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Environmental Impact Statement – Appendix F6: Biodiversity Offset Strategy

Warragamba Dam Raising

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Abbreviations and Acronyms

Abbreviation	Explanation
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BOS	Biodiversity Offset Strategy
CEMP	Construction Environment Management Plan
DoEE	Department of the Environment and Energy (former)
DPIE	Department of Planning, Industry, and Environment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EMP	Environmental Management Plan
FBA	Framework for Biodiversity Assessment
FFMP	Flora and Fauna Management Plan
FM Act	*Fisheries Management Act 1994* (NSW)
FMZ	Flood Mitigation Zone
GBMWHA	Greater Blue Mountains World Heritage Area
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage (former)
OEMP	Operational Environment Management Plan
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
TSC Act	*Threated Species Conservation Act 1995* (NSW)

1 Introduction

1.1 Objective of the Biodiversity Offset Strategy

The objective of the Biodiversity Offset Strategy (BOS) is to provide a framework for the delivery of offsets for the potential impacts of the Warragamba Dam Raising Project (the Project) and to achieve a long-term conservation gain for the threatened species, populations and communities, and biodiversity-related national parks and World Heritage values impacted by the Project. It includes the biodiversity offsets required under the Framework for Biodiversity Assessment (FBA) and set out in the SEARs, and offsets addressing potential loss of biodiversity-related World Heritage and national park values.

The BOS is supported by detailed investigations, which are documented in this report. The assessment of potential biodiversity impacts and mitigation measures is supported by detailed investigations, which have been documented in several working papers and summarised in the Environmental Impact Assessment (EIS). These are:

- Upstream Biodiversity Assessment Report (BAR), (Appendix F1, EIS Chapter 8)
- Downstream Ecological Assessment, (Appendix F2, EIS Chapter 9)
- Construction Biodiversity Assessment Report, (Appendix F3, EIS Chapter 10)
- Aquatic Ecology Assessment Report (Appendix F4, EIS Chapter 11)
- Matters of National Environmental Significance – Biodiversity (Appendix F5, EIS Chapter 12)
- World Heritage assessment report (Appendix J)
- Protected lands (Chapter 20).

The process for identifying, prioritising and meeting project biodiversity credit requirements for construction related impacts would comprise the following activities:

- Assessment of Biodiversity Stewardship Agreement site options
- Purchase of credits from the market
- Supplementary measures (if required)
- Contribution to the Biodiversity Conservation Fund where biodiversity credits could not be sourced from Biodiversity Stewardship Agreement sites on WaterNSW/private land, or on the credit market.

The Warragamba Offset Program provides for auditing of compliance with these four priorities.

The BOS is the cornerstone of the Warragamba Offset Program (see Section 6.2) to provide for no net loss of protected lands values for affected national parks and the Greater Blue Mountains World Heritage Area (GBMWHA). The Program also encompasses non-biodiversity matters such as:

- geodiversity
- water catchment protection
- cultural heritage
- landscape, natural beauty and aesthetic values
- recreation and visitor use
- social and economic benefits derived from visitation to these areas.

The mitigation measures identified in Section 29.7 of the EIS would contribute to offsetting impacts on protected lands and would support the Warragamba Offset Program.

The Warragamba Offset Program would be supported and complemented by the separate Environmental Management Plan (EMP) that WaterNSW is required to prepare under Part 5A of the *Water NSW Act 2014* before the temporary inundation of any land protected by the *National Parks and Wildlife Act 1974* can occur. The scope and content of the EMP have yet to be defined but would be consistent with the existing management plans for the national parks and the GBMWHA. The EMP would contribute to the maintenance and strengthening of protected lands values, including biodiversity.

1.1.1 Project description and impacts

Warragamba Dam Raising is a project to provide flood mitigation to reduce the significant existing risk to life and property in the Hawkesbury-Nepean Valley downstream of the dam. This is achieved through raising the level of the

central spillway crest by around 12 metres and the auxiliary spillway crest by around 14 metres above the existing full supply level for temporary storage of inflows. The spillway crest levels and outlets control the extent and duration of the temporary upstream inundation. There would be no change to the existing maximum volume of water stored for water supply.

The NSW Government announcement in 2016 proposed that the dam wall be raised by 14 metres. Subsequently, the NSW Department of Planning and Environment Secretary's Environmental Assessment Requirements (SEARs) required the project to be designed, constructed and operated to be resilient to the future impacts of climate change and incorporate specific adaptation actions in the design.

Peer reviewed climate change research found that by 2090 it is likely an additional three metres of spillway height would be required to provide similar flood mitigation outcomes as the current flood mitigation proposal. Raising the dam side walls and roadway by an additional three metres may not be feasible in the future, both in terms of engineering constraints and cost. The current design includes raising the dam side walls and roadway by 17 metres now to enable adaptation to projected climate change. Any consideration of raising spillway heights is unlikely before the mid to late 21st century and would be subject to a separate planning approval process.

The 17 metre raising height of the dam abutments (side walls) and roadway has been considered and accounted for in the EIS and design. The potential maximum height and duration of upstream inundation remains consistent with what was originally proposed in 2016.

The Project also includes providing infrastructure to facilitate variable environmental flows to be released from Warragamba Dam.

The Project would include the following main activities and elements:

- demolition or removal of parts of the existing Warragamba Dam, including the existing drum and radial gates,
- thickening and raising of the dam abutments
- thickening and raising of the central spillway
- new gates or slots to control discharge of water from the FMZ
- modifications to the auxiliary spillway
- operation of the dam for flood mitigation
- environmental flow infrastructure.

The Project would take the opportunity, during the construction period for the dam raising, to install the physical infrastructure to allow for management of environmental flows as outlined in the NSW Government *2017 Metropolitan Water Plan*. However, the actual environmental flow releases themselves do not form part of the Project and are subject to administration under the *Water Management Act 2000*.

A short description of the potential impacts from the Project is presented in the following sections.

1.1.2 Construction area

The construction of the Project would require the clearing of vegetation adjacent to the dam. Approximately 22 hectares of native vegetation would be cleared including a small area of one threatened ecological plant community. The native vegetation also provides habitat for flora and fauna species potentially including some threatened flora and fauna species.

1.1.3 Downstream area

The Project would:

- reduce the extent and duration of flooding downstream. Some plant communities that occur close to the extent of small flood events may experience less flooding from smaller flood events. While these plant communities would still experience flooding, the frequency at which this vegetation is flooded would decrease.
- release temporary stored flood waters in the flood mitigation zone (FMZ) after a flood event had peaked. Some vegetation along the main river and in low lying areas may experience increased duration of temporary inundation.

1.1.4 Upstream area

With the existing dam, the upstream catchment areas of Lake Burragorang already experience temporary inundation during major flood events. However, with the Project, the catchment area of Lake Burragorang would experience

temporary inundation at increased depths, for a longer duration, and over a larger extent during operation of the FMZ. The frequency, extent and duration of the increased temporary inundation varies across locations and flood events. The temporary inundation of vegetated areas may impact flora species and plant communities and lead to changes to habitat. The impact may result in temporary and permanent changes in plant community types (PCTs), loss of threatened flora species and loss of habitat for both threatened and non-threatened fauna.

1.1.4.1 Greater Blue Mountains World Heritage Area

Areas of the upstream catchment potentially impacted by the Project fall within the Greater Blue Mountains World Heritage Area (GBMWHA). The GBMWHA is inscribed on the World Heritage List because it satisfies criteria for natural values of outstanding universal significance.

Areas of the GBMWHA could be potentially impacted by temporary inundation during major flood events from the existing dam, however these impacts would not be significant and would not result in the material loss or degradation of the biodiversity-related outstanding universal values of the GBMWHA as:

- the area of the GBMWHA within the upstream impact area (304 hectares) is very small relative to the overall area of the GBMWHA (about 1.03 million hectares)
- comprehensive mitigation and offsetting measures have been identified which would ensure that any project impacts on the GBMWHA result in a net benefit to biodiversity-related World Heritage outstanding universal values.

1.1.4.2 Protected areas

The construction of Warragamba Dam commenced in 1948 with the dam formally opened in 1960. To protect the water quality in the dam, large areas of the catchment immediately around the dam were protected from development through enacting legal protections (that is, Special Areas) which limited further development and allowed the resumption of privately owned land. In the 1970s and 1980s, some areas of the Warragamba catchment were added to various national parks – and management of these areas was undertaken jointly by the National Parks and Wildlife Service (NPWS) and the dam owner/manager – which has included Sydney Water, Sydney Catchment Authority and WaterNSW over time. In June 2002, most of the Special Areas in the catchment were transferred to NPWS and included in existing national parks or state conservation areas, if they weren't already protected lands under the NSW *National Parks and Wildlife Act 1974* (NPW Act). The management responsibility for the Special Areas within national parks and state conservation areas continues to be undertaken by NPWS in consultation with WaterNSW.

The national parks and state conservation areas within the catchment of Lake Burragorang potentially impacted by the Project are:

- Blue Mountains National Park
- Burragorang State Conservation Area
- Kanangra-Boyd National Park
- Nattai National Park
- Nattai State Conservation Area
- Yerranderie State Conservation Area.

Areas of the national parks and state conservation areas are already potentially impacted during major flood events by temporary inundation from the existing dam.

1.2 Approaches to assessment across the Project study area

The varying impacts across the Project study area have necessitated different assessment types across the upstream, construction, and downstream study areas. A variable approach to offsets across each study area has also been adopted for this assessment.

The Secretary's Environmental Assessment Requirements (SEARs) require that the impact associated with the Project within the upstream operational area and construction area must be assessed via the Framework for Biodiversity Assessment (FBA).

It should be noted that the *Threatened Species Conservation Act 1995* (TSC Act) was repealed when the *Biodiversity Conservation Act 2016* commenced on 25 August 2017. However, given the SEARs for the Project were issued prior to

25 August 2017, the Project is being assessed under transitional arrangements that allow the Project to be assessed in accordance with the TSC Act and therefore the FBA applies to the Project.

The FBA does not assess downstream impacts of hydrology on surface vegetation and groundwater dependent ecosystems (GDEs). The SEARs require that impacts associated with the Project within the downstream operational area be assessed via Attachment B of the SEARs.

Details regarding the biodiversity assessment for each study area can be found in Appendix F1 through to Appendix F3 of the EIS. Details regarding potential impacts on World Heritage areas and protected lands (National Parks and State Conservation areas) can be found in Appendix J (World Heritage assessment) and Chapter 20 (Protected and Sensitive Lands, including World Heritage Properties) of the EIS.

1.3 2019-2020 bushfires

New South Wales, including the catchment of Lake Burragorang, experienced severe bushfires starting in June 2019 and continuing through to early 2020. The bushfires have been described as unprecedented in their extent and intensity affecting at least 5.4 million hectares (seven percent of NSW) including 27 percent of the national park estate, more than 81 percent of the GBMWHA and 54 percent of the NSW components of the Gondwana Rainforests of Australia World Heritage property (DPIE 2020).

The fires affecting the study area began in late October 2019 within remote bushland near Lake Burragorang, near Yerranderie, as well as within the Kanangra-Boyd National Park. Due to the extreme isolation of the area and rugged inaccessible terrain, the fire spread and merged to eventually become the Green Wattle Creek Fire on 27 November 2019. This fire rapidly affected the study area where it burnt out of control for over nine weeks. A total of 278,700 hectares in the Wollondilly area were affected by this fire until it was officially declared 'contained' on 30 January 2020. The fire was declared 'extinguished' by the NSW Rural Fire Service on 10 February 2020 following significant rainfall over the preceding week.

The effects of the 2019-2020 bushfires on the environment, including the ecological consequences, are not yet fully understood. In response, the then Department of the Environment and Energy (DoEE[1]) released initial advice relating to threatened and migratory species which have more than 10 percent of their known or predicted distribution in areas affected by bushfires in southern and eastern Australia from 1 August 2019 to 13 January 2020. Regular updates are progressively being provided through the Department's website[2].

In February 2020, the NSW Department of Planning, Industry and Environment (DPIE) released a set of guidelines relating to carrying out biodiversity assessments under the FBA at severely burnt sites (For further details refer to Appendix F1).

[1] On 1 February 2020, the Department of Agriculture, Water and the Environment was established, combining the former Department of Agriculture and Department of the Environment and Energy (Environment portfolio). Reference to DoEE has been used in this report in view of the Project commencing when DoEE was in existence.

[2] https://www.environment.gov.au/biodiversity/bushfire-recovery

2 Policy framework for the offset strategy

2.1 NSW Biodiversity Offsets Policy for Major Projects

The *NSW Biodiversity Offsets Policy for Major Projects* (NSW Government 2014) was adopted in September 2014 and applies to state significant developments and state significant infrastructure designated under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The policy provides a standard method for assessing impacts of major projects on biodiversity and determining offsetting requirements (NSW Government 2014). The policy is underpinned by six principles, which must be considered when assessing offsets for major projects. The Framework for Biodiversity Assessment (FBA) has been developed in conjunction with the policy to provide a method for determining the impacts resulting from development. The FBA provides rules and software for calculating the number and type of credits that a development site will require in order to offset its impacts and thus improve or maintain biodiversity values. 'Credits' are the currency used within FBA they are a measure of biodiversity value generated by the BioBanking Credit Calculator (BBCC). The FBA requires the preparation of the following documents:

- Biodiversity assessment report: to describe the biodiversity values present within the development site and the impact of the project on these values.
- Biodiversity offset strategy: to outline how the proponent intends to offset the impacts of the project.

Submission of these reports is required as part of the EIS.

The FBA does not provide guidance for assessing impacts that are not associated with the clearing of native vegetation, notably this includes downstream impacts on hydrology and environmental flows on surface vegetation and groundwater dependent ecosystems. Consequently, additional assessment requirements for the downstream impacts associated with dam operation were outlined within the Secretary's Environmental Assessment Requirements (SEARs).

As the FBA applies predominantly to terrestrial biodiversity, the NSW Offsets Policy for Major Projects and FBA refer to the NSW Department of Primary Industries Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 (DPI 2013) for guidance on assessing and offsetting aquatic impacts.

2.2 Secretary's Environmental Assessment Requirements

The relevant Secretary's Environmental Assessment Requirements (SEARs) are shown in Table 2-1. The former Office of Environment and Heritage (OEH[3]) has been consulted during the assessment process, through face to face meetings and teleconferences.

Table 2-1. SEARs relevant to offsets

Desired performance outcome	Secretary's Environmental Assessment Requirements	Where addressed
6. Biodiversity The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.	1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995*.	Appendix F1 – Upstream Biodiversity Assessment Report Appendix F3 – Construction Biodiversity Assessment Report
	2. The proponent must assess the downstream impacts on threatened biodiversity, native vegetation and habitats resulting from any changes to	Appendix F2 – Downstream Ecological Assessment Report

[3] The assessment for the Warragamba Dam Raising formally commenced in 2017 with the issue of the SEARs for the Project. On 1 July 2019 OEH was dissolved, with its biodiversity related functions transferred to the Environment, Energy and Science (EES) Group within DPIE. For the sake of convenience 'OEH' is used to refer to OEH in the historic context unless otherwise specifically noted.

Desired performance outcome	Secretary's Environmental Assessment Requirements	Where addressed
	hydrology and environmental flows. This assessment should address the matters in Attachment B.	
	3. The Proponent must assess impacts on the following: endangered ecological communities (EECs), threatened species and/or populations, and provide the information specified in s9.2 of the FBA. Specific environmental requirements are provided in Attachment C.	Appendix F1 – Upstream Biodiversity Assessment Report Appendix F3 – Construction Biodiversity Assessment Report
	4. The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process in accordance with the listings in the *Threatened Species Conservation Act 1997* (TSC Act), *Fisheries Management Act 1994* (FM Act) and *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act).	Appendix F1 – Upstream Biodiversity Assessment Report Appendix F3 – Construction Biodiversity Assessment Appendix F2 – Downstream Ecological Assessment Report

In addition to the above, Attachment A of the SEARs includes the following provisions:

- 11. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.
- 19. Where a significant residual adverse impact to a World Heritage property and/or a National Heritage place is considered likely the EIS must provide information on the proposed offset strategy. The offset strategy must:
  - (i) include a discussion and supporting evidence of the conservation benefit associated with the proposed offset strategy. The conservation benefit must demonstrate, at a minimum, how the
  - (ii) proposed offset will improve the integrity and resilience of the heritage values of the impacted heritage place or property; and
  - (iii) be consistent with the *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offset Policy (2012): www.environment.gov.au/epbc/publications/epbc-act- environmental-offsets-policy or an endorsed state policy.

Additionally, Attachment B of the SEARs includes the following provisions relating to biodiversity offsets for downstream operational impacts:

- meet OEH's principles for the use of biodiversity offsets in NSW
- identify the conservation mechanisms to be used to ensure the long-term protection and management of the offset sites
- 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 (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.

2.3 Principles of biodiversity offsets for major projects

The *NSW Biodiversity Offsets Policy for Major Projects* provides a standard method for assessing impacts of major projects on biodiversity and determining offsetting requirements (NSW Government 2014). The policy is underpinned

by six principles, which must be considered when assessing offsets for major projects. Details of the six principles are discussed as follows.

Principle 1: Before offsets are considered, impacts must first be avoided, and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts

The biodiversity offsets policy is built around the hierarchy of 'avoid-minimise-offset'. The premise of this hierarchy means that the first priority of a project is to avoid any unnecessary impacts to biodiversity. Where avoidance is not possible, reasonable steps to minimise impacts to biodiversity must be undertaken. Once all feasible measures have been undertaken to avoid and minimise impacts, offsets should be used to compensate for the residual impacts.

Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains

The Major Projects are assessed following a transparent assessment methodology, the FBA. The FBA uses clear and repeatable methods to assess impacts to biodiversity on development sites and likely gains on offset sites.

Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities

Offsets must have a clear relationship to the biodiversity values being lost. The default position of the policy is that offsets must be 'like-for-like' which is defined as:

- species must be offset with the same species
- PCTs must be offset with closely related PCTs.

Where a proponent is unable to source 'like-for-like' offsets after taking reasonable steps, as defined in Appendix A of NSW Government (2014), variation rules may be applied to locate an appropriate offset. The variation rules allow PCTs to be offset with a broader range of PCTs, and species to be offset with similar species that use the same habitat and are under a similar or greater level of threat.

Principle 4: Offsets must be additional to other legal requirements

Offsets must provide an actual addition to biodiversity, not an action that was to occur irrespective of the offset requirement. This principle is applied through the requirement that any management actions must be additional to other legal obligations for conservation that are attached to the land.

Principle 5: Offsets must be enduring, enforceable and auditable

Offsets must ensure that there is adequate funding available for current and future conservation management. Offsets must also have clear monitoring and reporting requirements.

Principle 6: Supplementary measures can be used in lieu of offsets

Where reasonable steps have been undertaken and suitable like-for-like offsets cannot be found, proponents have the option of funding supplementary measures. Supplementary measures are actions, other than protection and management of land as an offset site, that are known to improve biodiversity values. Examples of supplementary measures include:

- actions outlined in threatened species recovery programs
- actions that contribute to threat abatement programs
- biodiversity research and survey programs.

The money put aside to fund supplementary measures must be equivalent to the cost of sourcing an offset. By ensuring the cost of funding supplementary measures is commensurate with finding land-based offsets, the policy aims to ensure that the supplementary measures are improving biodiversity values.

2.4 Principles for the use of biodiversity offsets in NSW

Attachment B of the SEARs outlines the assessment and offset requirement for downstream impacts resulting from the proposal. Specifically, Attachment B require that downstream offsets meet *the Principles for the use of biodiversity offsets in NSW* (OEH 2018). Details of the principles are discussed as follows.

Principle 1: Impacts must be avoided first by using prevention and mitigation measures

Like Principle 1 described in Section 2.3 above, the development should follow the hierarchy of 'avoid-minimise-offset'. Impacts to biodiversity values should be avoided then minimised, before the residual impacts offset.

Principle 2: All regulatory requirements must be met

Biodiversity offsets cannot be used to satisfy approvals or assessments under other legislation. This may include, assessment requirements for Aboriginal cultural heritage sites, pollution, or other environmental assessments.

Principle 3: Offsets must never reward ongoing poor performance

Offset schemes should not encourage the proponent or landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.

Principle 4: Offsets will complement other government programs

Where feasible, offsets should support and complement other NSW Government's conservation objectives. This may include the establishment and management of new national parks, nature reserves, state conservation areas and regional parks, and incentives for private landholders.

Principle 5: Offsets must be underpinned by sound ecological principles

In order to be underpinned by sound ecological principles, offsets must:

- include the conservation of structure, function and compositional elements of biodiversity, including threatened species
- enhance biodiversity at a range of scales
- consider the conservation status of ecological communities
- ensure the long-term viability and functionality of biodiversity.

Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets.

Principle 6: Offsets should aim to result in a net improvement in biodiversity over time

Biodiversity offsets should result in the enhancement of biodiversity values so that they are equal to or greater than the loss in biodiversity from the impact site.

Suitable offsets may include:

- enhancing habitat
- reconstructing habitat in strategic areas to link areas of conservation value
- increasing buffer zones around areas of conservation value
- removing threats by conservation agreements or reservation.

The setting aside areas for biodiversity conservation without additional management or increased security is not enough to offset the loss of biodiversity from development.

Principle 7: Offsets must be enduring – they must offset the impact of the development for the period that the impact occurs

As the impacts from development are in perpetuity, so must the offset be secured in perpetuity. This is achieved by establishment of Biodiversity Stewardship Agreements, or land secured by a conservation agreement or reserved as part of national parks estate. Sufficient resources for ongoing management must accompany offset sites. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.

Principle 8: Offsets should be agreed prior to the impact occurring

Biodiversity offsets should minimise ecological risks from time-lags between impact and offset. The feasibility and in-principle agreements for the necessary offset actions should be confirmed prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval.

Principle 9: Offsets must be quantifiable – the impacts and benefits must be reliably estimated

Where feasible, biodiversity offsets should be based on quantitative assessment of the gain in biodiversity within an offset site. This is best achieved through the establishment of a biodiversity stewardship agreement.

Offsets will be of greater value where:

- they protect land with high conservation significance
- management actions have greater benefits for biodiversity
- the offset areas are not isolated or fragmented
- the management for biodiversity is in perpetuity, such as secured through a conservation agreement.

Management actions must be deliverable and enforceable.

Principle 10: Offsets must be targeted

Biodiversity offsets should be 'like-for-like' or achieve better conservation outcomes. Biodiversity offsets should be targeted based on the biodiversity priorities in the area, as well as the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats.

One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity, but these benefits do not reduce the biodiversity offset requirements.

Principle 11. Offsets must be located appropriately

Where feasible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.

Principle 12. Offsets must be supplementary

Biodiversity offsets must exceed existing conservation requirements and must not be funded by another scheme. Areas on private land protected under existing agreements cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open space, cannot be used as offsets.

Principle 13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or contracts

Biodiversity offsets must be audited to ensure that the actions have been carried out and monitored to determine that the actions are leading to positive biodiversity outcomes.

2.5 Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy

The Warragamba Dam Raising Project has been determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Assessment of impacts is to be undertaken in accordance with the New South Wales Bilateral Agreement for assessment of matters of national environmental significance. Attachment A of the SEARs provides guidelines for preparing assessment documentation under the bilateral which includes consideration of the Environmental Offsets Policy (DoSEWPaC 2012). The policy outlines the Australian Government's approach to biodiversity offsets. The policy defined offsets as measures that compensate for the residual adverse impacts resulting from an action on the environment. The policy ensures that the process around determining the suitability of an offset is transparent. The suitability of a proposed offset is considered as part of the decision as to whether or not to approve a proposed action under the EPBC Act.

The EPBC Environmental Offsets Policy relates to all matters protected under the EPBC Act. For this project, these matters are:

- World Heritage properties
- national heritage places
- listed threatened species and ecological communities.

There are two types of offsets under the policy:

- **Direct offset**: direct offsets are actions that provide a measurable conservation gain for an impacted protected matter. A minimum of 90 percent of the offset requirements for any given impact must be met through direct offsets. Direct offsets benefit from conservation gains delivered to the protected matter. Conservation gains can be achieved by:
  - Improving existing habitat for a protected matter
  - Creating new habitat for a protected matter
  - Reducing threats to a protected matter
  - Increasing values of a heritage place
  - Averting the loss of a protected matter or its habitat under threat.
- **Compensatory measures**: compensatory measures are actions that do not directly offset the impacts on the protected matter but are expected to lead to benefits for the impacted protected matter. Compensatory measures may include research or educational programs.

Suitable offsets under the policy meet must eight requirements as discussed below.

This notwithstanding, DAWE has advised WaterNSW that as the Department has endorsed the NSW Biodiversity Offsets Scheme, provided WaterNSW complies with the scheme, it is not required to simultaneously comply with the EPBC Environmental Offsets Policy.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter

Offsets must deliver a conservation outcome that improves or maintains the viability of the protected matter though directly contributing to its ongoing viability as compared to what would have likely happened under the status quo. This is achieved though offsets which specifically relate to the attribute of the protected matter impacted by the proposal. Offsets must:

- not be traded across different protected matters
- adequately compensate for the specific residual impact
- meet, as a minimum, the quality of the habitat on the impact site.

2. Suitable offsets must be built around direct offsets but may include other compensatory measures

Offsets should take the form of direct offsets over compensatory measures. Direct offsets should make up a minimum of 90 percent of the offset requirement, with compensatory measures making up to a minimum of 10 percent of the offset requirement. Where possible, an offset should reflect key priority actions for the protected matter, with higher priority action preferred over low priority actions.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter

Offsets for protected matters with a higher conservation status must be higher than offsets for protected matters with a lower conservation status. This is to account for the higher risk involved with protecting matters of greater conservation significance.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter

Offsets must adequately compensate for the impacts on the protected matter by being of proportionate size and scale of the residual impacts. The size and scale of the offset is determined by a number of different considerations, including but not limited to:

- level of statutory protection
- lag time between impact and the conservation gain of the offset
- risk of conservation gain not being achieved.

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding

Offsets should sufficiently consider the risk of the offsets not succeeding. This could be achieved by taking into account the nature of the impact, as well as the type, size, location, and timing of the offset.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs

Offsets must deliver a conservation gain which is new or additional to what is already required by a duty of care, or as a result of any other environmental planning laws at any level of government or paid for under other conservation schemes or programs. Where there is overlap between state and federal offset requirements, a state offset may count towards an offset under EPBC requirements to the extent to which it compensates for the residual impact on the protected matter.

7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable

Offsets which most efficient and effective are those which maintain or improve the viability of the protected matter though the sound allocation of resources and aligned offset requirements. Offsets must also be implemented either before or at the same point in time as the impact arising from the action. Lastly, offsets must be based on scientifically rigorous, robust, and transparent information which documents how the offset benefits the protected matter.

8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced

The delivery of offsets must include appropriate and transparent governance arrangements. They must also be delivered with an appropriate monitoring, compliance, and audit program. Annual reports must track the success of the offset so that the condition of approval as varied if the offsets are not delivering their desired outcome.

2.6 World Heritage offset requirements

Under the EPBC Environmental Offsets Policy, offsets to compensate for impacts to heritage values are appropriate in some circumstances. Where offsets are considered appropriate, the principles of the policy apply and should improve the integrity and resilience of the heritage values of the property involved.

2.7 National parks and state conservation offset requirements

National parks and state conservation areas would experience an increased extent and duration of temporary inundation due to the Project. The SEARs require the EIS to consider impacts on protected lands and identify measures to avoid and minimise impacts consistent with the *Revocation, recategorisation and road adjustment policy* (OEH 2012). The Project is not anticipated to require the revocation of any land reserved under the NPW Act, nor to require any road adjustments that could affect land reserved under the NPW Act. The Warragamba Offset Program (refer Section 6.2) would provide for the purchase of land suitable for inclusion in the National Park and protected areas system (and potentially including land within the World Heritage area). The policy may be relevant in this regard should any such land already be reserved under the NPW Act such as a State conservation area (SCA), and require recategorisation. It should be noted that the Project does not propose any recategorisation of land under the policy and this reference is included simply to comply with the SEARs.

While the Project does not require the revocation of land, a change to the reserve category, or an adjustment of boundaries to land reserved under the *National Parks and Wildlife Act 1974*, compensation has been considered consistent with the above Policy. The offset strategy has been developed in consultation with NPW managers. In 2018, an amendment to the *Water NSW Act 2014* was enacted which related specifically to the Project and the potential impacts of temporary inundation on national parks in the Warragamba Dam catchment. The amendment of the *Water NSW Act 2014* provided a special provision to allow the temporary inundation of national park land in the Warragamba Dam catchment.

To ensure the mitigation of any impacts from temporary inundation, the special provisions of the *Water NSW Act 2014* also require WaterNSW to prepare an environmental management plan (EMP) in consultation with the Chief Executive of OEH if approval for the Project is given. The EMP would be separate to the BOS but would need to be consistent with the BOS.

3 Project impacts that require consideration of offsetting

3.1 Construction impacts

Impacts associated with the construction of the raised dam wall, and offset credits for the construction related impacts, have been calculated using the FBA. However, as FBA credits are no longer available for purchase, the credits required would need to be converted into Biodiversity Assessment Method (BAM) credits for the offsetting of the project to be realised. WaterNSW will need to seek a 'credit equivalence' statement from EES before seeking to fulfil the offset requirements.

3.1.1 Native vegetation

Impacts resulting from Project construction that fall into the threshold of impacts that require offsetting include:

- The removal of 2.76 hectares of HN564: Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion.
- The removal of 12.25 hectares of HN566: Red Bloodwood - Scribbly Gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
- The removal of 5.77 hectares of HN568: Red Bloodwood - Sydney Peppermint - Blue-leaved Stringybark heathy forest of the southern Blue Mountains, Sydney Basin Bioregion
- The removal of 1.64 hectares of HN604: Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion

The offset requirement for the above PCTs were calculated using the BBCC. A summary of the vegetation zone impacted, threatened species associated with that vegetation zone, loss landscape value, loss in site value, and the number of ecosystem credits required for the impacts is detailed in Table 3-1.

Table 3-1. Credit requirements of the proposed construction works

Veg zone	PCT	Condition	Area impacted (ha)	Current site value	Future site value	Credit requirement
1	HN564	Moderate/Good	0.31	60.63	0.00	16
2	HN566	Moderate/Good	12.25	77.08	0.00	691
3	HN568	Moderate/Good	5.77	91.06	0.00	430
4	HN604	Moderate/Good	1.64	60.14	0.00	84
5	HN564	Moderate/Good_poor	2.45	30.68	0.00	72

3.1.2 Species and populations

Three species credit species were recorded within the development site. However, as outlined in Section 5.7.2 of the Construction BAR (Appendix F3 to the EIS), 54 candidate species credit species are assumed to be present and their habitat required to be offset. The offset requirement for the species credit species were calculated using the BBCC.

It is recommended that targeted surveys be carried out in line with relevant guidelines for threatened flora species currently assumed as present within the development site. Targeted surveys should focus on areas that had been subject to recent prescribed burning, as well as within the development footprint. These surveys would likely refine the quantification of impacts and associated credit liability generated by the Project. A summary of the area of habitat or the number of individuals to be impacted and the credit requirements for species credit species are detailed in Table 3-2. Species recorded are identified with an asterisk (*).

Table 3-2. Credit requirement of the Project for species assumed present

Species name	Common name	BC Act status	EPBC Act status	Area to be offset (ha)	Credit requirement
FLORA					
Acacia baueri subsp. *aspera**	*Acacia baueri* subsp. *aspera*	V	-	12.25	520
Acacia bynoeana	Bynoe's Wattle	E	V	19.96	1,540
Acacia flocktoniae	Flockton's Wattle	V	V	6.11	126
Acacia gordonii	*Acacia gordonii*	E	E	12.25	338
Acacia pubescens	Downy Wattle	V	V	19.66	380
Ancistrachne maidenii	*Ancistrachne maidenii*	V	-	12.55	286
Asterolasia elegans	*Asterolasia elegans*	E	E	12.55	234
Astrotricha crassifolia	Thick-leaf Star-hair	V	V	12.25	1,001
Caesia parviflora subsp. *Parviflora*	Small Pale Grass-lily	E	-	12.55	182
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	12.25	520
Darwinia biflora	*Darwinia biflora*	V	V	12.55	260
Darwinia peduncularis	*Darwinia peduncularis*	V	-	12.25	234
Dillwynia tenuifolia	*Dillwynia tenuifolia*	V	-	12.55	234
Epacris purpurascens var. purpurascens	*Epacris purpurascens var. purpurascens*	V	-	300[1]	5,100
Genoplesium baueri	Bauer's Midge Orchid	V	E	12.25	169
*Grammitis stenophylla**	Narrow-leaf Finger Fern	E	-	1.64	26
Grevillea evansiana	Evan's Grevillea	V	V	12.25	195
*Grevillea parviflora subsp. parviflora**	Small-flower Grevillea	E	-	14.19	210
Gyrostemon thesioides	*Gyrostemon thesioides*	E	-	1.95	154
Haloragodendron lucasii	Hal	E	E	12.25	1,001
Hibbertia puberula	*Hibbertia puberula*	E	-	19.96	800
Hygrocybe anomala subsp. *ianthinomarginata*	*Hygrocybe anomala* subsp. *ianthinomarginata*	V	-	13.89	1,078
Kunzea rupestris	*Kunzea rupestris*	V	V	12.55	338
Lastreopsis hispida	Bristly Shield Fern	E	-	5.79	462
Leucopogon exolasius	Woronora Beard-heath	V	V	18.32	266
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri* subsp. *fletcheri*	E	-	12.55	208
Melaleuca deanei	Deane's Paperbark	V	V	12.55	1,001
Melaleuca groveana	Grove's Paperbark	V	-	13[1]	1,560
Micromyrtus blakelyi	*Micromyrtus blakelyi*	V	V	12.55	338
Olearia cordata	*Olearia cordata*	V	V	12.55	169
Persoonia acerosa	Needle Geebung	V	V	18.02	247
Persoonia hirsuta	Hairy Geebung	E	E	19.96	1,540

Species name	Common name	BC Act status	EPBC Act status	Area to be offset (ha)	Credit requirement
Pimelea curviflora var. curviflora	*Pimelea curviflora var. curviflora*	V	V	14.19	1,155
*Pomaderris brunnea**	Brown Pomaderris	V	V	0.31	15
Pterostylis saxicola	Sydney Plains Greenhood	E	E	12.55	520
Pultenaea glabra	Smooth Bush-Pea	V	V	18.02	285
Pultenaea parviflora	*Pultenaea parviflora*	E	V	12.25	195
Pultenaea sp. Olinda	*Pultenaea sp.* Olinda	E	-	12.25	520
Rhodamnia rubescens	Scrub Turpentine	CE	-	1[1]	154
Syzygium paniculatum	Magenta Lilly Pilly	E	V	10[1]	130
Tetratheca glandulosa	*Tetratheca glandulosa*	V	-	19.96	320
Velleia perfoliata	*Velleia perfoliata*	V	V	12.55	221
Zieria involucrata	*Zieria involucrata*	E	E	1.70	30
Zieria murphyi	Velvet Zieria	V	V	12.55	195
FAUNA					
*Anthochaera phrygia**	Regent Honeyeater	CE	CE	19.96	1,537
Cercartetus nanus	Eastern Pygmy-possum	V	-	19.32	386
*Chalinolobus dwyeri**	Large-eared Pied Bat	V	V	19.96	259
Heleioporus australiacus	Giant Burrowing Frog	V	V	3.60	47
Hoplocephalus bungaroides	Broad-headed Snake	E	V	10.24	338
Isoodon obesulus subsp. obesulus	Southern Brown Bandicoot (eastern)	E	E	12.25	318
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	1.64	21
Petaurus norfolcensis	Squirrel Glider	V	-	19.66	433
Petrogale penicillata	Brush-tail Rock-wallaby	E	V	17.38	452
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	13.89	278
Phascolarctos cinereus	Koala	V	V	20.06	522
*Pseudophryne australis**	Red-crowned Toadlet	V	-	8.25	107
*Varanus rosenbergi**	Rosenberg's Goanna	V	-	19.96	659

1 Credit requirement calculated by number of individuals impacted.

3.2 Upstream impacts

Upstream impact area

The upstream study area comprises the maximum extent of flood prone land estimated from the probable maximum precipitation and resultant inundation. The probabilistic nature of flooding in the upstream study area presents a challenge in identifying appropriate flood events to inform an assessment of potential impacts, and noting that for a specific flood event of a particular chance of occurrence, there is already an existing potential impact associated with that particular flood event.

For the upstream study area, potential impacts would be principally associated with the effects of temporary inundation from operation of the FMZ, the lower limit of which is the existing FSL. The exact nature of the impacts would be dependent on multiple factors such as:

- the timing and magnitude of the rainfall events

- catchment conditions at the time of the rainfall event
- the existing storage level
- the duration, depth and extent of inundation for an individual flood event
- the potential change in vegetation integrity as a result of the differing responses of individual plant species to different inundation regimes
- the type and condition of Aboriginal cultural heritage items and places.

These and other factors contribute to substantial uncertainty with regard to quantifying the potential impacts on World Heritage values, notably biodiversity values and Aboriginal cultural heritage.

In view of this, it was determined that a different approach to assessing potential impacts was required in order to provide relative greater certainty around potential impacts and importantly, to provide a more objective basis for identification and development of mitigation measures. The approach taken has been to identify an 'impact area' that takes account of the variability of flood events and their extent over time.

A review of the historical record identified at least one large flood above FSL would occur within a 20 year period. Building on previous hydrological modelling carried out for the Project, further modelling was undertaken to assess the likely level of inundation upstream of the dam. Around 20,000 Monte Carlo simulated events were used to generate a 200,000 year flood record. This included the full range of possible events based on the latest hydrology analyses. This was then analysed by selecting the maximum inundation level in 20 year periods to determine the 'average' or likely inundation level. This was also undertaken for the existing dam scenario so that a comparison of inundation extents could be made.

Since flood behaviour in the Hawkesbury Nepean Valley has distinct multi-decade wet and dry periods, the inundation assessment modelled potential outcomes considering:

- randomly selected periods
- half wet / half dry periods
- wet dominated periods
- dry dominated periods.

The results from all these hypothetical flood sequences were then analysed to determine what the average or likely inundation outcomes would be.

The average results for the flood/drought sequence were then used to define the upper and lower elevations for the impact area as these were considered to provide the most likely outcome on a statistical basis. These are:

- Lower extent: 2.78 metres above FSL (119.5 mAHD)
- Upper extent: 10.25 metres above FSL (126.97 mAHD).

The likely inundation level for the existing dam is also about the maximum recorded level since construction of Warragamba Dam. For the purposes of the Project, the area between these two levels has been adopted as the upstream impact area. The size of the upstream impact area is about 1400 hectares.

The upstream impact area has been used as a means to offset the potential impacts of the Project. For the purposes of offsetting the potential impacts of the Project, it has been assumed that there would be a complete loss of values in this area. In reality, this is unlikely as sensitive areas/sites would have differing risks of impact depending on their respective locations in terms of elevation. Areas/sites at lower elevations would have a greater risk of temporary inundation than areas/sites at higher elevations within the upstream study area.

Biodiversity

The Project's ongoing operation would result in temporary inundation to native vegetation across the study area. The impact area has been used to calculate the ecosystem and species credit requirements for the project. The Project's credit requirements are summarised below. Details of the method for calculating the credits are outlined in Appendix F1 (Biodiversity Assessment Report – Upstream).

The offset requirement for each PCT was calculated using the BBCC across the four IBRA subregions. A summary of the vegetation zone impacted, loss in site value, and the number of ecosystem credits required for the impacts for each IBRA subregion are detailed in Table 3-3, Table 3-4, Table 3-5, and Table 3-6.

Species credit species requirements are detailed in Table 3-7. This table includes all species assumed to be present due to survey limitations at the time of survey (species recorded are identified with an asterisk (*)). As outlined in Appendix F1 (Biodiversity Assessment Report – Upstream), it is noted that species credit calculations will be reviewed through either additional survey or expert review and are subject to change based on the outcomes of these reviews.

Table 3-3. Ecosystem credit requirements within Bungonia IBRA as a result of the Project

Veg zone	PCT	Condition	Impact area (ha)	Current site value	Future site value	Credit requirement
6	HN553	Moderate/Good	2.58	68.12	0	150
7	HN538	Moderate/Good	0.92	84.44	0	65
13	HN527	Moderate/Good	6.43	72.22	0	392
14	HN527	Moderate/Good_DNG	18.0	53.38	0	844
17	HN557	Moderate/Good	1.89	73.44	0	117
21	HN574	Moderate/Good	54.29	74.64	0	3,412
Total			**84.10**			**4,980**

Table 3-4. Ecosystem credit requirements within the Kanangra IBRA as a result of the Project

Veg zone	PCT	Condition	Impact area (ha)	Current site value	Future site value	Credit requirement
1	HN564	Moderate/Good	0.59	68.12	0	34
2	HN566	Moderate/Good	22.07	84.44	0	1,549
3	HN568	Moderate/Good	5.49	100.00	0	449
9	HN536	Moderate/Good	1.52	86.28	0	109
11	HN535	Moderate/Good	5.90	100.00	0	483
12	HN532	Moderate/Good	0.62	59.42	0	32
16	HN607	Moderate/Good	58.94	76.09	0	3,767
18	HN557	Moderate/Good	0.53	73.44	0	33
19	HN606	Moderate/Good	16.92	74.64	0	1,063
Total			**112.58**			**7,519**

Table 3-5. Ecosystem credit requirements within the Wollemi IBRA as a result of the Project

Veg zone	PCT	Condition	Impact area (ha)	Current site value	Future site value	Credit requirement
1	HN564	Moderate/Good	1.92	60.63	0	100
2	HN566	Moderate/Good	6.04	77.08	0	343
3	HN568	Moderate/Good	17.84	91.06	0	1,339
9	HN536	Moderate/Good	6.19	82.28	0	442
11	HN533	Moderate/Good	1.28	75.36	0	81
12	HN532	Moderate/Good	3.19	59.42	0	164
16	HN517	Moderate/Good	0.34	78.26	0	22
18	HN607	Moderate/Good	1.84	64.98	0	102
19	HN606	Moderate/Good	20.54	85.99	0	1463
Total			**59.19**			**4,056**

Table 3-6. Ecosystem credit requirements within the Burragorang IBRA as a result of the Project

Veg zone	PCT	Condition	Impact area (ha)	Current site value	Future site value	Credit requirement
2	HN566	Moderate/Good	0.52	77.08	0	31
3	HN568	Moderate/Good	7.88	91.06	0	590
6	HN553	Moderate/Good	104.51	68.12	0	6,019
7	HN538	Moderate/Good	27.17	84.44	0	1,897
8	HN537	Moderate/Good	0.13	100.00	0	11
9	HN536	Moderate/Good	205.21	82.28	0	14,613
10	HN535	Moderate/Good	16.27	100.00	0	1,326
11	HN533	Moderate/Good	9.69	75.36	0	610
12	HN532	Moderate/Good	222.23	59.42	0	11,348
13	HN527	Moderate/Good	64.27	72.22	0	13,899
14	HN527	Moderate/Good_DNG	39.05	53.38	0	1,818
15	HN525	Moderate/Good	84.20	76.09	0	5,352
16	HN517	Moderate/Good	0.19	78.26	0	11
17	HN557	Moderate/Good	300.39	73.44	0	18,499
18	HN607	Moderate/Good	12.82	64.98	0	710
19	HN606	Moderate/Good	0.27	85.99	0	20
20	HN598	Moderate/Good	9.71	83.51	0	670
21	HN574	Moderate/Good	13.02	74.64	0	813
Total			**1,117.54**			**68,236**

Table 3-7. Species credit species

Scientific name	Common name	BC Act Status	EPBC Act Status	Upstream impact area (ha) or number of individuals (Ind)	Credit Requirement
FLORA					
Acacia baueri subsp. *aspera**	*Acacia baueri* subsp. *aspera*	V	-	7 ha	280
Acacia bynoeana	Bynoe's Wattle	E	V	35 ha	2,695
*Acacia clunies-rossiae**	Kanangra Wattle	V	-	770 ha	10,010
Acacia flocktoniae	Flockton Wattle	V	V	371 ha	6,678
Acacia gordonii	*Acacia gordonii*	E	E	8.00 ha	208
Acacia pubescens	Downy Wattle	V	V	35 ha	665
Acronychia littoralis[1]	Scented Acronychia	-	-	78 ha	3,878
Acrophyllum australe	*Acrophyllum australe*	V	V	13 ha	234
Ancistrachne maidenii	*Ancistrachne maidenii*	V	-	29 ha	638
Asterolasia buxifolia	*Asterolasia buxifolia*	E	-	14 ha	1,078
Asterolasia elegans	*Asterolasia elegans*	E	E	6 ha	108
Astrotricha crassifolia	Thick-leaf Star-hair	V	V	8 ha	616
Baloskion longipes	Dense Cord-rush	V	V	31 ha	558
*Bossiaea oligosperma**	Few-seeded Bossiaea	V	V	483 ha	7,245
Caesia parviflora subsp. minor	Small Pale Grass-lily	E	-	15 ha	210
*Callistemon linearifolius**	Netted Bottle Brush	V	-	1,968 ind	13,252
Callistemon megalongensis	Megalong Valley Bottlebrush	CE	CE	6 ha	462
Calomnion complanatum	*Calomnion complanatum*	E	-	1 ha	77
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	7 ha	280
Darwinia biflora	*Darwinia biflora*	V	V	8 ha	160
Darwinia peduncularis	*Darwinia peduncularis*	V	-	15 ha	270
Dillwynia tenuifolia	*Dillwynia tenuifolia*	V	-	2 ha	36
Epacris hamiltonii	*Epacris hamiltonii*	E	E	3 ha	54
Epacris purpurascens subsp. purpurascens	*Epacris purpurascens* subsp. *purpurascens*	V	-	300 ind	5,100
Epacris sparsa	Sparse Heath	V	V	2 ind	36
*Eucalyptus benthamii**	Camden White Gum	V	V	44 ha	616
*Eucalyptus glaucina**	Slaty Red Gum	V	V	10,970 ind	23,505
Eucalyptus pulverulenta	Silver-leafed Gum	V	V	170.44 / 275 ind	30
Euphrasia bowdeniae	*Euphrasia bowdeniae*	V	V	3 ha	231
Genoplesium baueri	Bauer's Midge Orchid	E	E	223 ha	2,899
Genoplesium superbum	Superb Midge Orchid	E	-	10 ha	770

Scientific name	Common name	BC Act Status	EPBC Act Status	Upstream impact area (ha) or number of individuals (Ind)	Credit Requirement
*Grammitis stenophylla**	Narrow-leaf Finger Fern	E	-	41 ha	533
Grevillea evansiana	Evans Grevillea	V	V	7 ha	105
*Grevillea parviflora subsp. parviflora**	Small-flower Grevillea	V	V	9 ha	126
Gyrostemon thesioides	*Gyrostemon thesioides*	E	-	886 ha	68,222
*Hakea dohertyi**	Kowmung Hakea	E	E	199 ha	3,781
Haloragodendron lucasii	*Haloragodendron lucasii*	V	V	8 ha	616
Hibbertia puberula	*Hibbertia puberula*	E	-	35 ha	1,400
Hibbertia superans	*Hibbertia superans*	E	E	8.00	208
Isopogon fletcheri	Fletcher's Drumsticks	V	V	3 ha	69
Kunzea rupestris	*Kunzea rupestris*	V	V	8 ha	208
Lastreopsis hispida	Bristly Shield Fern	E	-	23 ha	1,771
Leionema lachnaeoides	*Leionema lachnaeoides*	E	E	1 ha	77
Lepidosperma evansianum	Evans Sedge	V	E	1 ha	77
Leucopogon exolasius	Woronora Beard-heath	V	V	50 ha	392
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri* subsp. *fletcheri*	E	-	8 ha	128
Melaleuca deanei	Deane's Paperbark	V	V	9 ha	693
Melaleuca groveana	Grove's Paperbark	V	-	6 ind	84
Micromyrtus blakelyi	*Micromyrtus blakelyi*	V	V	8 ha	208
Olearia cordata	*Olearia cordata*	V	V	8 ha	104
Persicaria elatior	Tall Knotweed	V	V	896 ha	11,648
Persoonia acerosa	Needle Geebung	V	V	33 ha	429
Persoonia bargoensis	Bargo Geebung	E	V	22 ha	1,694
Persoonia glaucescens	Mittagong Geebung	E	V	9 ha	693
Persoonia hirsuta	Hairy Geebung	E	E	35 ha	2,695
Pherosphaera fitzgeraldii	Dwarf Mountain Pine	E	E	1 ha	26
Phyllota humifusa	Dwarf Phyllota	V	V	8 ha	144
Pimelea curviflora subsp. *curviflora*	*Pimelea curviflora* subsp. *curviflora*	V	V	8 ha	616
*Pomaderris brunnea**	Brown Pomaderris	E	V	1,146 ha	17,190
Pterostylis saxicola	Sydney Plains Greenhood	E	E	111 ha	4,440
Pultenaea glabra	Smooth Bush-Pea	V	V	33 ha	495
Pultenaea parviflora	*Pultenaea parviflora*	E	V	7 ha	105
Pultenaea sp. Olinda	*Pultenaea sp. Olinda*	E	-	7 ha	280

Scientific name	Common name	BC Act Status	EPBC Act Status	Upstream impact area (ha) or number of individuals (Ind)	Credit Requirement
Rhizanthella slateri	Eastern Australian Underground Orchid	V	E	23 ha	1,771
Rhodamnia rubescens	*Scrub Turpentine*	CE		78 ind	3,878
*Solanum amourense**	*Solanum amourense*	E	-	470 ha	6,110
Tetratheca glandulosa	*Tetratheca glandulosa*	V	-	305 ha	4,880
Trachymene scapigera	Mountain Trachymene	E	E	19 ha	760
Velleia perfoliata	*Velleia perfoliata*	V	V	18 ha	306
Xanthosia scopulicola	*Xanthosia scopulicola*	V	-	21 ha	315
Zieria covenyi	Coveny's Zieria	E	E	11 ha	1,100
Zieria involucrata	*Zieria involucrata*	E	V	21 ha	315
Zieria murphyi	Velvet Zieria	V	V	7 ha	105
FAUNA					
*Anthochaera phrygia**	Regent Honeyeater	CE	CE	1,264.55	97,370
Cercartetus nanus	Eastern Pygmy-possum	V	-	1,296.12	25,923
*Chalinolobus dwyeri**	Large-eared Pied Bat	V	V	1,203.02	15,640
Helioporus australiacus	Giant Burrowing Frog	V	V	883.64	11,487
Hoplocephalus bungaroides	Broad-Headed Snake	E	V	124.71	4,116
Isoodon obesulus subsp. obesulus	Southern Brown Bandicoot (Eastern)	E	E	1,167.29	30,348
Ixobrychus flavicollis	Black Bittern	V	-	1.84	24
Litoria littlejohnii	Littlejohn's Tree Frog	V	V	420.32	10,935
Macropus parma	Parma Wallaby	V	-	1.84	48
Myotis macropus	Southern Myotis	V	-	863.79	19,004
Petaurus norfolcensis	Squirrel Glider	V	-	1,238.37	27,244
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	411.70	10,706
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	32.98	660
Phascolarctos cinereus	Koala	V	V	1,380.35	35,890
*Pseudophryne australis**	Red-crowned Toadlet	V	-	760.31	9,874
*Varanus rosenbergi**	Rosenbergs Goanna	V	-	1,111.39	36,676
FUNGI					
Hygrocybe anomala subsp. *ianthinomarginata*	*Hygrocybe anomala* subsp. *ianthinomarginata*	V	V	267 ha	20,559
Hygrocybe aurantipes	*Hygrocybe aurantipes*	V	-	35 ha	1,400
Hygrocybe reesiae	*Hygrocybe reesiae*	CE	CE	35 ha	1,400

1 *Acronychia littoralis* (Scented Acronychia) has been used as a surrogate for *Rhodamnia rubescens* as the latter species is not available in the BBCC.

3.3 Downstream impacts

Assessment of potential impacts on downstream biodiversity has been carried out with reference to the matters specified in requirement 6.2 and Attachment B to the SEARs. A risk assessment framework was used to determine the key likely impacts of the Project and the biodiversity features likely to be most sensitive to the predicted changes in hydrological conditions. This involved carrying out a risk assessment on the key impacts relevant for biodiversity and cross-referenced with threatened species and communities with potential to occur within the downstream survey area. Threatened entities that had a moderate or higher potential to occur and were subject to 'Medium' or greater impact risk were further assessed through an Assessment of Significance under the TSC Act.

Downstream of the Project there are numerous land uses and activities that have an existing impact on the environment. For example, with regard to hydrology and water quality in the downstream catchment these would include inflows from downstream catchments (for example, the Nepean River, Grose River, Macdonald River, and Colo River), runoff from rural and urban land uses, and the discharge of sewage treatment plants. These will, to greater or lesser degrees, be occurring concurrent with the Project impacts and present practicable constraints to accurately apportioning impacts to the Project and to other sources. Local hydrology is likely to be the dominant influence on biodiversity and groundwater recharge. This uncertainty is likely to increase with increasing distance downstream, and this in turn presents challenges to practical management, mitigation and offsetting of potential impacts associated with the Project.

Because of this lack of quantifiable impacts resulting from the Project, no offsets are proposed for potential downstream impacts.

4 Avoid, minimise and mitigate

Principle 1 of the *NSW Biodiversity Offsets Policy for Major Projects* (NSW Government, 2014) requires that project proposals consider all reasonable measures to avoided and minimise impacts in biodiversity. The following chapter outlines how the project has avoided and minimised impacts to biodiversity in line with the policy.

4.1 Construction impacts

4.1.1 Avoidance of direct impacts

Under the FBA, a proponent must seek to avoid the direct impacts of a Major Project on all biodiversity values at the development site including impacts on:

- Endangered ecological communities (EECs) and critically endangered ecological communities (CEECs)
- PCTs that contain threatened species habitat
- Areas that contain habitat for vulnerable, endangered or critically endangered threatened species or populations
- An area of land that the Minister for Environment has declared as critical habitat in accordance with section 47 of the TSC Act
- The riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries
- State significant biodiversity links.

The scale and nature of the development type means that options to avoid impacts to biodiversity within the development site are very limited. The development site is necessarily tied to the current dam wall and direct impacts resulting from the footprint of any newly built section of dam wall, including abutments and spillway, cannot be avoided. However, where feasible, ancillaries such as batch plants, laydowns, and worker amenities have been located within areas which do not contain native vegetation or threatened species habitat.

4.1.2 Measures to minimise and mitigate impacts

The measures proposed to minimise and mitigate impacts to biodiversity during construction of the raised dam wall are outlined in Table 4-1.

Table 4-1. Summary of measures to minimise direct impacts of the proposed development during construction

Impact	Mitigation measure	Outcome	Timing	Responsibility
General flora and fauna	A flora and fauna management plan (FFMP) would be prepared as part of the construction environmental management plan (CEMP). Native vegetation clearing would not occur until the FFMP is approved.	Flora and fauna would be managed in accordance with the requirements of the FFMP	Pre-construction and construction	WaterNSW and Construction Contractor
	The FFMP would be prepared to manage the vegetation retained within the development site. The plan would include details on weed and pest management, nest boxes and fauna habitat maintenance and monitoring procedures.	The vegetation within the development site surrounding the storage area would be managed in accordance with the FFMP	Pre-construction, construction and post-construction phases	WaterNSW and Construction Contractor
Degradation of freshwater wetland habitats	Install appropriate drainage infrastructure (e.g. sediment basins, diversion drains), sediment and erosion controls prior to the commencement of construction.	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats	Pre-construction	WaterNSW and Construction Contractor
	Clearing of vegetation would be timed to avoid periods when rain is forecast	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats	Pre-construction and construction	WaterNSW and Construction Contractor
	Stabilisation of disturbed areas, including revegetation in accordance with the Erosion and Sediment Control Plan, is to be undertaken as soon as practicable after disturbance.	Prevents sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats	Pre-construction, construction and post-construction phases	WaterNSW and Construction Contractor
	Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak to be clearly articulated in the construction and operational environmental management plans.	Prevents pollution of waterways.	Pre-construction and construction	WaterNSW and Construction Contractor
	Spill kits to be located to allow for timely response to uncontained spills. Site inductions are to include a briefing on the use of spill kits.	Prevents pollution of waterways.	Pre-construction and construction	WaterNSW and Construction Contractor
Vegetation removal or disturbance	Clearly identifying sensitive areas ('no-go zones') which cannot be impacted by construction and managing clearing such that clearing activities are constrained to these approved areas only.	Prevention of over clearing of vegetation.	Pre-construction and construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	Site inductions are to include a briefing regarding the local threatened species and communities on the site, and protocols to be undertaken if they are encountered.	Prevention of impacts to threatened species and communities.	Construction and post-construction.	WaterNSW and Construction Contractor
Weed invasion and spread	Management of weeds in and adjacent to cleared areas will occur in accordance with the FFMP and CEMP. The plan would include details relating to the monitoring, management, and where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols, if required.	Prevention of weed establishment and weed invasion.	Pre-construction, construction, and post-construction.	WaterNSW and Construction Contractor
	Management of noxious weeds is to be undertaken in accordance with the *Biosecurity Act 2015*.	Prevention of weed establishment and weed invasion	Pre-construction and construction	WaterNSW and Construction Contractor
	Equipment used for treating weed infestation will be cleaned prior to moving to a new area within the development site to minimise the likelihood of transferring any plant material and soil.	Prevention of weed spread	Pre-construction and construction	WaterNSW and Construction Contractor
	Soil stripped and stockpiled from areas containing known weed infestations are to be stored on cleared land at least 40 m from native vegetation.	Prevention of weed establishment and weed invasion	Construction	Construction Contractor
Impacts to fauna and flora	Fauna microhabitat such as hollow logs and dead trees should be removed from areas to be cleared and relocated to adjacent woodland habitat.	Retaining fauna habitat resources	Pre-construction and construction	Construction Contractor
	A nest box and connectivity management strategy would be prepared prior to clearing of hollow bearing trees and connecting links. The strategy would inform the installation of nest boxes and fauna crossings in and between retained native vegetation adjacent to the site, and the on-going monitoring and maintenance of nest boxes and crossings through the construction and operational phases. This strategy would be included within the FFMP.	Replaces lost hollow resources in the landscape	Pre-construction and construction	Construction Contractor
	High visibility plastic fencing is to be installed to clearly define the limits of the works area.	Prevents disturbance or over clearing of fauna habitat and native vegetation outside the construction area	Construction	Construction Contractor
	Undertake a prestart-up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials.	Prevents fauna injury/mortality	Construction	Construction Contractor
	Site inductions are to include a briefing regarding the site's local fauna and protocols to be undertaken if fauna are encountered.	Prevents fauna injury/mortality	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	If any animal is injured, contact the relevant local wildlife rescue agency (for example, WIRES) and/or prequalified veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, minimise stress to the animal and reduce the risk of further injury by: ▪ handling fauna with care and as little as possible ▪ covering larger animals with a towel or blanket and placing in a large cardboard box ▪ placing smaller animals in a cotton bag or plastic bag (smaller reptiles and frogs), tied at the top ▪ keeping the animal in a quiet, warm and ventilated space.	Prevents fauna injury/mortality	Pre-construction, construction, and post-construction.	WaterNSW and Construction Contractor
	If any pits/trenches are to remain open overnight, they are to be securely covered, where reasonable and feasible. Alternatively, fauna ramps (logs or wooden planks) are to be installed to provide an escape for trapped fauna. Pits will be inspected prior to work recommencing and any fauna removed by the project ecologist or designated suitably qualified and licensed representative.	Prevents fauna injury/mortality	Construction	Construction Contractor
	The extent of vegetation clearing is to be clearly identified on construction plans.	Prevents impacts to fauna habitat and native vegetation outside the development footprint	Pre-construction	WaterNSW and Construction Contractor
	In circumstances where native vegetation or mature tree clearing is required outside of the biodiversity development site, the project ecologist will inspect the proposed area and provide advice on the impact to flora and fauna and appropriate management.	Prevents impacts to fauna habitat and native vegetation outside the development footprint	Construction	WaterNSW, Construction Contractor, and appointed project ecologist
	Directional lighting will be used where lighting is required in construction areas.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction Contractor
	Maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.	Prevents fauna injury/mortality	Construction	Construction Contractor
	Speed limits will be developed so as to minimise the potential for fauna to be struck by a vehicle within the development site. All vehicles and plant in operation during construction are to adhere to site rules relating to speed limits.	Prevents fauna injury/mortality	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
Bushfire risk connectivity	Bushfire awareness included in staff induction and in toolbox talks pre-commencement.	Reduces risk of possible bushfire events impacting on biodiversity values	Pre-construction and construction	Construction Contractor
Invasion and spread of pathogens and disease	Implementation of hygiene protocols to minimise risk of spreading pathogens and disease. Mitigations include vehicle and equipment washdowns, and follow relevant guidelines including: ▪ *Best Practice Management Guidelines for* Phytophthora cinnamomi *within the Sydney Metropolitan Catchment Management Authority Area* (Botanic Gardens Trust, 2008) ▪ *Hygiene protocol for the control of disease in frogs* (NPWS, 2008) ▪ *Management plan for myrtle rust on national parks estate* (OEH, 2011)	Prevents the spread and establishment of disease and pathogens	Pre-construction and construction	Construction Contractor

4.2 Upstream impacts

4.2.1 Avoidance of impacts

Chapter 4 of the EIS discusses the proposed alternatives that were considered for flood mitigation in the Hawkesbury-Nepean Valley, including:

- non-structural strategies: these do not alter flood levels but reduce the effects of flooding.
- floodplain works: localised physical works in the floodplain could be used to divert floodwaters from properties.
- drainage strategies: these lower flood levels by assisting floodwaters to escape from the floodplain.
- flood detention strategies: these temporarily store floodwaters on contributing rivers and thereby lower peak levels downstream.
- combined strategies: these combine some of the above approaches.

4.2.2 Measures to minimise and mitigate impacts

Upstream impacts have been minimised through the setting of the central and auxiliary spillway crest levels to reduce the extent and duration of upstream inundation. Operational protocols would be developed to as far as practicable limit the extent and duration of upstream inundation.

Section 64C of the *Water NSW Act 2014* requires WaterNSW to prepare, in consultation with the Chief Executive Officer of OEH, an environmental management plan relating to the temporary inundation of national park land resulting from the Warragamba Dam Project. Should the Warragamba Dam Project be approved under the EP&A Act, the National Parks and Wildlife Minister is to determine the matters that are to be addressed by a draft EMP.

As noted previously, the EMP is separate to the proposed mitigation measures for the Project but would complement and support these measures.

4.3 Downstream impacts

4.3.1 Avoidance of impacts

Chapter 4 of the EIS discusses the proposed alternatives that were considered for flood mitigation in the Hawkesbury-Nepean Valley. The principal alternatives assessed were:

- infrastructure upgrades to enhance drainage or protect downstream communities
- new flood mitigation dams, including new dams built and operated only for flood mitigation
- operational alternatives using existing infrastructure
- evacuation road upgrades
- non-infrastructure alternatives, such as changes to planning controls, improved flood monitoring and response and better coordination between agencies.
- strategies combining two or more of the above alternatives.

Criteria used to assess these options were based on reducing flood level peak, reducing risk to life, economic costs and environmental impacts. Other alternatives and options either did not achieve sufficient flood mitigation or had unacceptable economic or environmental costs. Other measures to avoid impacts include:

- Provision of a 14-metre FMZ rather than a 20-metre FMZ. While a 20-metre FMZ would provide a greater reduction in flooding downstream compared to a 14-metre FMZ, the greater environmental costs from the longer period and extent of upstream temporary inundation were a major factor in discounting this alternative.
- Emptying the FMZ as soon as practical. One of the key objectives of the discharge protocol for the FMZ would be to minimise the duration and extent of upstream temporary inundation.

The scale and nature of the development type means that options to avoid impacts to threatened entities within the project boundary are limited to above.

4.3.2 Measures to minimise and mitigate impacts

The measure proposed to minimise and mitigate impacts to biodiversity values is to develop and implement an operation protocol that aims to balance operational impacts within the upstream and downstream areas.

5 Offsetting options

Offset strategies can include both on-site and off-site or local area schemes that contribute to the long-term conservation of threatened species and communities. Biodiversity offsets are required to compensate for the residual biodiversity impacts associated with the Warragamba Dam Raising Project.

The *NSW Biodiversity Offsets Policy for Major Projects* (NSW Government 2014) prescribes four types of strategies that can be used to fulfil the offset requirements:

- offsetting through a site secured stewardship (formerly known as biobanking) agreement
- purchasing credits
- supplementary measures following the rules prescribed in Appendix B the policy
- monetary contribution into the Biodiversity Conservation Fund.

These are discussed as follows.

5.1 Offsetting through a site secured stewardship agreement

Offset sites will generally be secured using a conservation covenant, and an appropriate biodiversity management framework would then be implemented. The NSW Biodiversity Offset Scheme and Biodiversity Assessment Method (BAM) (formerly known as BioBanking) provides a mechanism for biodiversity offset sites to be securely titled under a legally binding conservation covenant known as a Biodiversity Stewardship Agreement (BSA) (formerly known as a BioBanking agreement). This system expresses the conservation gain delivered through conservation and management of the offset site in terms of biodiversity credits and provides rules for the like-for-like trading of credits to offset the impacts of the Project.

If the offset sites are secured under a BSA then the number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would be purchased and retired. This outcome will be achieved either through identification of suitable offset areas and completion of a BSA assessment to secure a new offset site, or purchase of biodiversity credits from existing BSA sites that contain habitat for the affected threatened biota. The biodiversity credits must be retired to offset the impact of the Project on biodiversity values.

There are three key areas for a potential biodiversity stewardship agreement as part of the Project:

- 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 reserve under a Plan of Management.

5.2 Purchase credits

The Environment, Energy and Science (EES) Group within DPIE maintains a number of BioBanking public registers, including:

- Biobanking agreement register – provides the location of each biobank site, the number and type of credits generated and a copy of the biobanking agreement.
- Biodiversity credits register – provides ownership information in relation to each credit, and their status.
- Biobank site expressions of interest (EOI) register – landowners who are interested in establishing biobank sites but have not entered into a biobanking agreement.

There is an opportunity for purchasing credits from landowners selling appropriate credits on the market, should they be available. Once purchased, the biodiversity credits must be retired to offset the impact of the Project on biodiversity values. Purchased credits would need to be consistent with the like for like offset rules set out in the FBA.

5.3 Supplementary measures

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. Before supplementary measures can be considered as an offset, WaterNSW must demonstrate that all reasonable steps have been taken to secure an offset site or biodiversity credits. Given the difficulty in sourcing biodiversity credits for all Plant Community Types and species credit species impacted by the project, the use of supplementary measures may be needed for the Project. Use of supplementary measures, if used, would be consistent with the requirements set out in Section 10 of the FBA.

WaterNSW must follow the four-tier decision hierarchy when identifying supplementary measures. The four tiers are described below:

1. Tier 1 – Actions directed to the entity impacted: Tier 1 actions are those which directly benefit the threatened species, community, or population impacted. Offsets for EPBC protected matters cannot move past Tier 1 of the hierarchy.
2. Tier 2 – Actions directed to similar entities in the locality: Tier 2 actions are those directed to similar entities to those impacted in line with the variation rules.
3. Tier 3 – Actions to benefit broader threatened species: Tier 3 actions are those directed to any threatened species, communities, and populations within the same IBRA subregion within which the impact occurs.
4. Tier 4 – Actions to benefit broader threatened species: Tier 4 actions are those directed to any threatened species, communities, and populations anywhere in NSW.

5.4 Biodiversity Conservation Fund

WaterNSW may deposit into the Biodiversity Conservation Fund as an alternative to retiring biodiversity credits. By doing this, the responsibility of finding an offset is transferred to the Biodiversity Conservation Trust. The financial contribution required for WaterNSW to meet its offset obligation is calculated by the Biodiversity Offset Payment Calculator which uses three modules to calculate the costs of paying into the fund based on previous credit trades made, market fluctuation risk, and administrative costs.

6 Offset strategy implementation

6.1 Offset strategy for construction related impacts

The process for identifying, prioritising and meeting project biodiversity credit requirements for the construction related impacts are described below in order of preference. The offset liability generated by construction related impacts would be offset before construction works commenced.

6.1.1 Assessment of BSA site options

WaterNSW would carry out an assessment of suitability of potential BSA sites on WaterNSW owned, or privately owned land via the BioBank site expressions of interest public register. This process would involve:

- Initial desktop assessment to identify land which potentially contain plant community types, and species credit species habitat which meet the requirements of like-for-like, or allowable under the variation rules, in order to identify potential BSA sites.
- Ground truth the identified potential BSA sites for suitable PCTs and species credit species habitat. Targeted surveys may be required to determine presence of species credit species within the potential BSA sites.
- Select BSA sites and carry out necessary assessment and reporting to establish a BSA.
- Retiring credits into the biodiversity conservation fund to meet offset requirements.

Works associated with this option will be carried out by an accredited person under the *Biodiversity Conservation Act 2016* (BC Act).

6.1.2 Purchase of credits from the market

The potential for purchasing credits from landowners selling appropriate credits on the market will be investigated as part of the offset strategy implementation. This investigation will involve searches of the Biodiversity credits register and following up responses from potential landowners/credit brokers to the Warragamba Dam Raising 'credits wanted' expression of interest. Should suitable biodiversity credits be identified, WaterNSW would commence negotiations to purchase available credits. Purchased credits would be retired into the biodiversity conservation fund to meet offset requirements.

6.1.3 Supplementary measures

Should supplementary measures be required in the event that suitable biodiversity credits are not available, WaterNSW would follow the process outlined in Section 5.3.

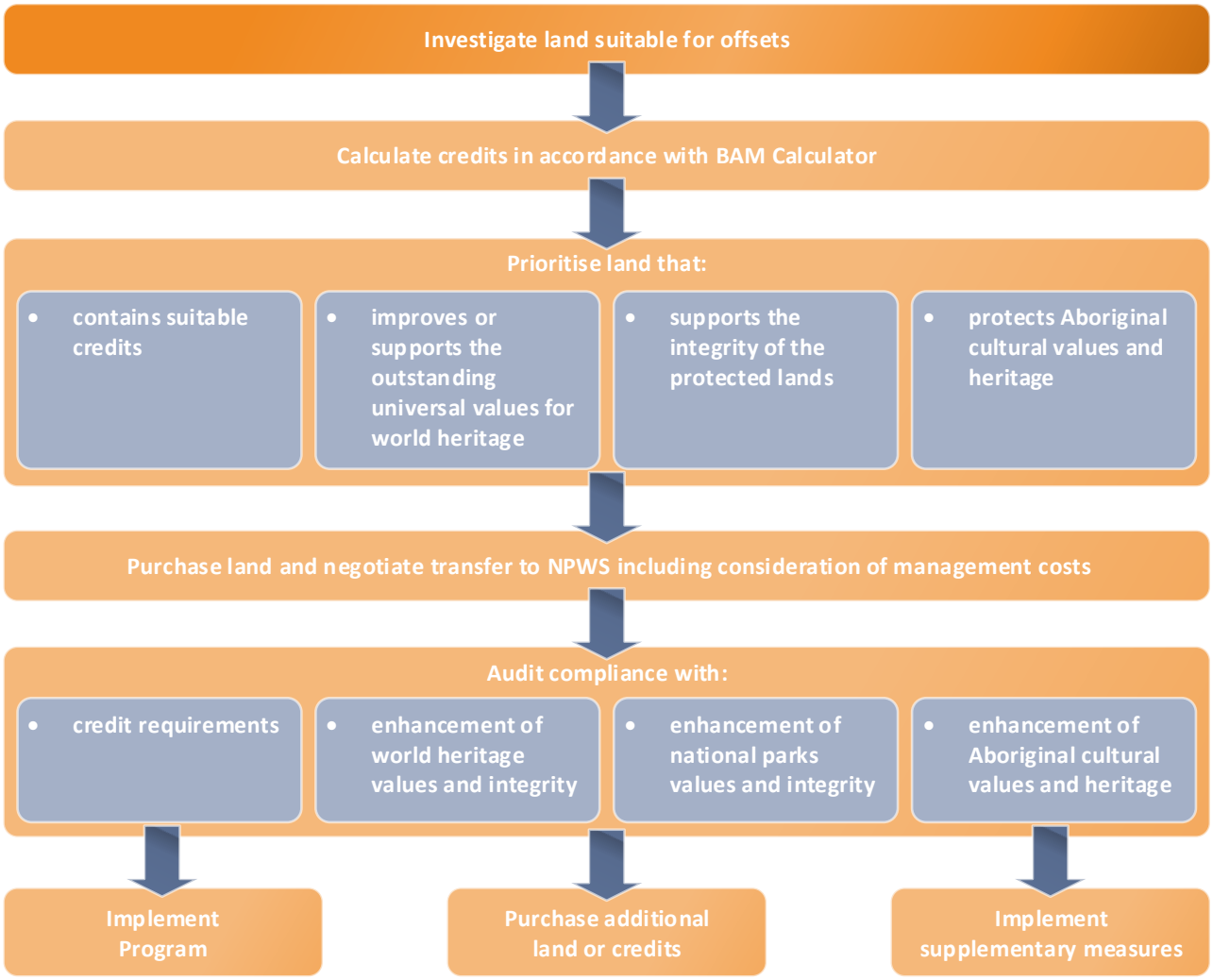
6.1.4 Biodiversity Conservation Fund

In the instance where biodiversity credits could not be sourced from BSA sites on WaterNSW/private land, or on the credit market, WaterNSW would deposit the balance of credits into the Biodiversity Conservation Fund to meet their offset obligations.

6.2 Offset strategy for upstream operational impacts

The process of identifying, prioritising and meeting project biodiversity credit requirements for the upstream operational impacts would be via a project-specific Warragamba Offset Program. The program would include specific actions which, when implemented, would offset for the potential impacts of the Project within the upstream study area.

Figure 6-1. Summary of the proposed approach to implementing the Warragamba Offset Program



It should be noted that while the Warragamba Offset Program will prioritise land suitable for inclusion in the National Park estate additional offsets may be needed through purchase and retirement of biodiversity credits in order to meet the credit requirements for the project. Any land containing suitable offsets must also be appropriate for the National Park estate and supported by NPWS for this purpose. It is intended that as a minimum the quantum of land required to compensate for impact on National Parks (including the affected part of the GBMWHA) will be equivalent to or greater than the area impacted (1,400 hectares) and that this would incorporate a minimum area of 304 hectares containing OUV values to offset potential impacts to the GBMWHA.

With regard to prioritising land that improves or supports the OUV for the GBMWHA, this would include consideration of, as appropriate:

- Wilderness areas
- Aboriginal cultural heritage
- plant communities identified in the OUV statement
- threatened flora species
- habitat of threatened fauna species
- Eucalyptus species
- other biodiversity related matters
  - scleromorphic species
  - ant-adapted plants
  - diversity and characteristics of the flora as a whole

  - species diversity
  - vertebrates and invertebrates identified in the OUV statement
- visual amenity
- users of the GBMWHA
- geological structure, geomorphology and water systems.

This would be informed by the detailed assessment provided in Appendix J (World Heritage Assessment Report).

The Warragamba Offset Program will include the establishment of an advisory committee which would comprise a group of core representatives from DAWE, DPIE, NPWS, Local Land Services, Biodiversity Conservation Trust, Greater Blue Mountains World Heritage Area Management Committee, WaterNSW, and Infrastructure NSW, and would involve other parties such as local council and relevant subject matter experts where required. The advisory committee would be overseen by an independent chairperson.

The advisory committee would provide input into:

- consideration of compensatory options for both downstream and upstream that adhere to the NSW Biodiversity Offsets Policy for Major Projects, EPBC Environmental Offsets Policy, and OEH's Principles for the use of biodiversity offsets in NSW
- identification and prioritisation of potential compensatory options
- selection of final suite of biodiversity compensation package
- determining allocation of compensation funds to each action
- an annual Implementation Report to be issued to NSW and Commonwealth Governments outlining the actions taken and how compensatory obligations are being fulfilled.

6.2.1 Timing of offset program implementation

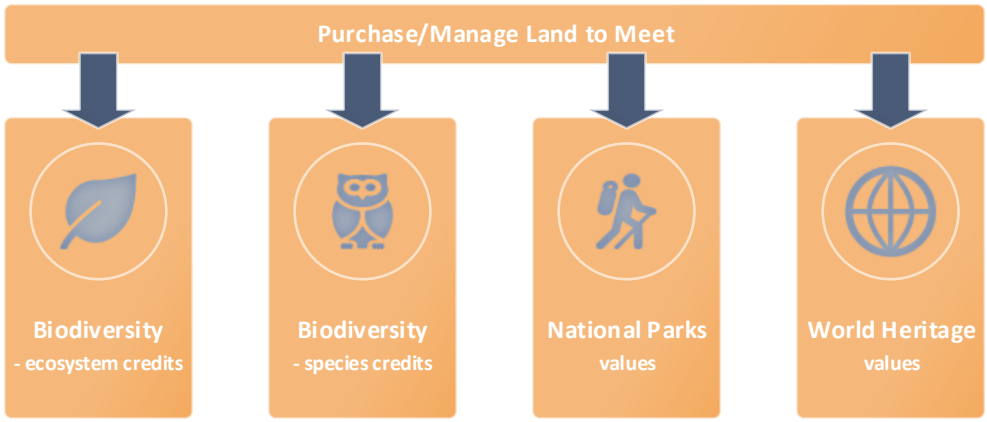
The Warragamba Offset Program for upstream impacts will be implemented prior to Project operation.

6.2.2 Assessment of offset site options

The Warragamba Offset Program would investigate the suitability of potential offset sites. This process would involve:

- Preliminary investigations have identified land which potentially contains plant community types, and species credit species habitat which meet the requirements of like-for-like, or allowable under the variation rules, in order to identify potential offset sites
- Ground truth the identified potential offset sites for suitable PCTs and species credit species habitat. Targeted surveys may be required to determine presence of species credit species within the potential offset sites
- Determine if areas of selected land are suitable for inclusion into national parks and World Heritage estate and add to the integrity of the world heritage area or protected land estate. Suitable lands may include freehold lands and properties within or immediately adjacent to the national parks and world heritage areas. Figure 6-2 illustrates the goal of the Warragamba Offset Program to target offset sites that meet both biodiversity and protected lands goals.
- Select offset sites and carry out necessary assessment and reporting consistent with establishing a Biodiversity Stewardship Agreement.
- Assessment will be carried out by an accredited person under the BC Act.

Figure 6-2. Targeting of offsets



6.2.3 Establishment of offsets

It is proposed that the priority for the Warragamba Offset Program will be purchase of land suitable for inclusion in the National Park and protected areas system potentially included within the World Heritage area. This is consistent with the potential impacts of the project occurring within the National Park system. WaterNSW would work with NPWS to ensure that the land is suitable for inclusion and that costs of management of the lands to ensure the offset is delivered is appropriately considered in the Warragamba Offset Program.

The implementation of the Warragamba Offset Program will be audited to measure progress towards providing the required biodiversity credits and improvements to the protected lands system and world heritage values. Should additional offsets be required the following actions would be considered:

- Purchase of additional land
- Purchase and retirement of credits from the credit market
- Implementation of supplementary measures that achieve benefits for species and communities potentially impacted by the project or benefit the management of the protected lands system or the integrity of world heritage values. The final suite of supplementary measures would meet the 18 rules governing the use of supplementary measures under the NSW Biodiversity Offsets Policy for Major Projects.

Potential supplementary measures may include species specific actions recommended within the NSW Saving our Species program and commonwealth recovery plans; actions that contribute to threat abatement programs; biodiversity research and survey programs; actions that promote protection of world heritage values within the regional community.

6.2.4 Development and implementation of environmental management plan

Under section 64C of the *Water NSW Act 2014*, WaterNSW is required to develop and implement an EMP for the upstream operational area related to the temporary inundation of national park land resulting from the Warragamba Dam Project. The EMP will be separate to the proposed Warragamba Offset Program but will complement and support the Program.

The *Water NSW Act 2014* establishes the powers and functions of WaterNSW and allows areas associated with water supply to be declared as special or controlled areas. These areas may include the catchment of water storages or other land used for water supply purposes (for example, pipeline and dam sites).

In 2018, an amendment to the *Water NSW Act 2014* was enacted which related specifically to the Project and the potential impacts of temporary inundation on national parks estate in the Warragamba Dam catchment. The amendment provided a special provision to allow the temporary inundation of national park land in the Warragamba Dam catchment.

To ensure the mitigation of any impacts from temporary inundation, the special provisions also require:

- WaterNSW to prepare an EMP in consultation with the Chief Executive of OEH if approval for the Project is given.
- The NPW Minister to determine the matters that are to be addressed by an EMP.

- The NPW Minister with the concurrence of the Minister for Water approve an acceptable EMP.
- The NPW Minister with the concurrence of the Minister for Water require an approved EMP to be updated or reviewed.
- The NPW Minister with the concurrence of the Minister for Water may direct Water NSW to take specified actions in relation to the temporary inundation of national park land resulting from the Warragamba Dam project, including action relating to the monitoring of risks associated with the temporary inundation and relating to the rehabilitation or remediation of land.
- WaterNSW to implement and monitor the EMPs.
- Water NSW to notify the Chief Executive of OEH if it is of the opinion that a flood event that may affect national park land in the vicinity of Warragamba Dam is likely to occur.

The scope and content of the EMP have yet to be defined but would need to be consistent with the existing management plans for the national parks and GBMWHA.

6.3 Offset strategy for downstream operational impacts

Offsets for potential impacts within the downstream area are not proposed as outlined in Appendix F2 (Downstream ecological assessment).

7 Evaluation of the proposed offset strategy against offset criteria

7.1 NSW offsetting principles

An evaluation of the proposed offset strategy against the NSW offsetting principles is provided below.

As outlined in Section 2.3, the *NSW Biodiversity Offsets Policy for Major Projects* is underpinned by six principles, which must be considered when assessing offsets for major projects. Details how the Project's offsets have been applied to the principles are discussed in Table 7-1 below.

Table 7-1. Application of NSW biodiversity offset policy principles

Principle	Application to the Project
1. Before offsets are considered, impacts must first be avoided, and unavoidable impacts minimised through mitigation measures. only then should offsets be considered for the remaining impacts.	The Project has applied the hierarchy of 'avoid-minimise-offset': Avoid: Options for avoidance are limited given the scale and nature of the development types, but alternatives to the project have been considered as outlined in Section 4 of this report and in detail in Chapter 4 of the EIS. Minimise: Mitigation measures to be employed as part of the construction and operational phases are outlined in Section 4.
2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.	The impacts of the Project have been assessed following a transparent assessment methodology, the Framework for Biodiversity Assessment (FBA). There are three key stages involved with the framework including: ▪ Stage 1 – biodiversity assessment ▪ Stage 2 – impact assessment of biodiversity values ▪ Stage 3 – biodiversity offset strategy. The Biodiversity Assessment Reports prepared for the Project are consistent with the methods outlined in the FBA to assess biodiversity in relation to the project impacts. The impact assessment on biodiversity values is found in: ▪ Appendix F1 to the EIS (Upstream biodiversity assessment report). ▪ Appendix F3 to the EIS (Construction biodiversity assessment report). Appendix F2 to the EIS (Downstream environmental assessment is compliant with Appendix B of the SEARs This document addresses the requirements of Stage 3 of the FBA.
3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	The proposed offset strategy targets the biodiversity values being potentially impacted and these are quantified through the FBA calculator.
4. Offsets must be additional to other legal requirements.	Offsets proposed in the BOS are additional to other legal requirements.
5. Offsets must be enduring, enforceable and auditable.	The Warragamba Offset Program would oversee the delivery of offsets to be made through either addition to the protected lands estate or through Biodiversity Stewardship Agreements. Any offsets made through these mechanisms would be enduring, enforceable, and auditable.
6. Supplementary measures can be used in lieu of offsets.	While efforts would be made to source biodiversity credits through land based offsets mechanisms, the use of supplementary measures may be required and be appropriate to meet offset requirements.

7.2 Commonwealth offsetting principles

The EPBC Act Environmental Offsets Policy identifies eight requirements to be addressed when considering impacts on protected matters related to the Project. Comment on how the Project is considered to address these requirements with regard to listed threatened species and ecological communities is provided in Table 7-2.

Table 7-2. Assessment against Environmental Offsets Policy requirements

Requirement	Assessment of the Project
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The proposed approach to offsetting potential impacts of the Project prioritises identification and investigation of suitable land for offsets, and prioritises land that contains suitable credits, improves or supports the OUV for World Heritage, supports the integrity of protected lands, and protects Aboriginal cultural heritage and values. The BOS would be implemented through the Warragamba Offset Program.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The priority for the Warragamba Offset Program is on securing direct offsets. The use of other compensatory measures may be required to meet offset requirements.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	This is inherent in the proposed approach to implementation of the Warragamba Offset Program (refer also above comment for first requirement).
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	Suitable offsets would be determined through the use of the FBA to ensure they are proportionate to the residual risks.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	The Warragamba Offset Program is being guided by the FBA which builds risk into the credit calculations. Offset sites would be protected through either protected land status or Biodiversity Stewardship Agreements that provide long term legal protection to the sites.
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The Warragamba Offset Program will be additional to any existing statutory requirements (such as the EMP required under the *Water NSW Act 2014*).
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The Warragamba Offset Program would be based on the FBA processes accredited under the EPBC Act that represent best practice in offset calculation. Any offsets made through these mechanisms would be efficient, effective, transparent, scientifically robust and reasonable.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The Warragamba Offset Program would provide a transparent process to audit and enforce implementation. An appropriate reporting program outlining progress towards meeting offset requirements will be included.

8 References

Department of the Environment (2014) *Environmental Management Plan Guidelines.* Department of the Environment, Canberra.

Department of Sustainability, Environment, Water, Population and Communities (2012) *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

NSW Government (2014) *NSW Biodiversity Offsets Policy for Major Projects*. State Government of NSW and Office of Environment and Heritage. Sydney.

Office of Environment and Heritage (2018) OEH's Principles for the use of biodiversity offsets in NSW. https://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm, last accessed 15th June 2019.

Office of Environment and Heritage (2012) *Revocation, Re-categorisation and Road Adjustment Policy*

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