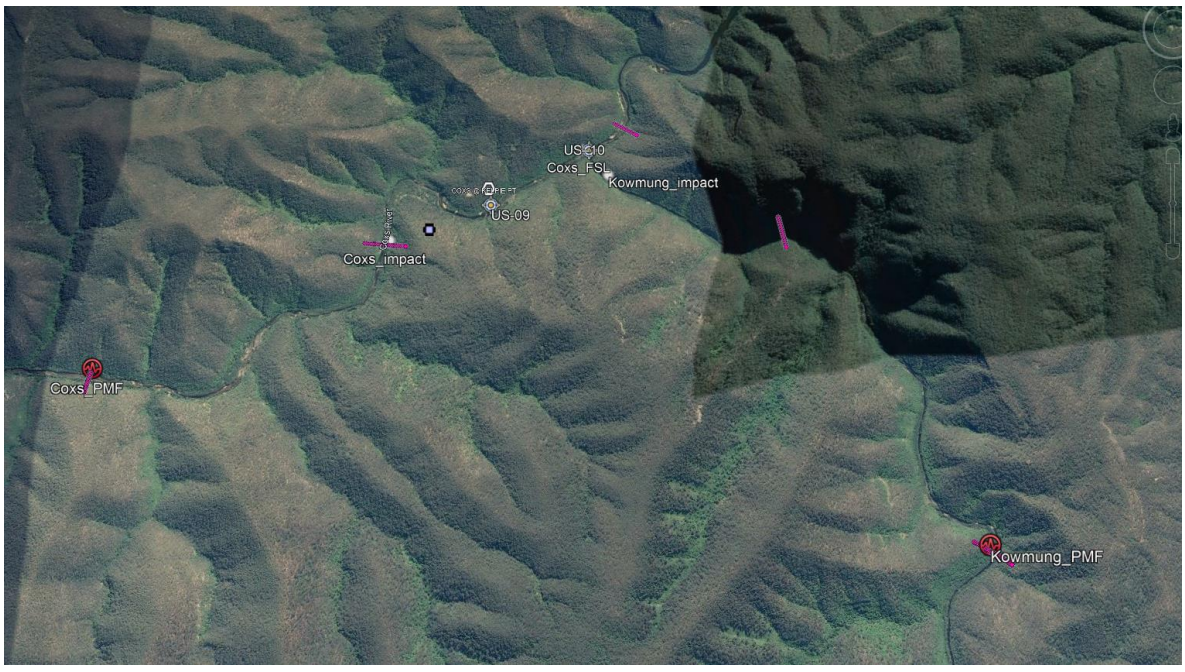


Figure 14. Kowmung River: Existing FSL, Impact extent and PMF inundation.

Coxs River

The Coxs River rises on the Great Dividing Range near Pipers Flat and Lidsdale. It originally cut a great trench through the Blue Mountains all the way to the Wollondilly River, prior to much of the valley being submerged with the building of Warragamba Dam and creation of Lake Burragorang. The Coxs River receives water from three other main rivers: the Jenolan River, Kanangra River and the Kowmung River. The stretch in between the Jenolan River and Kowmung River is in a natural and undeveloped state (Barrett 1993) and is protected within the Blue Mountains and Kanangra Boyd National Parks, part of the GBMWHA.

The Coxs River is a 7th order stream (Strahler categorisation) where it joins Lake Burragorang and the FSL of Warragamba Dam extends to the confluence of the Kowmung River approximately 900m downstream of Kelpie Point. There is approximately 6.4 kilometres of stream length mapped above the current FSL that is inside the 'new' PMF level for the Coxs River.

Depth-duration curves were examined for three cross-sections on the Coxs River:

- Location 6 (COX_US_7335) the approximate location of the Project PMF event.
- Location 7 (COX_US_9985) the approximate location of the 1% AEP event, about 2.5 kilometres downstream of COX_US_7335.
- Location 8 (COXS_28800) further downstream and located within Lake Burragorang.

Predicted changes along the Coxs River are:

- Increases in the depth and duration of inundation are half a metre (for the PMF event) or less and half a day respectively for Location 6 (COX_US_7335) for all events.
- Increases in the depth of inundation for Location 7 (COX_US_9985) are half a metre or less up to the 1% AEP event and about 3.5 metres for the PMF event.
- Increases in the duration of temporary inundation for Location 7 (COX_US_9985) are less than half a day up to the 5% AEP event; this increases slightly to 0.7 days for the 1% AEP event and the PMF event.
- At Location 8 (COXS_28800), there is a clear increase in depths and durations for inundation for all events.
- An increasing influence of the Project moving downstream with the increase in depth and duration of inundation within Lake Burragorang generally reflecting that at the dam wall.

Inundation impacts like the existing impacts of the current FSL may occur up to the full PMF level in the Coxs River - an extension of inundation impacts to approximately 6.4 kilometres of river length. It is likely that the Coxs River gauge at Kelpie Point will be flooded in a PMF event (see Figure 15).

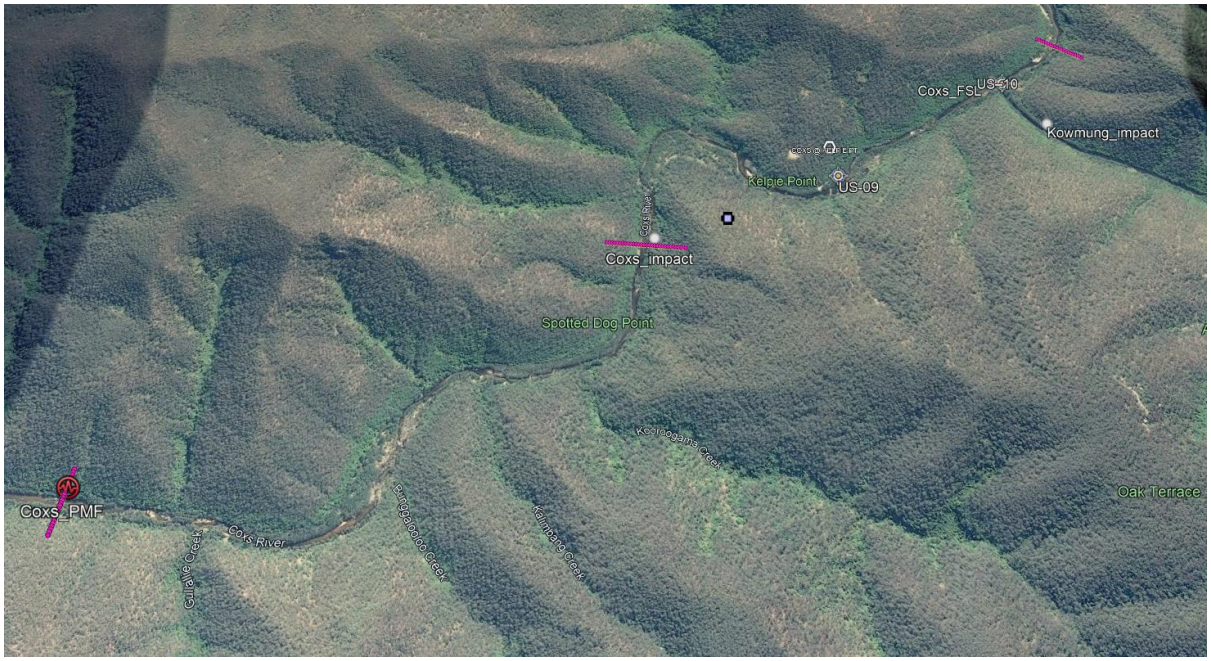


Figure 15. Coxs River: Existing FSL, Impact extent and PMF inundation.

Aquatic Ecology Assessment

For the scale of this project, the Aquatic Ecology Assessment is considered inadequate as:

- It does not identify raising of the dam wall will extend inundation impacts to about 284 km of rivers/streams[7].
- It fails to identify that current FSL areas also experience 'temporary inundation' yet demonstrate significant, likely permanent impacts (bare ground, no riparian vegetation, sand slugs in streams) in areas close to the current FSL.
- There has been no targeted sampling of aquatic species in the 'new' inundation zones.
- Only 15 small water samples (from 5 sites) were sent for eDNA[8] analysis out of the approximately 1100 plus streams that will be impacted by the 'new' inundation zone at some level/duration.
- The desktop assessment of aquatic ecology has not identified all known threatened species locations, some of which will be directly impacted by inundation.
- Water Quality impacts are only discussed in very general terms and only considered Total Nitrogen, Total Phosphorus, Chlorophyll-a and Total Suspended Solids.

The predicted inundation is also predicated on some very strong assumptions (water level at dam wall only goes to approximately 10m) without any clear idea/statement of how water will be released from Warragamba during extreme floods and therefore the veracity of predicted inundation levels and duration upstream.

As recently as the week beginning 1 November 2021 WaterNSW were drawing Warragamba dam down to try and decrease levels by 1m. WaterNSW suggested this would take about 5 days (WaterNSW 2021). Yet statements were made that the upper end of inundation would likely increase by only 0.5m for a duration of half a day. Assumptions underlying the model need much closer scrutiny and to be clearly articulated. The Aquatic Ecology Assessment

[7] Roughly the road distance between Sydney and Canberra
[8] The specific eDNA report was identified but not included in the Appendix for the Aquatic Studies.

has failed to consider the uncertainty around inundation extent and duration and its potential impacts on the upstream environment.

'New' Inundation Zone

The potential extent of the 'new' inundation zone created at PMF was discussed above. Approximately 284 kilometres[9] of upstream rivers, streams and creeks may be inundated by the proposed raising of Warragamba Dam wall[10].Very little if any attention has been paid to the aquatic ecology in these inundation areas, despite them containing known locations of threatened/endangered or protected species.

Macquarie Perch

The Macquarie perch (*Macquaria australasica*) is listed as endangered under the Fisheries Management Act 1994 (*FM Act*). The Macquarie perch is also listed as an endangered species under the Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*).

There has been a significant decline in the distribution and abundance of Macquarie perch in all river systems in NSW. The species has not been sampled at many locations in the Murray and Murrumbidgee Rivers over the last two decades, including locations where it was reasonably abundant and captured regularly in the period between the 1930's and 1980's. Macquarie perch may be extirpated in the lower Murray and Murrumbidgee rivers. The remaining populations in the upper reaches of the Murray, Murrumbidgee and Lachlan Rivers, above the major impoundments (Hume Weir, Burrinjuck Dam and Wyangala Dam respectively) are all relatively small, restricted and fragmented. The species is now uncommon in the eastern drainage, and no longer found in some rivers (Fisheries Scientific Committee listing 2008).

The Aquatic Ecology Assessment states:

> *Macquarie perch (Macquaria australasica) distribution within the study area is fragmented and they often occur in low numbers (Bruce et al., 2007; Knight, 2010). Bruce et al. (2007) and Knight (2010) recorded this species in 20 of 48 water bodies sampled, including the Colo River, lower Coxs River, Lake Burragorang and the Nepean River. This species was typically one of the most abundant species in locations where it was recorded (Bruce et al. 2007, Knight 2010). eDNA analysis undertaken to inform this assessment suggest this species also occurs in the Kedumba River within the upstream study area.*
>
> *Macquarie perch are a riverine schooling species preferring deep rocky holes with ample cover. They are most abundant above 200 metres altitude. Macquarie perch require shallow cobble or gravel riffle areas for breeding, with water depths of 20 to 90 cm and water velocity of 0.3 to 0.6 metres per second. The most viable populations of Macquarie perch remain in the upper reaches of river catchments where siltation loads are reduced and deep holes, interspersed with shallow riffles, are undisturbed. Silt creates unfavourable conditions for the eggs by filling deep holes and settling on the river bottom, blanketing rocky substrates and filling small spaces between the gravel and cobbles.*
>
> *Material impacts to downstream habitat preferred by the Macquarie perch (clear, cool, rocky fast-flowing streams with deep holes and riffles) resulting from the project*

[9] The impacted stream length (284 kilometres) is almost the same as the road distance from Sydney to Canberra.

[10] Based on PMF mapping (which could potentially become the 'new' FSL for Warragamba Dam).

are considered unlikely. However, due to the inundation of the flood mitigation zone, material impacts to upstream habitats preferred by Macquarie perch may occur.

Nine sites were assessed – two on the Nattai River, one on Little River, three on the Wollondilly River, two on the Kedumba River, and one on the Upper Coxs River (see Figure 2-1 of Appendix A[11]).

No targeted extractive surveys of fish communities within the study area were undertaken as part of this assessment. However, data was obtained from existing sources supplemented by a rapid field assessment and targeted eDNA sampling at five sites[12].

In relation to Macquarie perch. Appendix A of the Aquatic Ecology Report concludes:

Site 1 - Nattai River (downstream)[13]

It is unlikely that the Macquarie perch would occur at this site due to unsuitable habitat.

Site 3 - Nattai River (upstream)

It is possible that the Macquarie perch would occur at this site due to some suitable habitat.

Site 2 - Little River (downstream)[14]

It is unlikely that the Macquarie perch would occur at this site due to unsuitable habitat.

Site 12 - Wollondilly River (upstream)

It is possible that the Macquarie perch would occur at this site due to some suitable habitat.

Site 5 - Wollondilly River (mid-stream)

It is possible that the Macquarie perch would occur at this site due to some suitable habitat.

Site 4 - Wollondilly River (downstream)

It is very unlikely that the Macquarie perch would occur at this site due to the lack of suitable habitat[15].

Site 11 - Kedumba River (upstream)

It is possible that the Macquarie perch would be found at this site due to suitable habitat. However, the presence of the introduced carp may suggest that the potential Macquarie perch breeding sites may be disturbed.

Site 9 - Kedumba River (downstream)

It is possible that the Macquarie perch would be found at this site due to suitable habitat. However, the presence of the introduced carp may suggest that the potential Macquarie perch breeding sites may be disturbed.

Site 13 - Coxs River

[11] This Appendix was not supplied with the EIS.
[12] This Appendix was also not supplied with the EIS and it is unclear where the eDNA water samples were collected and whether they found evidence of Macquarie perch.
[13] This site appears to be within the existing FSL for Warragamba Dam.
[14] This site appears to be within the existing FSL for Warragamba Dam.
[15] This site appears to be within the existing FSL for Warragamba Dam.

> It is possible that the Macquarie perch would be found at this site due to suitable habitat. However, the presence of the introduced carp may suggest that the potential Macquarie perch breeding sites may be disturbed.

This assessment is highly subjective since no targeted surveys for Macquarie perch were undertaken. Further, the eDNA results (Appendix B) identified Macquarie perch at sites 9 and 13. Caution should be placed on the assessments of presence/absence of Macquarie perch above given the inadequate survey effort and the very few sites that were considered (see discussion below regarding previous known occurrences of Macquarie perch).

While Knight (2010) identified the Macquarie perch was often one of the most common fish sampled at those sites found supporting the species, it had a fragmented and patchy distribution in the catchment and often occurred in low numbers. Knight (2010) also observed that all sites where Macquarie perch occurred were in an undisturbed condition, suggesting that their distribution is limited by their sensitivity to in-stream habitat conditions. Despite citing Knight (2010) on numerous occasions, the aquatic ecology assessment appears to not acknowledge the central theme of Knight's (2010) paper, *The feasibility of excluding alien redfin perch from Macquarie perch habitat in the Hawkesbury-Nepean Catchment.* It is obvious that further inundation of approximately 284 kilometres of upstream rivers, streams and creeks will enhance the potential for redfin perch to invade Macquarie perch habitat.

Despite identifying nine sites for Macquarie perch 'assessment', no targeted sampling of Macquarie perch was undertaken for this Project. What was recorded was a range of habitat variables that did not relate directly to Macquarie perch presence or absence. Only five sites in four rivers/streams were surveyed for eDNA out of the approximately 1100 plus streams that will be impacted by the 'new' inundation zone at some level/duration. Two of these sites produced evidence of Macquarie perch DNA.

Macquarie perch have previously been found (Dennis Ashton, Sydney Catchment Authority catchment officer pers comm) in:

- Kowmung River, (both up and downstream of the gauging station).
- Wollondilly River, various sections above FSL up to Goodmans Ford.
- Coxs River, near gauging station.
- Nattai River, above FSL up to and including Alum River and Martins Creek.
- Little River (Warragamba catchment), above FSL up to (west of) Buxton.
- Blue gum Creek, between Little River and Thirlmere Lakes.
- Jacobs Creek, from Blue Gum Creek to near Buxton.
- Lake Burragorang, near Butchers Creek camp, stored water.

It is noted that there was no habitat assessment in the Kowmung River, Butchers Creek or many of the other streams likely impacted by the project.

The reasoning for the lack of targeted Macquarie perch sampling was:

> *This site assessment was undertaken between September and December 2017, which coincided with the spawning period for Macquarie Perch and other threatened species, and as such extractive sampling (e.g., e-fishing, netting, trapping) were not feasible to undertake.*

It has been nearly 4 years since the site assessments in which time targeted Macquarie perch sampling was clearly 'feasible' and could easily have occurred. The Aquatic Ecology Assessment is considered deficient in its sampling and assessment of Macquarie perch populations likely to be impacted by the project.

Adams Emerald Dragonfly

The Adam's Emerald Dragonfly (*Archaeophya adamsi*) is listed as an endangered species in NSW under the *FM Act* (DPI 2013) and is one of Australia's rarest dragonflies. Only a small number of adults have ever been collected, and the species is only known from a few sites in the Greater Sydney region. Some remaining areas of habitat are under threat from urban, industrial and agricultural development.

Adam's Emerald Dragonfly larvae have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms. Adam's Emerald Dragonfly larvae may live up to 7 years and undergo various moults before metamorphosing into adults. Adults are thought to live for a few months at most. Adult dragonflies generally fly away from the water to mature before returning to breed. Males fly actively at breeding sites and often guard a territory. Females probably lay their eggs into the water. This species seems to have a low natural rate of recruitment and limited dispersal abilities (DPI 2013).

The Aquatic Ecology Assessment states:

> *The Adam's emerald dragonfly (Archaeophya adamsi) is listed as endangered under the FM Act. Larvae of the Adam's emerald dragonfly generally occur in small to moderate sized creeks with gravel or sandy beds, with narrow, shaded riffle zones containing moss and abundant riparian vegetation (DPI 2013). Such habitat conditions are present in tributary streams feeding into Lake Burragorang. Construction activities for the Project would be confined to a relatively small area and would not be expected to impact on habitat utilised by this species.*

This statement fails to identify the published occurrence of Adam's Emerald Dragonfly in Reedy Creek at a location inside the potential inundation zone (Theischinger et al 2011[16]). This individual was collected by OEH in 2011 and Theischinger et al (2011) provided the details:

> *Reedy Creek at Kedumba Valley Rd, Kings Tableland, Blue Mountains National Park (33.826335˚S/150.37164˚E), ca 150 m asl: 1 F-?3 larva, 11-05-2011, G. Theischinger & M. Krogh.*

[16] Theischinger G, Jacobs, S. and Krogh, M. 2011. *Archaeophya adamsi* Fraser (Odonata, Gomphomacromiidae): not in Queensland, but safe in New South Wales? *Agrion* 15(2) 64-68 July 2011

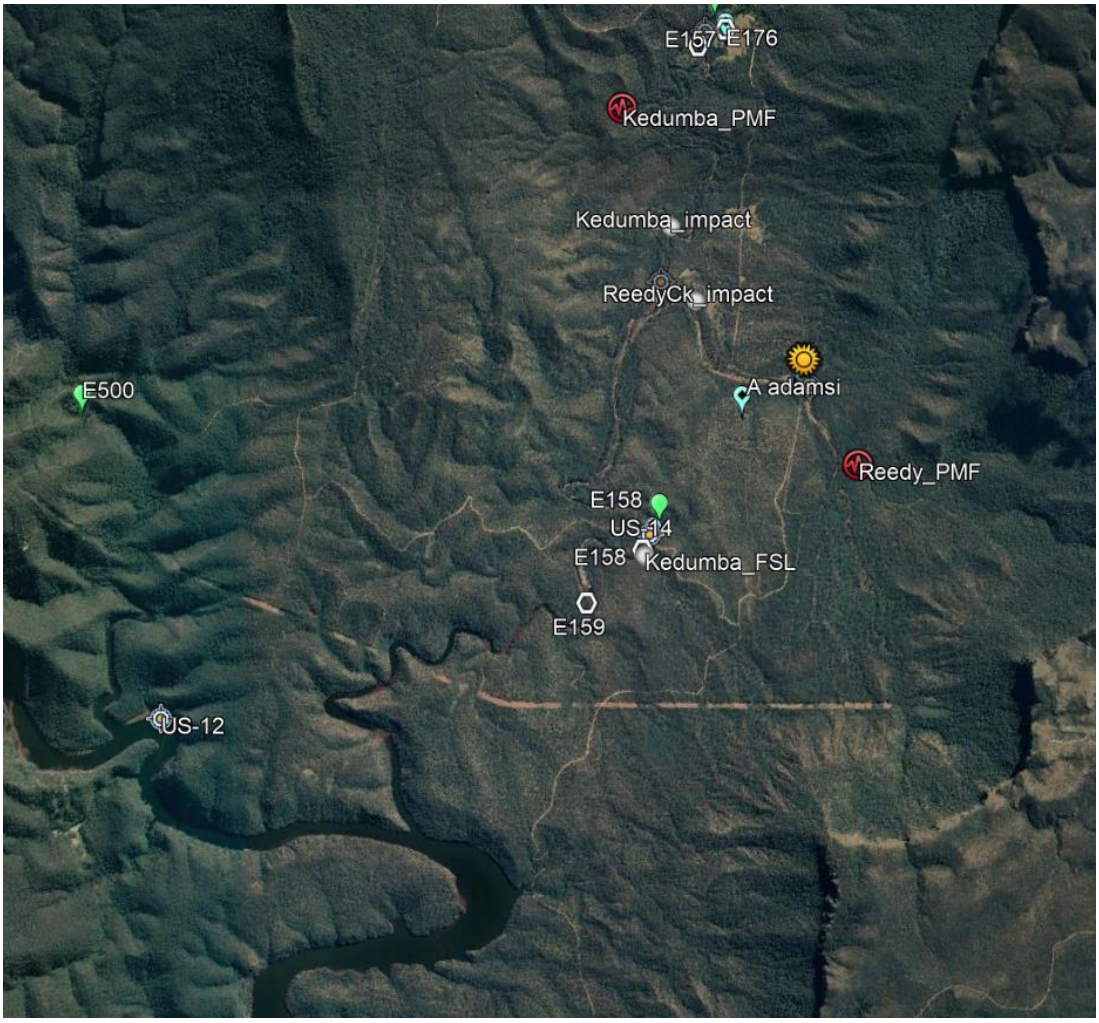


Figure 16. Location of Adam's Emerald Dragonfly (*Archaeophya adamsi*) in Reedy Creek relative to existing FSL, Impact extent and PMF inundation.

The Aquatic Ecology Assessment has failed to adequately survey the scientific literature in relation the Adam's Emerald Dragonfly. Further, no targeted sampling for the species has occurred. The Aquatic Ecology Assessment is considered deficient in its sampling and assessment of Adam's Emerald Dragonfly populations likely to be impacted by the project.

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Climate Change Risk and Sustainability

Climate Change Risk

EES advice is mainly focused on the information and assessment contained in Chapter 14 and Appendix G of the EIS.

Compliance with SEARs

7.1. The Proponent must assess the risk and vulnerability of the project to climate change in accordance with the current guidelines.

The EIS has referenced and broadly applied frameworks, standards and processes relevant for the purposes of assessing the risks and vulnerabilities of the Project to climate change. However, EES considers the engagement with community, experts and stakeholders and the scope of the risk assessment is limited. As a result, the assessment is unable to demonstrate an appropriate level of adequacy to mitigate the risks identified and potentially excludes consideration of other government objectives and outcomes. EES notes the following issues with the risk assessment:

- The residual risk of downstream flooding following completion of the Project will still be high (downgraded from extreme) and requires further articulation of proposed risk treatments, or consideration in the detailed project design.
- The scope of the risk assessment is narrow and basic, focusing on construction and the operation of the dam, however there will be other values, assets and objectives that may be impacted that are within the control of the proponent and should be analysed in more detail, such as ecological and Aboriginal cultural heritage values. EES is concerned the EIS does not demonstrate a meaningful analysis of the risks identified and the associated adaptation options, or effective planning and prioritising of adaptation options. This is a significant oversight and means that the adequacy of the adaptation strategies identified cannot be assessed.
- Loss of biodiversity has been identified as a risk and assessed with a moderate consequence, however risks to Aboriginal cultural assets does not appear to have been identified. While ecological risks have been identified, the analysis of these and the adaptation/risk mitigation responses indicate that these risks have not been analysed in any meaningful way. It is unclear how the risks responses/adaptations will effectively mitigate these risks, despite the risk being downgraded to medium with the risk treatments. EES is also concerned with the lack of proposed risk treatment options to address fire risks, and the high number of risks that have a residual risk rating of medium or high.
- It is unclear if the risk identification and assessment processes only involved representatives from WaterNSW and Infrastructure NSW. More detail about the engagement process is needed to determine the adequacy of the risk assessment process as limited engagement may mean there are missed risks and opportunities to meet broader government objectives and outcomes and community expectations. Given the significance of the Project, EES would expect a wide range of stakeholders and experts to be included at all key stages of the process with evidence of this engagement supplied in the EIS.
- Near future (2030) has been considered for construction phases, and far future (2070) has been considered for operation phases. Some NARCliM data has been referenced, and the proponent has referenced other reputable sources as part of the assessment.

7.2. The Proponent must quantify specific climate change risks with reference to the NSW Government's climate projections at 10km resolution (or lesser resolution if 10km projections are not available) and incorporate specific adaptation actions in the design.

Flood considerations

Given the significant nature of the Project, the risks associated with potential maladaptation and the changing pace of climate projections and modelling, EES recommends that the most up to date advice and data on climate change is used for every stage of the Project. This should include updating projection information to consider insights from Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) as useable and relevant data is made available.

EES notes the proponent has referred to and used NARCliM (1.0) and Climate Change in Australia (CSIRO) data for projections not suitable for assessment with NARCliM data to inform the assessment of risks (Appendix G, section 3, pages 23-27).

EES also notes the recently published report on climate change and flooding in the Hawkesbury-Nepean which highlights the uncertainty and limitations of climate projections with determining changes to rainfall and precipitation (*Climate Change and Flooding Effects on the Hawkesbury-Nepean, Final Report, Infrastructure NSW, September 2021*). The EIS has considered increased precipitation due to climate change in line with the ARR approach and factored this into the design of the Project.

The report notes there has been a range of data sources and methods applied to assess the impacts of climate change on flooding relevant to the Project which has produced a range of rainfall increases drawing from all data and approaches including NARCliM. The EIS has applied the report and adopted a 9.5% increase by 2060 (considered the 'reasonable midway estimate') to model the impacts of climate change. As a result the EIS has proposed a design intervention which will involve raising the abutments by a further three metres (to a total of 17 metres above the current height) to allow for potential further raising of the spillway to this height at a future time if needed. This is to account for the potential increases in rainfall under climate change and to 'future proof' the asset if climate change results in increased rainfall.

This main design intervention demonstrates that the Project has incorporated a design measure that considers potential increases in flood producing rainfall events due to climate change; and that this is not based on the NARCliM projections due to the uncertainty and limitations of applying NARCliM precipitation projections in flood modelling.

Other considerations

It is unclear how other potential climate change risks have been factored into the Project design and operation, particularly fire, elevated carbon emissions, and the mitigation of risks such as damage and the loss of Aboriginal cultural assets. Technical assessment of these and other climate change risks and any proposed treatment/adaptation measures should be included as part of this process to inform the Project design.

Sustainability

The following advice is focusing on the information and assessment contain in Chapter 23 of the EIS.

Priority 4 of the NSW Net Zero Plan Stage 1: 2020-2030 is for NSW government to lead by example. As a major infrastructure project, the Warragamba Dam Raising Project has the scale and opportunity to go beyond the minimum requirements set by NSW Government Resource Efficiency Policy (GREP) and be an exemplar for other major infrastructure projects to minimise emissions towards net zero for both operations and construction. EES notes, for example, an initiative in Table 23-5 proposes that construction related Greenhouse Gas (GHG) emissions will be reduced by a minimum 5% from the Project baseline GHG footprint. EES does not consider a 5% reduction accords with science-based targets or the ambition of the NSW Net Zero Plan.

EES recommends the following actions to improve the sustainability of the Project:

- The Project should target a “Leading” or “Excellent” infrastructure sustainability (IS) rating at minimum. A project of this magnitude and with current NSW Government policy context, applying a minimum GREP or targeting a ‘Commended’ IS rating is not considered sufficient.
- The Project should deliver a full life-cycle assessment and consider whole-of-life carbon due to the significant impact of emissions from construction.
- Additional detail should be provided on how the embodied emissions in materials will be reduced. For example, the Project should actively require low-emissions building materials (recycled, repurposed, biomaterials and renewable materials). The Project will have significant procurement power and therefore an opportunity to influence supply chains towards providing low-emission building material solutions.
- The impacts of the emissions from energy generation and transportation could be further mitigated and should be given greater emphasis and consideration.
- Additional weighting and stronger outcomes should be sought for the IS Rating, particularly in emissions reduction, materials footprint and renewable energy. There should be far greater focus on:
    - renewable energy options both onsite and offsite (e.g. through procurement of renewable energy certificates).
    - opportunities for embodied emissions reduction particularly in structural materials of the dam but also in on-site buildings.
    - materials footprint reduction at all stages of the Project, as well as considerations for decommissioning the construction site in the future.
    - the use of electric vehicles and charging infrastructure.
- The Project should be developed to be as energy efficient as possible, maximising onsite renewable energy with the remainder powered by 100% renewables (e.g. Green Power or other renewable energy certificates).

Section/page	Text/issue	Comments
Chapter 3: Strategic Justification and Project Need		
Section 3.2.1.6, page 3–7	*Under a medium climate change projection, by 2090 the 1 in 100 chance in a year flood level is forecast to increase by around 1.1 metres at Windsor and 0.7 metres at Penrith (WMAwater 2017). For a flood like the Brisbane 2011 floods (1 in 100 chance in a year flood) the Taskforce estimated only 2,500 residential properties would be impacted compared to 7,600 properties if the Project were not to proceed. In a flood similar to the largest flood since European settlement (1867 flood – 1 in 500 chance in a year flood), 5,000 residential properties would be impacted, compared to 15,500 if the Project were not to proceed.*	This section on climate change should also refer to sea level rise. This paragraph seeks to justify the Project, citing reductions in evacuees. It would also be appropriate to note what sea level rise was applied to this scenario e.g. how would these numbers of properties and evacuees change with different sea level rise projections?
Section 3.2.2, page 3-9	*However, based upon additional climate change and hydrological modelling, to provide similar current flood mitigation benefit as the 14-metre FMZ, in 2090 the dam spillways may need to be raised to create an FMZ of 17 metres. For all raising options considered, the full supply level would not change.*	Consideration should be given to reviewing the planning horizon for the Project and the associated climate projections given the release of IPCC AR6.

Section/page	Text/issue	Comments
Chapter 4: Project Development and Alternatives		
Section 4.8.2 and Figure 4-21, page 4-53	*This proposal does not seek or provide for any increase the level of the spillways above 14 metres. It allows for the spillway crest heights to be constructed at the levels that would create an FMZ of 14 metres. This FMZ has been applied to the assessment of upstream temporary inundation impacts and the downstream flood mitigation benefits as previously discussed in this section.'* Figure 4-21: *'Dam with 14m raising as per application No. 2017/7940.'*	This chapter indicates that the assessment has applied a FMZ of depth 14m. However, Chapter 15 (page 15-63) states *The Project would involve raising the dam wall and spillways to create a dedicated FMZ, with a depth of around 12 metres above FSL.* It appears the economic assessment in Chapter 4 has applied FMZ of depth 14m, however, it is not clear whether an FMZ of depth 14m as indicated in Chapter 4 or 12m as indicated in Chapter 15 has been applied in all other assessments undertaken to support the EIS.
Chapter 15: Flooding and Hydrology		
Section 15.1.2, page 15-6	*The project study area comprises:* • *upstream: area within the Project probable maximum flood (PMF) extent* • *downstream: area within the current PMF (note that the downstream Project PMF area would be less than that for the current PMF).*	The upstream study area should be based on the extent of PMF level under the raised dam conditions. The incremental impacts should be documented by considering the impacts under baseline and raised dam conditions. The downstream study area should be based on the PMF flooding extent under baseline and raised dam conditions to assess the incremental impacts and benefits.
Section 15.3.1.4, page 15-23	*Monthly flows into and out of Warragamba Dam are summarised in Figure 15-11, which shows that unregulated river flows into Warragamba Dam are notably higher than regulated river flows released downstream of the dam.*	The regulated flows need some clarification. For example: • Additional information regarding the long-term releases from the dam into the downstream waterways and for water supply purposes. • An explanation of why the regulated flows would be highest in June when the Sydney's water demand is low during winter.

Section/page	Text/issue	Comments
Section 15.3.1.4, page 15-23	*Daily base flow releases (or riparian releases) also occur from the dam, which are typically between 20 megalitres and 30 megalitres per day.*	The flow releases are possibly not related to baseflows. Clarification should be provided about the releases for the North Richmond Water Filtration Plant, which has an average demand of 20 ML/day and peak demand of 30 ML/day.
Figure 15-1, page 15-23	The y-axis label is missing.	Should be ML.
Section 15.4.1, page 15-32	Inclusion of other flood events.	Refence should be made to the February - March 2012 and March 2021 flooding events when the dam level was high.
Section 15.4.5.3, Table 15-9 (and Section 15.7.6, Table 15-27), page 15-47 (and page 15-98)	Hazard category linkage to building constraints.	As is, the tables suggest no building constraints unless the hazard level is H5 or above. This is incorrect as it depends on the event (i.e. if the land is below the flood planning level, minimum floor levels will apply, which is a building constraint). The title 'building constraints' should be 'no additional building constraints needed to address flood hazard'.
Section 15.4.6, page 15-55	*Currently the Bureau of Meteorology can provide up to 15-hour flood level predictions for large flood events. However, the SES requires more than 15 hours to evacuate some flood islands in the Hawkesbury-Nepean Valley during large flood events.*	The flood prediction and forecasting system recently developed and evaluated for the Hawkesbury-Nepean Valley by the Bureau of Meteorology would be able to increase the forecast time to 24 hours to 36 hours. The predictive capability is expected to be increased in the future.
Table 15-10, page 15-56	Number of people requiring evacuation.	The assessment appears to be based on the evacuation of all the residential and non-residential populations in flood affected areas. This may be conservative. The actual number of people requiring evacuation is likely to be less.
Table 15-12, page 15-62	Reference to 'Brisbane River Foreshore Flood Study'.	Should this be: Brisbane Water Foreshore Flood Study?
Table 15-13, page 15-64	Title of Columns 4 and 5.	The title should be 'Increase in area due to Project'.

Section/page	Text/issue	Comments
Table 15-14, page 15-65	Title of Column 6 and additional information.	Title of column should be 'Increase in Depth (m)' as it shows only the increase in water depth above the existing scenario not the actual Project depth. It is recommended an additional column be added showing the total inundation depth (i.e. 3.6, 6.4, 10.1, 15.3 and 27.2 metres for 1 in 5, 10, 20, 100 and PMF respectively) as shown in Figure 15-30.
Tables 15-15, 15-16, 15-17 and 15-18, pages 15-67, 15-70, 15-73 and 15-76	Depth and duration information.	The tables only present the depth and duration impacts of the Project as changes from the existing and not as totals. It is recommended 'P= Project' be redefined as 'P = increase in Project impact'. Alternatively, the total impacts of the Project should be included.
Section 15.7.2.1 and table 15-20, pages 15-82-3	Additional information required.	Additional information (incorporating information like Tables 15-14 and 15-15, the depth-duration curves in Figures 15-31 to 15-34 and the flood frequency distributions in Figures 15-35) should be provided showing likely changes on the following services under the raised dam conditions: • Bridge closures along the Hawkesbury River. • Duration of traffic interruption at road bridges for prolonged release of the floodwater from the FMZ. • Bank full conditions of the river (baseline conditions and the raised dam conditions) and the potential risk for erosion. The main reach of the river would carry the major loading in transferring the flood flow from the FMZ and would be subject to stress and risk. • Risk for water supply interruption within the North Richmond Delivery Zone. A high level of turbidity would exist during the controlled release of floodwater from the FMZ and the water filtration plant may not be functional. As a result, residents and businesses may not have access to potable water which could incur significant risks. If these impacts are significant, they should be included in the economic assessment (i.e. SEIA – Appendix M). The benefits

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		of the reduction of flood damage to people and properties are likely to be compensated to some extent by the disbenefits of the interruption of services in some areas, whereas services in other areas may be improved.
Section 15.6.5, page 15-80	*For upstream locations, approximating the limit of the Project PMF event, the analysis shows:*	Locations at the upper end of the PMF extent should be identified (i.e. Location 2 - Wollondilly River, Location 6 - Cox River, Location 9 - Nattai River and Location 15 - Kowmung River).
Section 15.6.5, page 15-80	*For locations approximating the limit of the 1 in 100 chance in a year event, the analysis shows:*	Locations at the upper end of the 1 in 100 chance in a year event should be identified (i.e. Location 3 - Wollondilly River, Location 7 - Cox River, Location 10 - Nattai River and Location 14 - Kowmung River).
Section 15.6.5, page 15-80	*There would be an overall decrease in flood velocities, both in the tributaries and within Lake Burragorang.*	This does not seem to be correct. The velocities along the tributaries and within the reservoir are expected to be decreased due to containment of flood storage within the FMZ. There would not be any changes in velocities under baseline and raised dam conditions for floodwater level up to the FSL (full supply level) of the dam. Would the reduction of velocities in raised dam conditions when the FMZ is in use increase the potential for sedimentation within the tributaries and reservoir, mainly the upstream side of the dam wall than under the existing conditions and if so, would this have water supply implications?
Section 15.7.1, page 15-81	*However, there are potential negative impacts that need to be considered including:* • *the impacts of water discharge from the FMZ after a rainfall event. This may result in environmental, social, and economic impacts as water levels and velocities downstream of the dam would be higher for a longer period than the existing situation*	There are significant benefits from the Project for the downstream communities which extend to Wiseman Ferry, in relation to the reduction in the frequency of flooding (section 15.7.2.2), substantial reduction in flood depth (Table 15-20) and reduction in flood extents (section 15.7.2.3). However, additional information should be provided on the impacts of longer periods of inundation on properties in low-lying areas (more likely properties impacted by the 1 in 5-year chance in a year flood). It is noted from Table 15-21, for example, the

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	• *environmental impacts from the reduction in flooding extents and peak water velocities, especially for sensitive features such as wetlands.*	duration of flooding increases by around 100 hours to 200 hours. Acknowledging the overall reduction in Annual Average Damage (AAD) due to the Project, adequate data on the properties impacted by longer duration flooding including changes in AAD, loss of access, isolation period, income loss and extended recovery period should be provided. A negative environmental impact that also needs to be considered is the potential reduction in fertility of the Hawkesbury-Nepean floodplains downstream of the dam due to changes in the deposition of sediments and nutrients from floodplain inundation. Consideration should be given to whether these impacts are significant.
Table 15-20, page 15-83	Consideration of sea level rise due to climate change.	The impacts of sea level rise if adopting the parameters in the recent IPCC report may reduce the Project benefit shown in Table 15-20 from M1 Motorway to Lower Portland the limit of tide effect. However, these impacts are unlikely to apply to the areas of concern for this Project i.e. Penrith and Windsor for the target scale of events this Project aims to address.
Table 15-21, pages 15-85 to 88	Table title.	The title should be 'summary change in flood levels and duration for selected flood events'.
Section 15.7.2.3, Figures 15-38 to 15-41 and tables 15-22 to 15-25, pages 15-89 to 15-92	Information included.	Longitudinal profiles of flood extents in terms of reduction of peak water levels under baseline conditions and the raised dam conditions would be useful to visualise the extent of river reach, where improvement would be possible. Consideration should also be given to including similar figures and tables on changes to service interruption, under the current and Project scenarios. This would provide additional information on the Project benefits and disbenefits.

Section/page	Text/issue	Comments
Section 15.7.9.1, page 15-106	Changes to the morphology of the downstream river, bank erosion sedimentation and services.	Consideration should be given to the potential for changes to the morphology of the downstream river system altering bank erosion (as occurred in the March 21 flood) due to prolonged discharge of the stored floodwater within the FMZ relative to higher flows over a shorter timespan without the Project. If differences are significant, consideration should be given to incorporating these in the economic assessment (i.e. in terms of any changes to the cost of restoration of riverbanks and managing change in morphological conditions). Consideration should also be given to whether the project significantly alters the potential for sedimentation within the reservoir and any potential loss of water supply storage. If these issues are significant the impacts should be considered based on the life cycle performance of the water supply infrastructure and the related impacts in the downstream waterways. The significance of the benefits/disbenefits of the project on services (water supply and transport), should be also considered. If significant, consideration should be given to incorporating these in the economic assessment (Appendix M (SEIA).
Section 15.7.10, page 15-106	*Potential negative impacts include:* • *discharge of the FMZ would result in longer periods of low level flooding and flood hazard, disruption to transport and businesses as well as an increase in the risk of bank erosion: see Chapter 21 (Socio-economic, land use and property), Chapter 24 (Transport and traffic) and Chapter 22 (Soils)* • *existing wetland and flood plain habitats that are dependent on a specific long-term flooding regime may be impacted due to the reduction in frequency of flooding: see Chapter 9 (Downstream biodiversity assessment report)*	Where there are likely to be significant changes to riverbank degradation, riverbank erosion and morphological changes due to prolonged bank full discharge of floodwater from the FMZ due to the project, relative to the existing shorter duration higher flows, their inclusion in the summary of downstream impacts should be considered. The Hawkesbury-Nepean river will be running full for a prolonged period following a flood event. The water level will then drop to the normal level (or baseflow level). Consideration should be given to whether this would create an increased risk for slip failure of saturated banks along with the potential changes of riverbank conditions and cross-sectional patterns of the river. A finer scale geotechnical

Section/page	Text/issue	Comments
	• *agricultural land uses that currently benefit from the nutrients and sediments deposited on the floodplain may be impacted by reduced periods of inundation; see Chapter 21 (Socio-economic, land use and property)'*	analysis would be required for the long-term assessment of these changes. The potential changes associated with the sedimentation patterns in the upstream reach of the dam and the erosion and morphological changes of the downstream reach of the dam do not appear to have been considered in sufficient detail. The erosion rates and potential morphological changes in the downstream reach may be limited by emptying the FMZ at a rate lower than 100 GL/day. This may be possible considering the joint probability of two consecutive flood producing rainfall events in the dam's catchment. While acknowledging the potential impacts of reduced inundation on agricultural land uses with regards to the deposition of nutrients and sediments, an assessment of impacts cannot be found in Chapter 21.
Section 15.8.4, page 15-109	*The timing and rate of discharge during flood events would be determined on a case-by-case basis.*	Clarification is required regarding the timing and rate of the releases of the piggyback discharges used in the assessment.
Section 15.8.5.1, page 15-109	*Flood mitigation zone releases are made after the flood at the downstream location has peaked; with a slight delay and a temporary fall in river levels whilst downstream peak is confirmed. The FMZ is then discharged at a rate that does not cause the river to exceed the previous flood level peak and is gradually reduced in stages…* *The maximum discharge rate through the new outlet conduits would be 230 gigalitres per day…* *In the event of a second forecast significant flood inflow, it would be possible to empty the whole of the FMZ with piggybacking within 3-4 days. This would allow FMZ capacity to mitigate further downstream flooding.*	The assessment indicates that, the FMZ releases are made after the flood at the downstream location has peaked, however, it is not clear whether the assessment has considered events with multiple peaks. If the maximum discharge rate of 230 GL/day is released and it coincides with a second peak of the event, the impact on the downstream areas, particularly Richmond-Windsor floodplain, would be significant. The report indicates that, in the event of a second forecast significant flood inflow, it would be possible to empty the whole of the FMZ with piggybacking within 3-4 days. The assessment should undertake a sensitivity testing for this scenario to estimate the impacts on the downstream community. It would be prudent to run various scenarios selected from the Monte Carlo approach to provide a better understanding of the potential impacts of the piggyback discharge. It would be useful to present the outcomes of the impacts of the piggyback

Section/page	Text/issue	Comments
		discharge in figures like that provided for the constant discharge in Section 15.8.5.2, Table 16-29 and Section 15.8.6.
Section 15.8.5.2, page 15-109	*A constant FMZ discharge rate of around 100 gigalitres per day was assessed against a range of environmental, social, and economic factors (Table 15-29).*	It is unclear if the proposed constant discharge would proceed after the Hawkesbury-Nepean recedes to its normal level or while it is receding (i.e. during the falling limp of the hydrograph). Details of the assumptions made to assess the potential impacts from a prolonged 100GL/day discharge rate (as presented in Table 15-29) should be provided.
Section 15.8.5.2, page 15-109	*However, water quality of the FMZ would be higher than typical wet weather water quality in the Hawkesbury-Nepean River. This is because at Richmond the flood water would also contain runoff from urban and agricultural areas within the downstream catchment, which would be more polluted than the runoff from the heavily vegetated Warragamba catchment.*	Water quality within Lake Burragorang may also be impacted when intercepting floodwater following bushfires due to sediments and debris which may accumulate in the FMZ and reservoir. Additional water treatment and/or supply restrictions may therefore be required following major wet weather events. The long-term risks to water supply because of climate change should also be considered by an assessment of the projected multi-hazards (e.g. drought, extreme hot days, heatwaves, bushfires, air quality, flooding and water quality).
Table 15-29, page 15-111	*River water quality - It is expected that the higher FMZ releases would generally have a positive effect on water quality due to their "flushing" of the river and destratification of the deeper pools, particularly in the upper reaches…* *Riverbank erosion and protection - Medium flows are likely to result in some erosion. Older structures may degrade or collapse.*	It is also possible that river water quality may not improve by releasing the water from the FMZ at a rate of 100GL/day and further details should be provided comparing existing with raised dam conditions. It is recommended further details be provided on the impacts from the controlled release of 100 GL/day on riverbank erosion.
Table 15-30, page 15-117	Table 15-30 provides the change in probability of a 1 in 100 chance in a year event by 2090.	Table 15-30 provides the change in probability of a 1 in 100 chance in a year event by 2090. The text indicates this information for the Project without an additional allowance 3m for climate change. It would be prudent to add another row to show the probability with additional 3m in the abutment height.

Section/page	Text/issue	Comments
Table 15-31, page 15-117	Impact from operation of FMZ (measure HF2): *A detailed operational protocol for the operation of the FMZ will be developed in consultation with relevant downstream and upstream stakeholders.*	To prepare a detailed protocol, a full assessment of the impacts of FMZ discharges, including the piggy-back discharges, on downstream areas is required.
Figure 15-49, page 15-119	Information in figure (table).	The risk matrix table may need to be elaborated by capturing a range of risk factors (such as water quality issues due to flooding after bushfire) currently not considered in the operational stage of the raised dam.
Section 15.14.2, pages 15-131 onwards	Additional maps.	Additional maps should be included showing changes in bank full discharge in terms of duration under existing conditions and with the project to provide an indication of the risks of prolonged bank full discharges. This would vary depending on the cross-sectional size of the downstream reaches, which could also be included on maps.
Chapter 21: Socio-Economic, Land use, and Property		
Section 21.7.3.3, page 21-60	Impacts from discharge of FMZ water.	The discussion on impacts is insufficient with no quantification of the impacts.

Section/page	Text/issue	Comments
Appendix H1: Flooding and Hydrology Assessment Report		
Section 1.3.3, page 8	*There will be two different emptying protocol:* *(1) Minor flood releases – releases of inflows captured from a 5% to 2.5% AEP event or at the tail end of larger floods. The rate of discharge of these releases will be identified based on potential flooding risks downstream, … the subsequent release from the dam will need to be restricted to avoid increases in these reduced downstream flooding extents. Typically, discharges would be at 1,150m^3/s (around 100GL/day) but would not occur until after the peak of the flooding downstream has passed.* *(2) Major flood releases – releases for significant flood events. As the FMZ is designed to contain a 5% to 2.5% AEP event above FSL, any event above this will cause spilling to downstream areas, albeit at a lower level. During this scenario there is an opportunity to increase the rate of discharge from the FMZ at a higher rate than for minor flood releases without increasing the extent of downstream flooding (that is, piggyback releases). This can typically occur for the first two days before the FMZ discharge rate would then be reduced to the same rate as for minor flood releases (that is, 1,150m^3/s).*	There is some inconsistency regarding the emptying protocol and the prolonged duration of flooding: • For minor flood releases it indicates the rate of the discharge will be determined subject to the risk downstream. However, it also indicates the rate of discharge would be typically 100GL/day. How has the 100GL/day discharge rate been calculated? • For major flood releases it indicates that piggyback releases will apply to events greater than 5% AEP (i.e. 1 in 20 chance in a year) to a 2.5% AEP (approximately 1 in 40 chance in a year). However, this is inconsistent with section 15.8.5.1 which states, *piggybacking at this rate would be suitable for any downstream flood greater that (sic) a 1 in 5 chance in a year flood event.* Section 15.8.5.1 also states *piggybacking of discharges would generally occur for two to three days after the peak of a flood event, after which a constant discharge rate of around 100 gigalitres per day (1,160 cubic metres per second) would be implemented',* however, Figure 4-26 of Appendix H1 (and Figure 15-36 of Chapter 15) show the drawdown release for the 1% AEP extends to around 115 hrs ~4.7 days before the discharge reduced to a constant of 100GL/day.
Section 1.3.3 and Table 1-1, page 8	*The extent and duration of inundation is important to defining potential impacts on environmental values. The approximate change to upstream lake surface area based on recent hydrosurvey data of Lake Burragorang (data provided by INSW, 19 February 2015) is summarised in Table 1-1.*	Table 1-1 is based on raised dam wall of 12m – it is assumed this is the level of the central spillway crest as described on page 5-1 and that it accords with the current proposal.
Table 3-12, page 75	Consistency with data in Table 8-15 in Appendix M.	The data in the tables for residential properties affected by events greater than 1% AEP is different.

Section/page	Text/issue	Comments
Table 3-15, page 88	Consistency with data in Table 8-18 in Appendix M.	For the same flood event, it is assumed the data for 'Number of people requiring evacuation (2018) - Total residents requiring evacuation' in the Table 3-15 of Appendix H1 should match the data for 'Existing risk (2018) - Total residents considered in evacuation planning' in Table 8-18 of Appendix M. However, this is not case for events greater than 1% AEP.
Table 3-17, page 96	*Draft South Creek Floodplain Risk Management Strategy and Plan, Dec-2019, Penrith City Council.*	Penrith City Council adopted the South Creek Floodplain Risk Management Study and Plan in February 2020 (i.e. prior to completion date of the Flooding and Hydrology Assessment report).
Table 4-7, page 123	Inconsistency of project scenario discharge rate.	In Table 4-7 the project scenario discharge rate is 1,160m^3/s while on page 8 it is 1,150m^3/s. Throughout the EIS (apart from Appendix H1) the constant release of 1,157 m^3/s is rounded up to 1,160m^3/s.
Appendix M: Socio-economic, Land Use, and Property Assessment Report		
Executive Summary - Demography and community values, page ix	*According to the 2016 ABS Census, there were an estimated 260,511 residents in the identified 74 PMF-affected suburbs in the downstream communities' study area.*	It is not clear whether this represents the total of all residents in the 74 PMF-affected suburbs or only the residents impacted by PMF flooding in those suburbs. It is noted from Table 8-18 that the 'total people considered in evacuation planning (2041)' will be 259,000 (resident and employees) in a PMF event.
Executive Summary - Summary table of residual significance ratings in the SEIA study areas, pages xvii to xix	Adequacy of data in table.	This table should also include: the disbenefits from the FMZ in upstream and downstream areas, what would be its impacts (environmental and economic contexts and the associated risks), what risk mitigation measures are available and the residual risks. Details on the flood affected properties (including those flood affected properties along with evacuation difficulties) should be included in this table and in the executive summary of Appendix M.

Section/page	Text/issue	Comments
Section 8.4.1.1, pages 199 to 204	Population affected by flooding.	The combined populations of suburbs potentially threatened by flooding does not provide an accurate indication of the benefits of the project, as not all populations in these suburbs are affected by flooding. The population requiring evacuation is the population that should be referenced. Using the combined populations is also inconsistent with Tables 8-10, 8-11 ,8-12 and 8-14 which detail the number of properties affected by flooding.
Section 8.4.1.1 - Flood related land use controls, page 207	*Under the current land use planning system, the 1 in 100 chance in a year event is the default planning level for local councils to set flood planning controls for residential development, unless they apply for and receive approval to impose more stringent flood controls under 'exceptional circumstances.*	A new planning circular (PS21-006 - Considering flooding in land use planning) has been in effect since 14 July 2021. This replaced the need for 'exceptional circumstances'.
Section 8.4.1.1 - Flood related land use controls, page 207	*The Hawkesbury-Nepean Valley Flood Risk Management Strategy recommended that a suitable planning instrument such as State Environmental Planning Policy (SEPP) be prepared …*	The discussion should focus on outcome 3 of the Strategy and the regional land use planning framework. A SEPP is not specified as the planning mechanism to achieve this outcome.
Section 8.4.1.1 - Flood related land use controls, page 207	*The SEPP would directly amend the relevant local council Local Environmental Plans to include maps showing the flood planning area that is to be maintained. This may be supported by a direction under s9.1 of the Environmental Planning and Assessment Act 1979 to prohibit councils subsequently amending the flood planning area.*	Flood studies are live documents that are continuously updated due to changes in topography, new information, new industry practice or a major event. Subsequently, the flood planning area may also change with modified and up-to-date modelling undertaken by local councils. The application of a SEPP would need to be limited to the area impacted by the Hawkesbury Nepean backwater as there may be local flood issues that need to be managed by local councils and will influence their flood planning areas.

Section/page	Text/issue	Comments
Section 8.4.1.1 - Flood related land use controls, page 207	*… the effectiveness of the flood planning system will be reliant upon collaboration and coordination between State driven policy and local government implementation.*	Considering flooding in land use planning is part of the established flood risk management process in NSW. Given local councils are primarily responsible for flood risk management in their local government areas, the Hawkesbury-Nepean regional land use planning framework, undertaken as part of outcome 3 of the Hawkesbury-Nepean Valley Flood Strategy aims to facilitate the effective consideration of Hawkesbury-Nepean regional flooding in local government land use planning decisions: it is not, however, a 'flood planning system' - this is incorrect terminology.
Table 8-26, page 228	*No. 6 - Operation – Decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge.*	Alteration of flow regime would occur due to the prolonged discharge along the river (bank full conditions) following floods. The consequences of this prolonged discharge as being 'moderate' is questioned given the potential for banks to degrade, bank instability, and long-term morphological changes. There may be environmental damage and associated costs (non-market value), which should be considered in economic analysis. Water quality in Lake Burragorang may be degraded at a higher propensity during flooding events associated with bushfires and this may create water supply risks, which should be addressed.

Section/page	Text/issue	Comments
Appendix G: Climate Change Risk		
Section 5.1.1.3, page 35	*Sea-level rise impacts for 2100 are projected to occur as far inland as Sackville and the lower Colo River (Coastal Risk Australia 2018). While these impacts would be important to consider when modelling the potential increased flood risk to the Hawkesbury-Nepean valley under climate change scenarios, the risk to the construction and operation of the Project was considered minor to negligible. The interaction of future sea-level rise and rainfall and the effect this may have on the flood risk to the Hawkesbury-Nepean Valley was addressed by WMAwater (2018), and the results are discussed in Chapter 15 (Flooding and hydrology) of the EIS.*	The SEARs require *'the Proponent (to) assess and model the impacts on flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (accounting for sea level rise and storm intensity due to climate change.'* However, it is noted (from Table 14-3 in Chapter 14) that sea level rise was excluded from the risk assessment and *'justification for why (sea level rise it was) excluded is provided in Appendix G'.* This justification appears to be limited to a statement that '*the risk (from sea level rise) to the construction and operation of the Project was considered minor to negligible.'* Given the downstream limit of the downstream study area is Wisemans Ferry, which is well within the tidal influence of the estuary, particularly with very high sea level rise projections relevant to reasonable planning horizons, further information should be provided to demonstrate how flooding risks and impacts have been assessed and modelled.
Section 1.3, page 7	*The Project timeframes assessed were:* • *construction - 2021-2025* • *operation (design-life) - 2025-2125.* *In relation to the climate projections referenced in this document, this corresponds to:* • *construction NSW and ACT Regional Climate Modelling (NARCliM) near-future projections, which represent 2020 to 2039, and are referred to in this assessment as 2030 projections* • *operation (design-life) - NARCliM far-future projections, 2060 to 2079, and are referred to in this assessment as 2070 projections.*	While the design life of the project (operational life) has been specified to be up to 2125, Climate Change impacts to 2070 only have been assumed to be the 'far-future projection' planning horizon based on IPCC AR5 and NSW and ACT Regional Climate Modelling (NARClim). It should be noted that IPCC AR6 has now superseded IPCC AR5 and projections beyond 2125 are now available. It should also be noted that the NARClim Climate Change Impacts considers only increased rainfall intensity, not sea level rise. While IPCC AR6 was not available when Appendix G was prepared, it should now be considered to better understand the full range of climate change implications for the full design life of the project.

Protected Lands

Introduction

This advice is focused on how the EIS addresses issues relevant to the protected lands managed by the National Parks and Wildlife Service (NPWS) under the *National Parks and Wildlife Act 1974*, the *Wilderness Act 1987,* the *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. These issues include:

- National park values
- World Heritage values
- Aboriginal cultural heritage values in parks
- Non-Aboriginal heritage (historic heritage) values in parks
- Biodiversity values in parks
- Wilderness and wild rivers
- Offsets.

National park values

The Project impacts on all national park values from temporary inundation of up to 1,303 ha of reserves, including up to 304 ha of the Greater Blue Mountains World Heritage Area (GBMWHA). Those values include biodiversity, Aboriginal cultural heritage, historic heritage, World Heritage, wilderness and wild rivers, roads and fire trails, and other facilities.

The EIS proposes that offsets for impacts on protected area values be included in the proposed Warragamba Offset Program, and states that the Environmental Management Plan (EMP) required under Part 5A of the *Water NSW Act 2014* would support and complement the Warragamba Offset Program (Chapter 13: Biodiversity Offset Strategy).

Comments

- The EIS has not fully responded to recommendations provided following the review of consistency of the draft EIS with the Secretary's Environmental Assessment Requirements (SEARs).
- The impacts on national park values of up to 1,303 ha, including 304 ha of World Heritage Area will need to be offset.
- The EMP is not the mechanism – either in part or wholly – for determining offsets for the Project impacts on protected area values. The Warragamba Offset Program must address offsets for impacts on protected area values (see 'Offsets' comments below).

Recommendations

- The proposed Warragamba Offset Program for the upstream study area recognise the impacts on those protected area values and detail how those impacts will be offset.
- WaterNSW consult NPWS in preparing the Warragamba Offset Program in relation to offsets for impacts on protected area values; and that the determination for the Project requires that the Deputy Secretary, NPWS approve the Warragamba Offset Program.

Wilderness areas affected by the Project

The EIS addresses wilderness areas that fall within the World Heritage area, which includes a section of the Nattai Wilderness near the Wollondilly and Nattai Rivers and a small section of the Kanangra-Boyd Wilderness on Butchers, Laceys and Green Wattle Creeks. The EIS states that 36 ha of declared wilderness will be impacted (Appendix J, page 72).

Comments

- A section of the Kanangra- Boyd Wilderness between the Cox's River and Tonalli Cove, along the Lake Burragorang Foreshore and associated creeks falls outside of the World Heritage area but will be impacted by the proposal.
- The EIS only addresses matters of consent under section 15 of the *Wilderness Act 1987* and provides an assessment of impacts to wilderness within the World Heritage area (in Appendix J, section 6.1.7).

Recommendations

- The EIS address the impacts of inundation on all declared wilderness areas (i.e. not only the Nattai Wilderness within the World Heritage area).
- The EIS addresses consistency with the management principles under section 9 of the *Wilderness Act 1987*.

Impacts on Katoomba-Mittagong walk

The EIS states that temporary inundation will not impact on recreational access due to the area of inundation being 'Schedule 1 lands' where access is restricted.

Comments

- The Katoomba to Mittagong Walk has two 'walking corridors' through the Schedule 1 Catchment, where walking is permitted. The proposed inundation will impact on access to those corridors at the Wollondilly River and Cox's River crossings.
- Information is available publicly on WaterNSW's website on the walking corridors at: https://www.waternsw.com.au/__data/assets/pdf_file/0011/55946/Map1-FINAL-what-you-can-and-cant-do-in-special-areas-2016-2.pdf

Recommendation

The EIS address impacts of inundation on recreational access to the Katoomba to Mittagong Walk.

Assessment of risk from erosion and sedimentation

EES considers the impact of erosion and sedimentation is likely to be higher than 'low or medium', particularly if there are several inundation events occurring with an interval that is too short for vegetation to recover. This cumulative impact of multiple inundation events is not considered by the EIS.

Recommendation

The EIS address the likely impacts of erosion and sedimentation and consider the cumulative impact of multiple inundation events.

Assessment of weed and pest issues

The EIS does not consider weed and pest issues resulting from increased inundation. It is considered likely that the death of vegetation, increased erosion and siltation will provide habitat for weeds and pest species such as feral pigs and deer.

Recommendations

- The EIS address weed and pest issues resulting from increased inundation.
- The EMP consider increased pest and weed control programs after any inundation events.

Bushfire impacts

While the post-fire mapping indicates that most of the inundation area is unburnt or low intensity, this increases the importance of this area as a post-fire refuge. This is likely to be the case in future fires.

The cumulative impact of fires followed by a flood event (as occurred in 2020) needs to be examined, particularly around post fire refuge for animals and the impact on obligate-seeding plant species.

While the EIS notes that as biodiversity survey work was undertaken prior to the fire, it would be valuable to assess any changes to species distribution within the study area. That is particularly for species which may have had their habitat severely reduced by fire and are using the inundation area as a refuge.

Recommendations

- Post-fire surveys be undertaken to assess any changes to species distribution within the study area.
- An assessment of the cumulative impact of fires followed by a flood event (as occurred in 2020) be undertaken particularly around post fire refuge for animals and the impact on obligate-seeding plant species.
- The role of the inundation area as a post-fire refuge after the 2019/20 bushfires be considered.

Road and trail access

Chapter 20 of the EIS states that there is unlikely to be material damage to roads and fire trails. However, section 6.1.20 of Appendix J: World Heritage Assessment Report states: '*The Project may result in the increased extent and duration of flooding of fire trails that are used to access areas in the GBMWHA, however this is likely to be minimal in relation to the upstream impact area within the GBMWHA.'*

Comment

The inundation area will impact an estimated 26 bridges and culverts, particularly along the W4 trail in Nattai National Park and Nattai State Conservation Area. The EIS does not consider the impact on these assets. EES considers there is likely to be damage either by erosion or sedimentation to road, trail, bridge and culvert assets on NPWS estate as a result of inundation.

Recommendations

- The likely impacts to roads, trails, bridges and culverts resulting from inundation be more fully address.

- The EMP address the assessment and repair of assets that are inundated including:
    - An engineering assessment of bridges and culverts prior to any inundation event to identify any upgrades required to ensure that they can withstand inundation.
    - Contingency planning for access by NPWS and WaterNSW (as land management agencies) and for emergency agencies such as the Rural Fire Service if trail repairs take time to complete.

World Heritage values

The EIS does not sufficiently consider the Project impacts on World Heritage values. The EIS makes incorrect assumptions about how to determine the World Heritage values.

Comments

- The EIS has not fully responded to recommendations provided following the review of consistency of the draft EIS with the SEARs.
- World Heritage values should be assessed against the Statement of Outstanding Universal Value, the listing criteria and integrity and management arrangements.
- Integrity and management arrangements are set out in the Statement of Outstanding Universal Value.[1] The integrity of the World Heritage area includes Aboriginal cultural connection, wilderness, geology, geomorphology and water systems, and the fact the World Heritage area is surrounded by other public lands as part of the boundary integrity for the property.
- Boundary integrity is central to the integrity of the property. An assessment of the impacts on World Heritage values should include an assessment of impacts on the integrity of the property, including an assessment of impacts on buffer areas.
- Wilderness is part of the integrity of the property. An assessment of the impacts on the integrity of the property should include an assessment of impacts on wilderness areas, both within and adjacent to the world heritage property. The EIS has not assessed the impact of inundation on wilderness areas outside the current boundary of the World Heritage area.

Recommendations

- Comments on World Heritage provided in the consistency review be addressed.
- The Project impacts on World Heritage values be assessed against:
    - the listing criteria for the WH area
    - the Statement of Outstanding Universal Value, and
    - the integrity and management arrangements (which are detailed in the Statement of Outstanding Universal Values).

Impacts on World Heritage values are not proportionate to inundation area

The EIS states that the area impacted by the Project (i.e. 304 ha) is 0.03% of the World Heritage area, and therefore the Project impacts will not be significant.

The diminution of values on any area of land with World Heritage values is significant. The World Heritage values include the diversity of species (e.g. of *Eucalyptus* species), the high number of threatened species or species endemic to the area (e.g. Wollemi pine),

[1] https://whc.unesco.org/en/list/917/

threatened ecological communities, and habitats with a restricted range (e.g. for the Regent Honeyeater) – all of which contribute to the area's World Heritage status. These factors mean, by definition, they are not widespread or abundant across the World Heritage property.

Comments

- The significance of impacts should be assessed on impacts on the World Heritage values in the directly impacted area, not based on the proportion of the World Heritage area impacted. The habitats and values in the World Heritage area are not evenly distributed.
- The impacts on listed World Heritage values (species, habitats and communities within the impact area) should be assessed at a local, not regional or property-wide, scale. The impacts on World Heritage values are not proportionate to the percentage of the World Heritage area directly impacted.

Recommendation

The impacts on the World Heritage values in the inundated area be assessed not on a percentage of the World Heritage area impacted by inundation.

Assessment of all biodiversity values that are part of the outstanding universal value

There is insufficient analysis of World Heritage values related to biodiversity in section 6.1 of Appendix J which focuses on species listed as threatened or endangered and presents brief analyses of impacts to *Eucalyptus* species, scleromorphic species, ant-adapted plants and vertebrates (specifically platypus, short-beaked echidna, Macquarie perch/Blue Mountains perch and Regent Honeyeater); and very brief analyses of impacts to reptiles and amphibians.

Comment

The ecosystems of the WH area are globally significant because they contain outstanding examples of the evolution and adaptation of the *Eucalyptus* genus and eucalypt-dominated vegetation. The evolutionary processes include the full range of interaction between eucalypts, understorey, fauna, environment and fire.

Recommendation

An assessment of the impact of temporary inundation on those aspects of the World Heritage value be undertaken. At a minimum this should include all ecological communities and species within the impact area as significantly impacted for the purposes of offsetting. This is particularly important given the proposed mitigation for loss of or damage to those values is offsetting only the area currently listed as World Heritage.

Assessment of impacts on threatened species

The EIS's conclusions of minimal impact on threatened species is not supported by the data or evidence in the EIS or insufficient information is provided. For example:

- *Eucalyptus Benthamii* (Camden white gum) - there is no information available on the impact of repeated flooding on mature trees of as only juveniles were included in the study referred to in the EIS. The CSIRO study has limited application as it was not commissioned for the Project and did not address the specific questions raised by the Project.
- Regent Honeyeater (*Anthochaera phrygia*) – the EIS bases its conclusion of minimal impact to this species on the extensive area of available habitat nearby. This species has very specific habitat requirements and suitable habitat is limited. The EIS does

not assess the suitability of adjoining woodland habitat for Regent Honeyeater. This is a critically endangered species, and one of the reasons for its rarity is that it is forced out of woodland habitat through competition with aggressive species such as noisy miners which are associated with disturbed habitat.[2]

Appendix F1 Upstream BAR states that *'the local population potentially impacted by the Project comprises a minimum of 21-35 individuals'*, which *'represents 5-7 % of the estimated population of the Regent Honeyeater'.* However, the EIS does not provide a comparison with population sizes in other areas or the impact of the loss of 21-35 individuals on a local breeding population. The EIS states that *'this breeding population represents one of less than five known remaining breeding populations that are known to support at least 20 individuals'*, which indicates the significance of the potential loss of this breeding population.

The assessment of the impact does not reflect the significance of the impact of the Project on Regent Honeyeater or provide strong evidence for the justification of minimal impact. It is not credible to dismiss the value of habitat where a significant percentage of the total population of a critically endangered species was observed during the study to be feeding and breeding.

Recommendations

- A more comprehensive assessment of World Heritage values related to biodiversity and a full analysis of impacts on those biodiversity values than that provided in section 6.1 of Appendix J be undertaken. This should include:
  - an assessment of impacts on the other components of the area's outstanding universal value:
    - ongoing ecological and biological processes
    - the evolution of eucalypt species
    - Gondwanan flora and fauna associations and
    - taxa of conservation significance i.e. species and communities which are endemic or have a restricted range – e.g. endemic plants are part of the OUV but have not been assessed
  - a table showing each ecological community and threatened species and for each World Heritage value and attribute listed under the EPBC Act with the following information:
    - extent in the construction area, upstream and downstream
    - PCT's and the corresponding hectares impacted by the Project needs to be converted to the equivalent EPBC TEC's. The basis for determining equivalence also needs to be outlined in the MNES chapter/appendix i.e. based on Conservation Advice, or dominant species etc
    - area (hectares) impacted in the construction area, upstream and downstream (for the 1 in 5 year, 1 in 100 year and PMF event)
    - proposed mitigation
    - proposed offset.

[2] https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10841

World Heritage Committee's request

The UNESCO World Heritage Committee decision in July 2021 included a request that the EIS:

1. Fully assesses all potential impacts on the OUV and other values including Aboriginal cultural values [and]
2. [Considers] whether raising the wall could exacerbate bushfire risk and recovery of species and habitat within the world heritage areas and to refer the EIS to World Heritage Centre.

Whilst the EIS concludes that the 2019-20 fire impacts have no bearing on the Project impacts, it does not provide sufficient information or to determine that, or to determine if the area that will be inundated is important to species and habitats that were impacted by the 2019-20 bushfires.

Comments

- The EIS has not addressed the requests of the World Heritage Committee.
- The EIS does not identify the value of the unburnt areas as refugia supporting the recovery of species from the catastrophic 2019-20 bushfires and therefore it does not assess the impacts of inundation on those refugia.

Recommendations

- The EIS address the World Heritage Committee's request that *'the EIS fully assesses all potential impacts on the OUV and other values including Aboriginal cultural values'*.
- The EIS address the request from the World Heritage Committee's that *'the EIS [considers] whether raising the wall could exacerbate bushfire risk and recovery of species and habitat within the world heritage areas'.*

Cumulative impacts

The assessment has not sufficiently addressed cumulative impact. The parameters of cumulative impact are not defined i.e. multiple extreme events that are likely to impact on the species, habitats and processes that support persistence of species. For example, the 2019-20 bushfires followed an extreme drought and were followed by an extreme flood event.

Recommendation

- The cumulative impact of multiple events that are likely to impact protected area values and World Heritage values, including impacts on species, habitats and processes that support the persistence of species be more thoroughly address.

National Heritage list

The SEARs requirement that land to be included on the National Heritage List be assessed has not been addressed. This includes land identified in the current National heritage list proposal for Greater Blue Mountains Area that is currently with the Commonwealth for consideration. This would require an assessment of impacts on their potential outstanding universal values.

Recommendations

- Impacts on potential outstanding universal values of lands proposed for addition to the National Heritage List (Yerranderie, Nattai and Burragorang State Conservation Areas) be assessed.
- When evaluating the impact on the integrity of the World Heritage area and determining the area of offset these adjoining lands should be considered.

Aboriginal cultural heritage

EES notes from Appendix K that the Registered Aboriginal parties (RAPs) do not support the Project and recommend it not proceed.

Comment

A critical issue is the RAPs' disengagement in the process in relation to the assessment of Aboriginal cultural values. Given the RAPs' disengagement with the assessment process, the intention to consult the RAPs as part of assessment of the EIS proposal is strongly supported.

Recommendation

The RAPs' view is considered in assessing the proposal and if this recommendation is not supported then WaterNSW should provide reasons for that decision.

Cumulative impacts on Aboriginal cultural heritage

EES notes from Appendix K that the *'…Project is seen by the RAPs as a further accumulation of impacts to Aboriginal cultural heritage that has previously been affected by the original development of the Warragamba Dam'*.

Recommendation

The cumulative impacts on Aboriginal cultural heritage (ACH) be assessed in acknowledgement that previous destruction and irreplaceable loss of ACH heightens the need to protect existing heritage.

Assessment of Aboriginal cultural heritage values

The ACH values assessment is a desktop assessment only and has not been informed by Aboriginal people who have cultural association, because of Aboriginal people disengaging from the process. RAPs did not want to participate in the cultural values assessment and did not provide knowledge-holders. Consequently, the cultural values assessment has been sourced from other reports and documents.

Alternative predictive modelling tools (e.g. the Aboriginal Sites Decision Support Tool) could have improved the survey design and helped to restore the confidence of the RAPs. The ACH assessment report did not assess Potential Archaeological Deposits. This is problematic considering the erosional nature of soils subject to periodic inundation.

There was no agreement that the upstream impact area used to quantify biodiversity impacts would also apply to ACH assessment. The area assessed for ACH impacts should have been based on factors relevant to the Aboriginal cultural landscape and the context of Aboriginal heritage and cultural values.

The Aboriginal cultural heritage assessment report (ACHAR) and the Aboriginal heritage chapter both refer to the number of archaeological sites in the World Heritage area and that no cultural values sites are in the impact area within the World Heritage area. This contrasts with the statement in the ACHAR that the whole cultural landscape is highly significant.

The ACHAR and Appendix K incorrectly identifies that Aboriginal heritage is not part of World Heritage values and note it is included in the GBMWHA strategic management plan. Aboriginal heritage is part of the World Heritage values, as it is part of the integrity of the property[3].

Comments

- There is a risk that cultural values of high significance have not been identified, resulting in impacts on those values not being assessed.
- The outcomes of the Aboriginal cultural heritage assessment have not been recorded in the Aboriginal Heritage Information Management System as required in the SEARs.

Recommendations

- The RAPs' position of not participating in the cultural values assessment be considered. Even without the in-depth stories or analysis of information, the RAPs have said the cultural values are of high significance.
- The significance of the cultural landscape and the impact area within the World Heritage area as part of that significant cultural landscape be acknowledged.
- Reference (from the Statement of Outstanding Universal Value) to the Aboriginal cultural values of the World Heritage area and that this is part of the World Heritage values be acknowledged.
- The significance of the cultural landscape and the detailed issues in the ACHAR, some of which were not referred to in the main chapters of the EIS be addressed when considering the Project.
- The records of archaeological surveys be provided to DPIE for recording in the Aboriginal Heritage Information Management System.

Mitigation measures

ACH assessments would normally include an option for a major project not proceeding as a mitigation measure and, where that is not possible, state other available mitigation measures.

It does not appear that the proposed mitigation measures have been discussed with the RAPs. An Aboriginal cultural heritage management plan (ACHMP) has not been developed. Consequently, the RAPs have not agreed to management protocols.

Recommendations

- The option of the Project not proceeding as a mitigation measure and, where that is not possible, other available mitigation measures be addressed.
- An Aboriginal cultural heritage management plan be developed.
- Mitigating measures including actions to manage impact to sites prior to harm from inundation be required (for example surface collection of artefacts or salvage). The protocol for these should be developed before any approval with the RAPs and the Gundungurra Consultative Committee and could be developed when preparing the Aboriginal Cultural Heritage Management Plan.

[3] https://whc.unesco.org/en/list/917/

- Mitigating measures should consider salvage of deposits either by:
    - RAPs highlighting which deposits need to be excavated via salvage before the raising of the wall, or
    - continued monitoring to highlight that the inundation is slowly damaging the sites through erosion.

  These protocols should be developed before approval (if approved) with the RAPs and with the Gundungurra Consultative Committee, as a part of the ACHMP process.
- Additional measures which should be considered and discussed with the RAPs and the Gundungurra Consultative Committee:
    - The ACHMP should be prepared before an approval if the RAPs and Gundungurra Consultative Committee are willing to engage in this process.
    - The ACHMP should be used to manage those sites not being impacted to ensure their condition is kept to a high standard and cared for, given the loss of other values in the area. The ACHMP should look to manage the wider landscape not just the impact area.
    - Other management or mitigation measures that the RAPs and the Gundungurra Consultative Committee may propose, given they do not appear to have had input on the measures included in the EIS.

Engagement of archaeologist

The EIS recommends an archaeologist is employed in WaterNSW. An archaeologist would only be useful where qualifications in archaeology are required for requirements relating to the ACHMP and approval of the EIS and associated methodologies. An Aboriginal heritage specialist who is an Aboriginal person would provide better cultural support. This issue should be discussed with the Aboriginal community.

Recommendation

WaterNSW fund an Aboriginal Identified position with relevant technical skills and experience in NPWS for the entire operating period of the raised dam wall through a community service obligation mechanism.

Non-Aboriginal heritage in parks

The Historic Heritage Management System (HHIMS) maintained by NPWS constitutes the register that NPWS is required to establish and maintain under section 170 of the *Heritage Act 1977*. This is a register of heritage items on national park estate.

There is no reference in Chapter 17: Non-Aboriginal heritage to items in national parks on the s.170 register.

The EIS states that Jooriland homestead (which may be affected by the Project based on the modelled inundation levels) is not listed on any statutory heritage register, and that to determine its heritage significance an assessment should be undertaken by the asset owner (i.e. NPWS). HHIMS provides information on the Jooriland homestead, which has been assessed as having local significance and a Conservation Management Plan has been completed for this site.

NPWS is the consent authority for any heritage items in parks (not the local council), therefore NPWS should be referred to in the EIS.

The are 7 other records in HHIMS in the potential inundation area: the yards at Murphys Flat, ruins across river north of Murphys, Orange Tree Flat house on Little River, Old Cedar Rd, Black Dog Ridge, Kiaramba Hut on Cox's Arm.

Recommendations

- The EIS identify all items on NPWS section 170 heritage register HHIMS, especially Jooriland Homestead, including its significance, so that the management measures at 17-12 NAH1 are applied.
- WaterNSW consult NPWS on any works and related impacts associated with Jooriland Homstead.
- A heritage impact statement (as per Heritage Council of NSW terminology) be prepared for this property, including consideration of alternatives to the Project impacts or mitigation measures proposed for any impacts.

Offsets

NPWS provided comments in June 2020 on the EIS's consistency with the SEARs, noting that offsets for impacts on protected area values must be in addition to any existing requirements related to offsets for biodiversity or other specific attributes of the land. This is recognised in other major project planning approvals.

NPWS also noted that the EIS does not demonstrate how it complies with the Environmental Offsets Policy October 2012 under the EPBC Act to offset all World Heritage values.[4]

The SEARs require WaterNSW to address in the EIS "an assessment of the cumulative impacts of the project" and "a compilation of the impacts of the project that have not been avoided".

The EIS has not fully responded to recommendations provided following the review of consistency of the draft EIS with the SEARs, or the requirement to assess cumulative impacts, as highlighted in the recommendations below.

Operational procedures to minimise inundation times are identified as a mitigation measure. The EIS does not provide sufficient detail about the proposed offsets and mitigation measures and how these interact with each other and with the operational procedures for the dam, i.e.:

- Biodiversity Offsets Strategy
- Warragamba Offset Program
- Environmental management plan (required under section 64C of the *Water NSW Act 2014*), and
- Aboriginal cultural heritage management plan.

Recommendations

- The EIS detail how the operational procedures will be prepared and who will be involved in developing them. The operational procedures will need to address impacts on ACH in parks, biodiversity in parks, historic heritage in parks and other park values.
- The EIS clarify how the environmental management plan (EMP) will interact with other offsets and mitigation measures to reduce and manage impacts from the proposal and from inundation events.

[4] https://www.awe.gov.au/sites/default/files/documents/offsets-policy_2.pdf

- The EIS address the cumulative impacts on all values in parks which will result from the additional inundation – in terms of both frequency and duration – in the current flood zone i.e. the 'bathtub effect' zone between the current FSL and 2.78 metres above FSL.
- Conditions of approval require NPWS involvement in preparing the operational procedures.

Warragamba Offset Program

The Warragamba Offset Program proposed in the EIS will prioritise acquisition of land that improves or supports the OUV for World Heritage; supports the integrity of protected lands; and protects Aboriginal cultural values and heritage (Chapter 13 – Figure 13-1).

The EIS states that the Project is not anticipated to require the revocation of any land reserved under the NPW Act, or to require any road adjustments that could affect land reserved under the NPW Act, all of which are guided by the *NPWS Revocation, Recategorisation and Road Adjustment Policy* (under 13.2.5 Revocation, recategorisation and road adjustment policy).

In discussions with WaterNSW about offsets for impacts on park values and World Heritage values, NPWS advised that the principles in the Revocation, Recategorisation and Road Adjustment Policy should guide determining acceptable offsets for impacts on those values. Biodiversity Offsets which relate to impacts on land reserved under the NPW Act must be delivered on land reserved under the NPW Act. The only exception to this should be if it is not possible to deliver the offset on land reserved under the NPW Act. The key principles in the Policy are:

- compensation must result in an overall public good outcome having regard to all the conservation, cultural heritage and other values of the land being impacted and the values of any land provided as compensation
- compensatory land should preferably be of greater size than the area of land being revoked, and must at least be of equal size
- it is desirable to match the area, type and quality of habitat, and cultural heritage values on land being impacted with the area of land proposed as compensation where possible. Exceptions to this may include:
    - compensation that includes a higher conservation priority habitat type (e.g. that is poorly reserved) where the habitat to be impacted is commonly represented within the relevant park
    - compensation lands that have unique and particularly significant conservation values
    - it is desirable that land to be transferred as compensation is close to the area being revoked and preferably adjacent to the affected reserve.

The EIS proposes a separate offset strategy for impacts on biodiversity (Appendix F6: Biodiversity Offset Strategy).

Recommendations

- The EIS and the Warragamba Offset Program implement NPWS' previous recommendations (see NPWS comments on consistency with SEARs).
- The proposed Warragamba Offset Program for the upstream study area recognise the impacts on protected area values and World Heritage values and detail how those impacts will be offset.

- Offsets for impacts on park values and World Heritage values comprise additions to the parks affected (or nearby parks) in the World Heritage area.
- Offsets for impacts on park values and World Heritage values include compensation and management costs for park additions be provided for enhanced (landscape scale) land management activities in national parks which are part of or adjacent to the World Heritage area.
- WaterNSW identify acceptable offsets for impacts on park values and World Heritage values by applying the principles in the *NPWS Revocation, Recategorisation and Road Adjustment Policy*, and consult NPWS about the suitability of lands proposed to be acquired for compensation.
- Conditions of approval require WaterNSW to consult NPWS in preparing the Warragamba Offset Program and approval from the Deputy Secretary, NPWS in relation to protected areas values and World Heritage values.
- The proposed advisory committee for the Warragamba Offset Program is not established, as it would duplicate legislated advisory bodies under the NPW Act and the World Heritage advisory committee and has not been justified (under 6.2 Offset strategy for upstream operational impacts).

World Heritage

NPWS comments on consistency with SEARs noted that the draft EIS did not sufficiently address offsets for World Heritage values, including the specific need to demonstrate "at a minimum, how the proposed offset will improve the integrity and resilience of the heritage values of the impacted heritage place or property."

The *Environment Protection and Biodiversity Conservation Act 1999* – Environmental Offsets Policy states: "Offsets for impacts on heritage values should improve the integrity and resilience of the heritage values of the property involved. This may include offsets in areas adjacent to the property."[5]

Statements in the EIS relating to offsets for impacts on World Heritage do not align with these concepts.

Also note that for impacts on World Heritage values to be sufficiently offset, the EIS must first clearly articulate those values and impacts. Earlier comments address deficiencies in the identification and evaluation of impacts on World Heritage Values. The EIS should be clear about how the Project will avoid, mitigate and compensate for World Heritage values that fall outside the NSW Biodiversity Offsets policy. The EPBC Act provides the appropriate framework for the evaluation and offset of World Heritage values.

For example, the EIS does not provide any assessment of endemic species – endemic species contribute to the OUV of the area. Some endemic species will not be assessed under the NSW Framework for Biodiversity Assessment.

Recommendations

- The EIS and the Warragamba Offset Program implement NPWS' previous recommendations in relation to offsets for impacts on World Heritage values, particularly the specific need to demonstrate "at a minimum, how the proposed offset will improve the integrity and resilience of the heritage values of the impacted heritage place or property."

[5] https://www.awe.gov.au/sites/default/files/documents/offsets-policy_2.pdf

- The EIS and the Warragamba Offset Program identify options to avoid, minimise and offset World Heritage impacts based on a full assessment of impacts using the appropriate assessment and offset frameworks for World Heritage under the EPBC Act.
- Heritage NSW and the Gundungurra Consultative Committee are involved in determining offsets relating to Aboriginal heritage values, including consideration of the outcomes of the Aboriginal cultural heritage management plan and information that is available as a result of the other management measures for Aboriginal heritage.

Protecting land owned by WaterNSW under a BSA

The EIS proposes three options for establishing a potential biodiversity stewardship agreement (BSA) as part of the Project (under 13.5.1 Offsetting through a site secured stewardship agreement):

- protecting land owned by WaterNSW under a BSA
- purchase of land and protection of land under a BSA
- purchase of land and protection of land through inclusion in a national park under a Plan of Management.

Lands owned by Water NSW (i.e. as part of the catchment of Warragamba Dam) are already protected and managed under the *Water NSW Act 2014*, and therefore are likely to be ineligible as biodiversity offsets under a BSA. Consequently, WaterNSW's potential options are purchasing land and protecting it under a BSA; or purchasing land and protecting it by transferring it to NPWS for management as part of a national park under the *National Parks and Wildlife Act 1974*.

Recommendations

- For impacts on values that would otherwise be offset by a biodiversity stewardship agreement (BSA), that WaterNSW acquire suitable land for addition to a national park and management under the *National Parks and Wildlife Act 1974*.
- If suitable land is not available, that WaterNSW provide supplementary measures (including compensation and management costs) to NPWS for enhanced land management activities in national parks that are part of or adjacent to the World Heritage area.

Biodiversity offsets related to NPWS lands

The EIS states that "where biodiversity credits are not available, or where better conservation outcomes would be achieved through measures directly related to particular species, supplementary measures may be considered as an appropriate offset" (under 13.5.3 Supplementary measures).

The four-tier decision hierarchy which proponents must follow when identifying supplementary measures should state, for actions relating to impacts on NPWS-managed lands, that those actions occur exclusively on NPWS-managed lands.

Recommendations

- That a condition be added to the four-tier decision hierarchy to require, for actions relating to impacts on NPWS-managed lands, that those actions occur exclusively on NPWS-managed lands.

EPBC Act Environmental Offsets Policy requirements

The assessment against the Environmental Offsets Policy (Table 13) does not address impacts on park values. Note that the Framework for Biodiversity Assessment (FBA) is designed for offsetting impacts on values which are not already protected, e.g. in national parks or other legislatively protected areas.

Recommendations

- WaterNSW should detail mechanisms for assessing land for inclusion in NPWS estate and timelines and mechanisms for triggering supplementary measures for when appropriate lands are not available for inclusion in offsetting impacts on NPWS lands.
- WaterNSW commit to funding an Officer in NPWS to facilitate the process of securing offsets and covers associated costs for the duration of the Offset Program, given the length of time such an offsetting program will take with respect to the impact on park and the requirement for assessment and ground truthing of any purchases.