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Environmental Impact Statement – Chapter 18: Aboriginal Cultural Heritage

Warragamba Dam Raising

Reference No. 30012078
Prepared for WaterNSW
10 September 2021

SMEC INTERNAL REF. 30012078

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18 Aboriginal cultural heritage assessment

This chapter provides an assessment of potential impacts to Aboriginal cultural heritage during construction and operation of the Warragamba Dam Raising with reference to the SEARs shown in Table 18-1.

Table 18-1. Secretary's Environmental Assessment Requirements: Aboriginal heritage

Desired performance outcomes	Secretary's Environmental Assessment Requirements[1]	Where addressed
10. Heritage The design, construction and operation of the project facilitates, to the greatest extent possible, the long term protection, conservation and management of the heritage significance of items of environmental heritage and Aboriginal objects and places.	1. The Proponent must identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of: (a) Aboriginal places and objects, as defined under the National Parks and Wildlife Act 1974 and in accordance with the principles and methods of assessment identified in the current guidelines (b) Aboriginal places of heritage significance, as defined in the Standard Instrument – Principal Local Environmental Plan (c) environmental heritage, as defined under the Heritage Act 1977 (d) items listed on the National and World Heritage lists. Investigations including surveys and identification of cultural values should be conducted in consultation with OEH regional officers.	Section 18.6, Section 18.7, Section 18.8, Section 18.9
	2. Where impacts to State or locally significant heritage items are identified, the assessment must: (a) Include a statement of heritage impact for all heritage items (including significance assessment) (b) Consider impact to the item of significance caused by, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, visual amenity, landscape and vistas, curtilage, subsidence and architectural noise treatment (as relevant) (c) Outline measures to avoid and minimise those impacts in accordance with the current guidelines (d) Be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed, the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria).	Chapter 17
	3. Where archaeological investigations of Aboriginal objects are proposed, these must be conducted by a suitably qualified archaeologist, in accordance with section 1.6 of the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010).	Section 18.2, Section 18.3, Section 18.7

Desired performance outcomes	Secretary's Environmental Assessment Requirements[1]	Where addressed
	Consultation with Aboriginal people must be undertaken prior to investigations. Significance of cultural values for Aboriginal people who have a cultural association with and must be documented in the EIS.	
	4. Where impacts to Aboriginal objects and/or places are proposed, consultation must be undertaken with Aboriginal people in accordance with the current guidelines.	Section 18.3
	5. Any objects recorded as part of the assessment must be documented and notified to OEH.	Section 18.6
	6. Where the land is declared wilderness under the Wilderness Act 1987 or on the World Heritage List as part of the Greater Blue Mountains World Heritage Area (GBMWHA) and lands declared as Wild Rivers under the NPW Act the Proponent: (a) must define the area and extent of impact on such lands (b) provide evidence that the proposal is consistent with the Wilderness Act 1987 and the management principles for wilderness areas (c) assess impacts on land to be included on the National Heritage List.	Chapter 20 Appendix J, Section 6.1.7

[1] Note: this chapter specifically addresses SEARs requirement 10 in addition to those general requirements of the SEARs applicable to all chapters and as identified as such in Chapter 1 (Section 1.5, Table 1-1).

The Aboriginal cultural heritage assessment is supported by detailed investigations, which have been documented in the Aboriginal Cultural Heritage Assessment (ACHA) report (Niche Environment and Heritage 2019, Appendix K).

The ACHA also includes a separate Aboriginal Cultural Values Assessment report (CVAR), which is provided in Appendix K (ACHA, Appendix 2).

The proposed management and mitigation measures in this Chapter are collated in Chapter 29 (Environmental impact statement synthesis, Project justification and conclusion).

18.1 Project description and study area

18.1.1 Project description

A detailed description of the Project is provided in Chapter 5 and site location shown on Figure 18-1. 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 would be achieved through raising the level of the central spillway crest by around 12 metres and the auxiliary spillway crest by around 14 metres above full supply level (FSL) for temporary storage of inflows in the FMZ. 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 current design includes raising the dam side walls and roadway by 17 metres to enable adaptation to projected climate change. The Project would delay dam spills which would reduce current downstream flood peaks and extents.

The dam would be subject to the following operational regimes, depending on the water level.

Normal operations

Normal operations would apply when the reservoir level is at or lower than FSL, which is when the water level in Lake Burragorang is at or below 116.7 metres Australian Height Datum (mAHD).

Flood operations

Flood operations are shown on Figure 18-2 and would apply when the water level is higher than the FSL. The FMZ would provide capacity to capture temporarily around 1,000 gigalitres of water during a flood event. For events that fill the FMZ, uncontrolled discharge would occur over the central spillway, and potentially, auxiliary spillway of the dam.

Operational objectives are to:

- maintain the structural integrity of the dam
- minimise risk to life
- maintain Sydney's water supply
- minimise downstream impact of flooding to properties
- minimise environmental impact
- minimise social impact.

The Project would result in construction works, temporary inundation of natural areas upstream of Warragamba Dam and change downstream flow regimes, resulting in potential impacts on Aboriginal cultural values.

Figure 18-1. Project location and study area

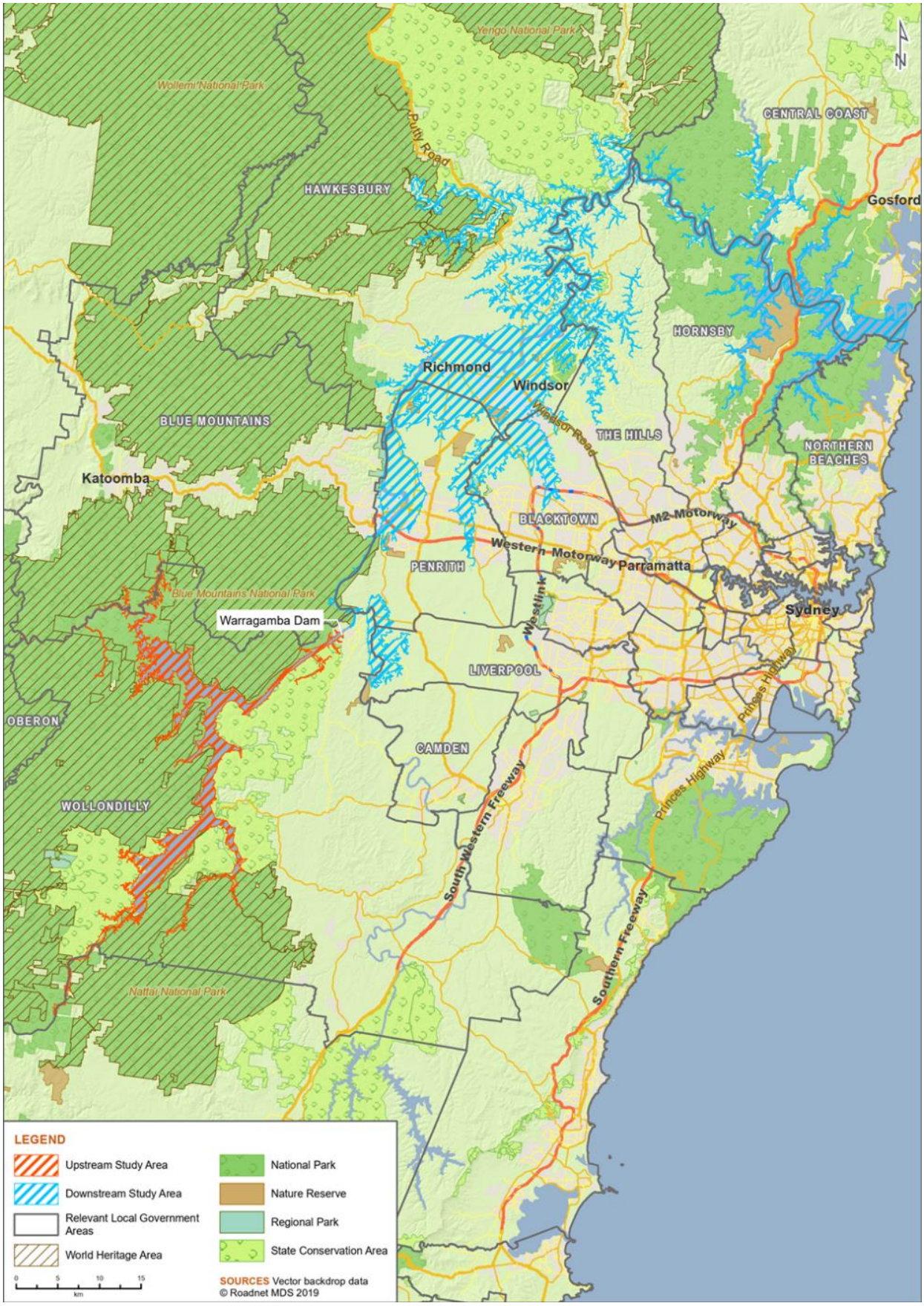
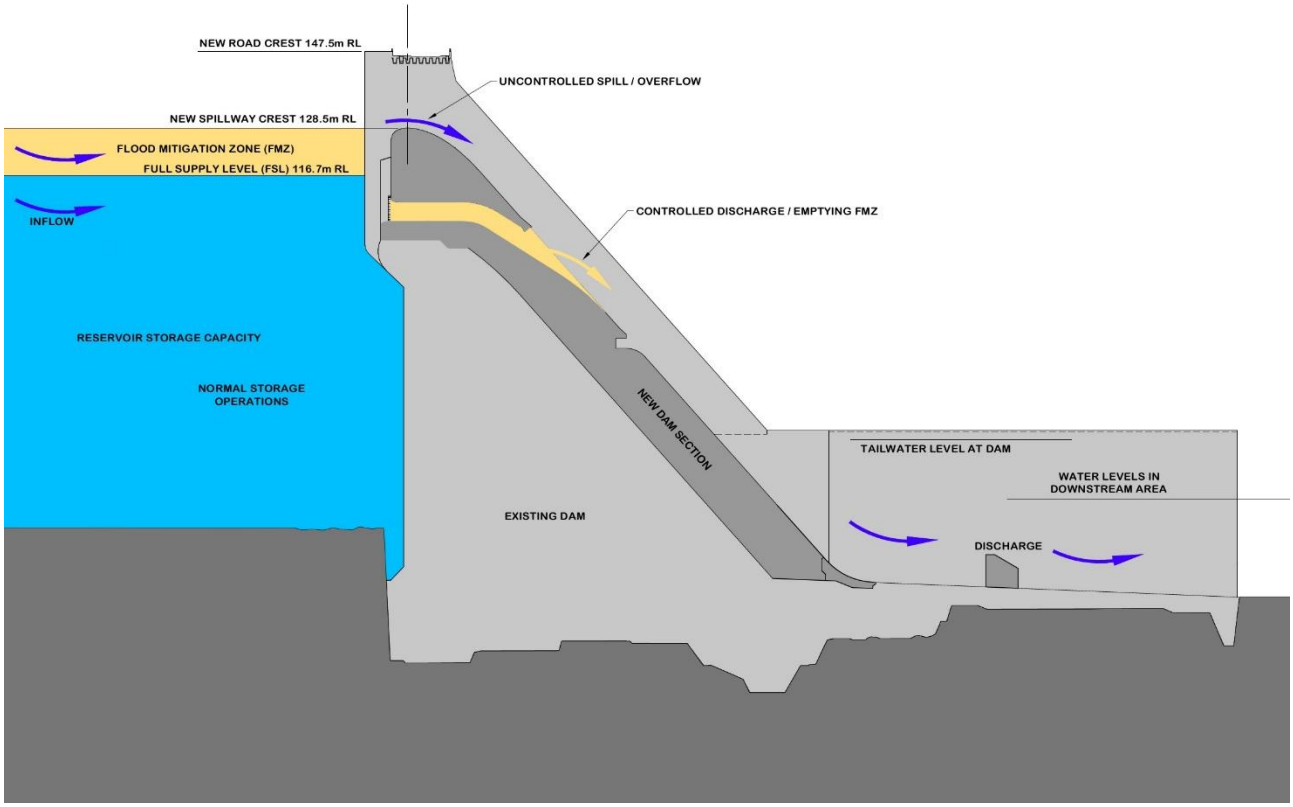


Figure 18-2. Flood operations



18.1.2 Site location and investigation area

Warragamba Dam is located approximately 65 kilometres west of Sydney in a narrow gorge on the lower section of the Warragamba River. The township of Warragamba is located approximately one kilometre east of the dam wall. The dam location and general study area are shown on Figure 18-1.

The upstream environment includes the reservoir formed by Warragamba Dam (Lake Burragorang) and its tributaries. The dam catchment covers an area of approximately 9,050 square kilometres, of which approximately 75 square kilometres is occupied by Lake Burragorang. The catchment includes state conservation areas, national parks and parts of the Greater Blue Mountains World Heritage Area (GBMWHA). Two major river systems drain into the reservoir; the Coxs River and the Wollondilly River. The Coxs river catchment includes the Kowmung River and small tributaries such as Kedumba Creek, Butcher Creek and Green Wattle Creek. The Wollondilly River catchment includes Nattai River and small tributaries such as the Tonalli River, Byrnes Creek and Jooriland Creek.

The downstream environment includes a short section of the Warragamba River, before it joins the Nepean River near Penrith. The Nepean River then becomes the Hawkesbury River at the junction of the Grose River at Yarramundi. The entire river is referred to as the Hawkesbury-Nepean River. The downstream catchment includes a variety of natural landscapes, from rainforests to open woodlands, grasslands to wetlands, and a river system that flows from highland freshwater streams to the Hawkesbury River estuary at Broken Bay. Although many of these landscapes have been altered due to development and agriculture, almost half of the catchment is protected in over one million hectares of national parks and reserves. The Project would affect areas downstream of Warragamba Dam including a short section of the Warragamba River, the Hawkesbury-Nepean River and its floodplain, and some of the tributaries of the Hawkesbury-Nepean River (such as South Creek) that experience backwater flooding affects.

The dam was constructed between 1948 and 1960 in a narrow sandstone gorge of the Warragamba River. The flooded gorge is now called Lake Burragorang, an Aboriginal name meaning *'a tribe which lives in a valley where there is plenty of game'* (Shaw 1984). Surrounding Lake Burragorang are the water catchment Special Areas extending to the Blue Mountains and the Southern Tablelands.

The study area and specific areas of investigation adopted for the Aboriginal cultural heritage assessment (refer Appendix K, ACHA, Section 2) are described as follows:

- **Upstream study area** (Figure 18-1): This area is within the probable maximum flood (PMF) extent during operation of the Project. The upstream flooding area between the full supply level (FSL) and the Project PMF covers about 5,280 hectares, of which 2,345 hectares lies between the existing and Project PMF levels. The PMF is a hypothetical flood estimate relevant to a specific catchment whose magnitude is such that there is negligible chance of it being exceeded and has an extremely low probability of occurrence of happening. It represents a notional upper limit of flood magnitude and is used for dam safety and emergency planning purposes.
- **Survey area**: This covers the extent of archaeological site surveys and includes parts of the study area and adjoining areas including accessible areas below the dam FSL.
- **Upstream impact area** (Figure 18-3, Figure 18-4, Figure 18-5, Figure 18-6). The upstream impact area is described in Chapter 8 (Section 8.2.5), which was based on a review of the historical record that identified at least one large flood above FSL would occur within a 20-year period. Modelling was then done of around 20,000 hypothetical scenarios to determine what the average or likely inundation level would be for the existing dam and with the Project.
  Definitions used in the archaeological study are:
  - **Project Upstream Impact Area (PUIA)**: The area between 119.5 mAHD and 126.97 mAHD, and covers 1,401 hectares. (note: The ACHA uses the terminology 'Subject Area' to represent the PUIA which is consistent with assessment guideline terminology)
  - **Existing Upstream Impact Area (EUIA)**: The area below 119.5 mAHD (including below FSL or 116.7 mAHD)
- **Construction footprint** (Figure 18-7): This area covers about 105 hectares, of which about 33 hectares will be cleared during construction activities.
- **Downstream study** area (Figure 18-8): This area includes flood areas up to the existing PMF. The Project will not increase regional inundation levels downstream. Therefore, any previously recorded Aboriginal sites that have been identified do not require impact assessment, noting that those sites in the floodplain will have been subject to inundation from past flood events.

Figure 18-3. Upstream impact area

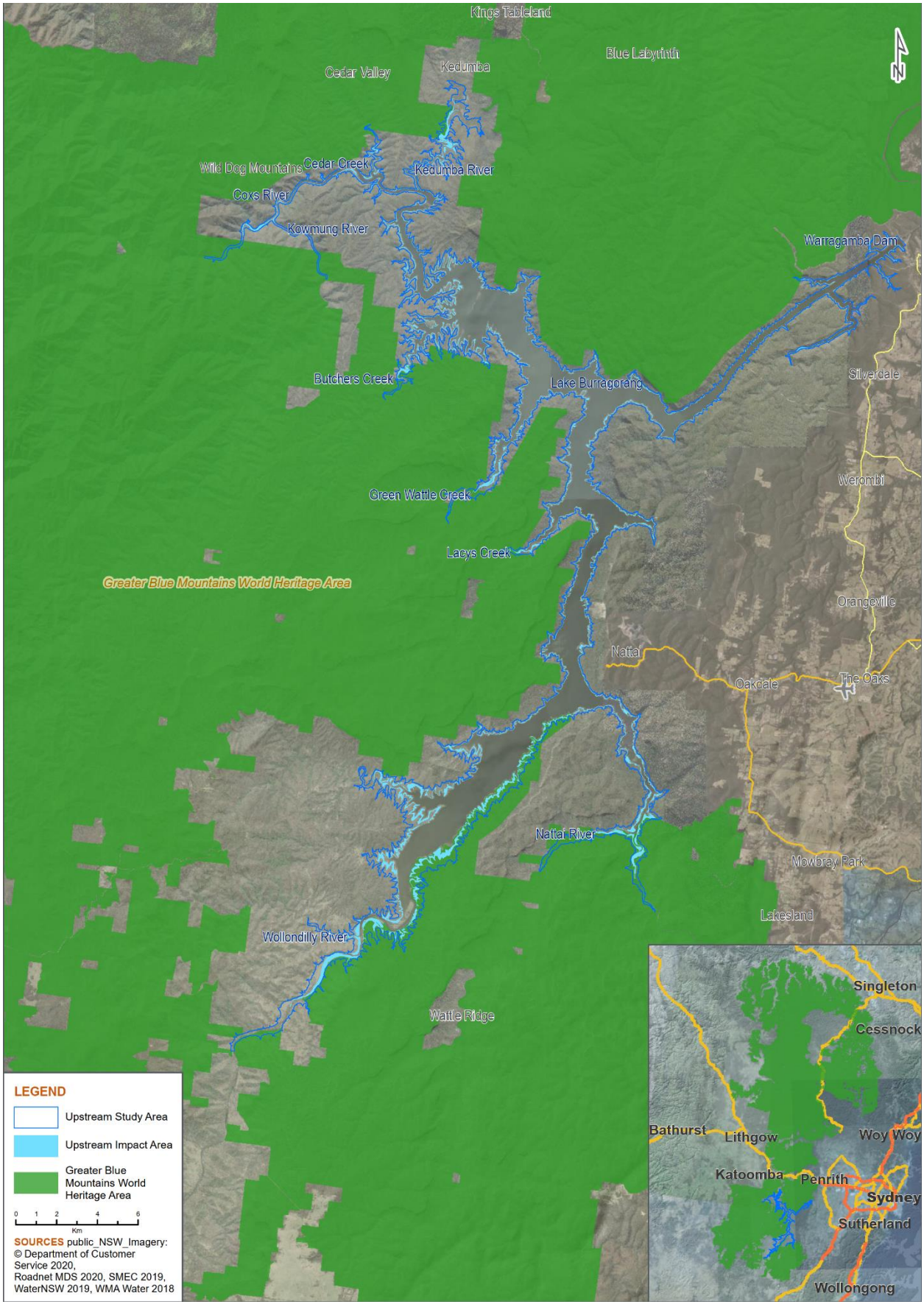


Figure 18-4. Upstream impact area: Kedumba River, Coxs River and Kowmung River

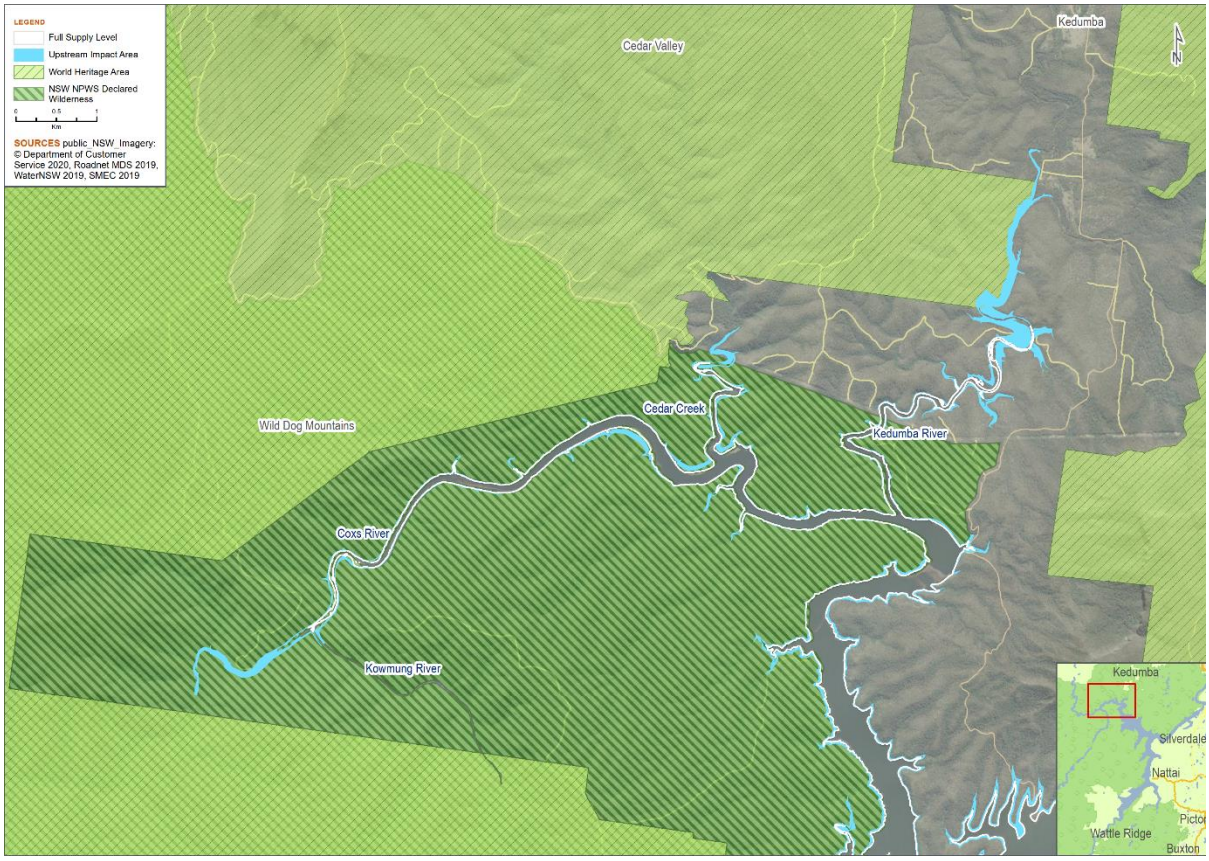


Figure 18-5. Upstream impact area: Lake Burragorang tributaries

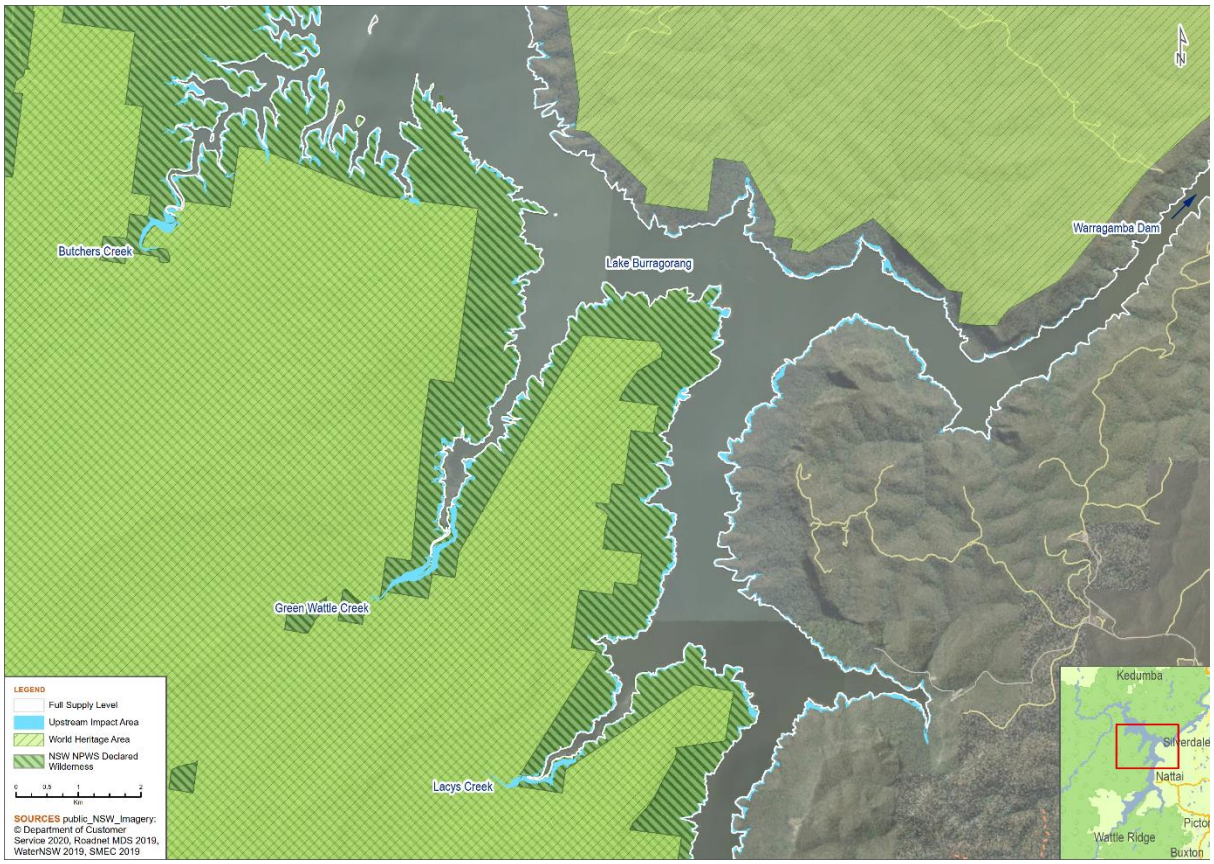


Figure 18-6. Upstream impact area: Wollondilly River and Nattai River

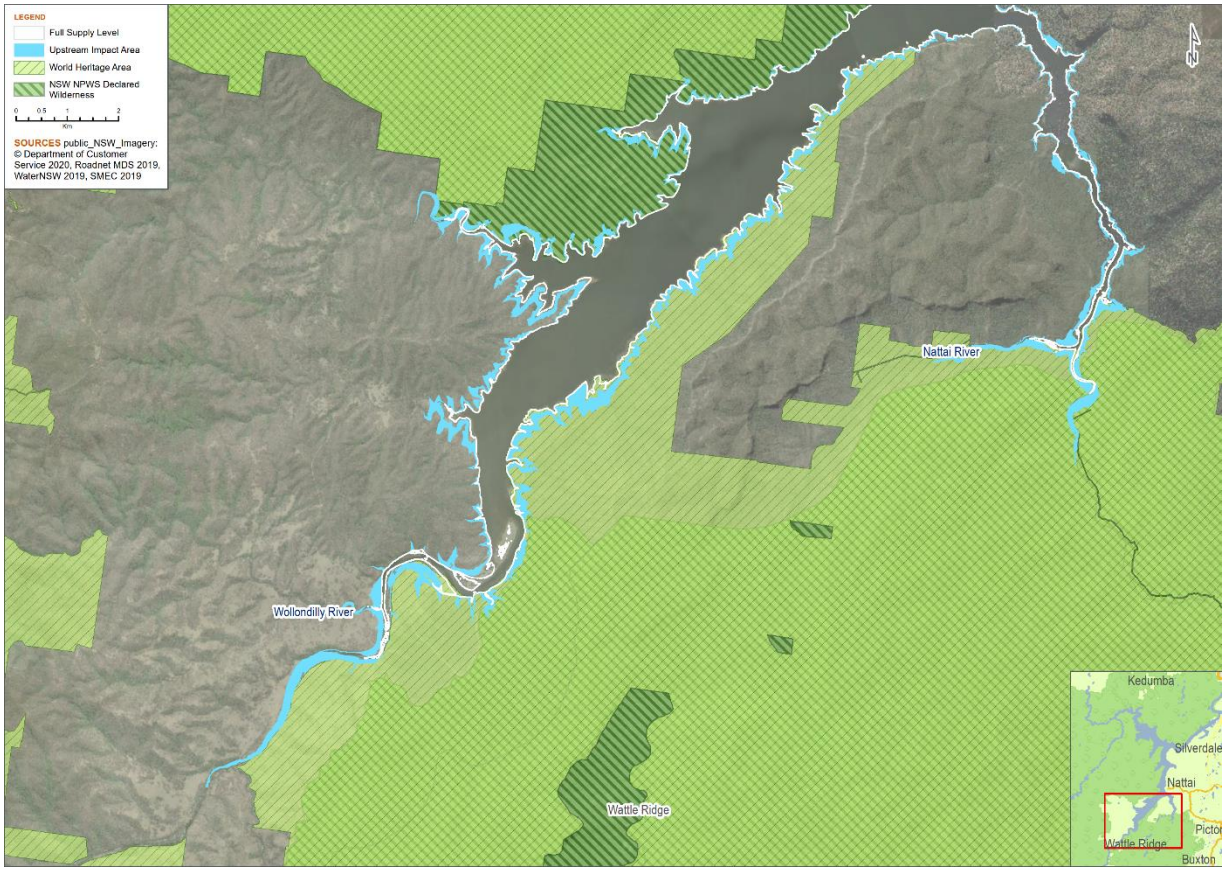


Figure 18-7. Construction footprint

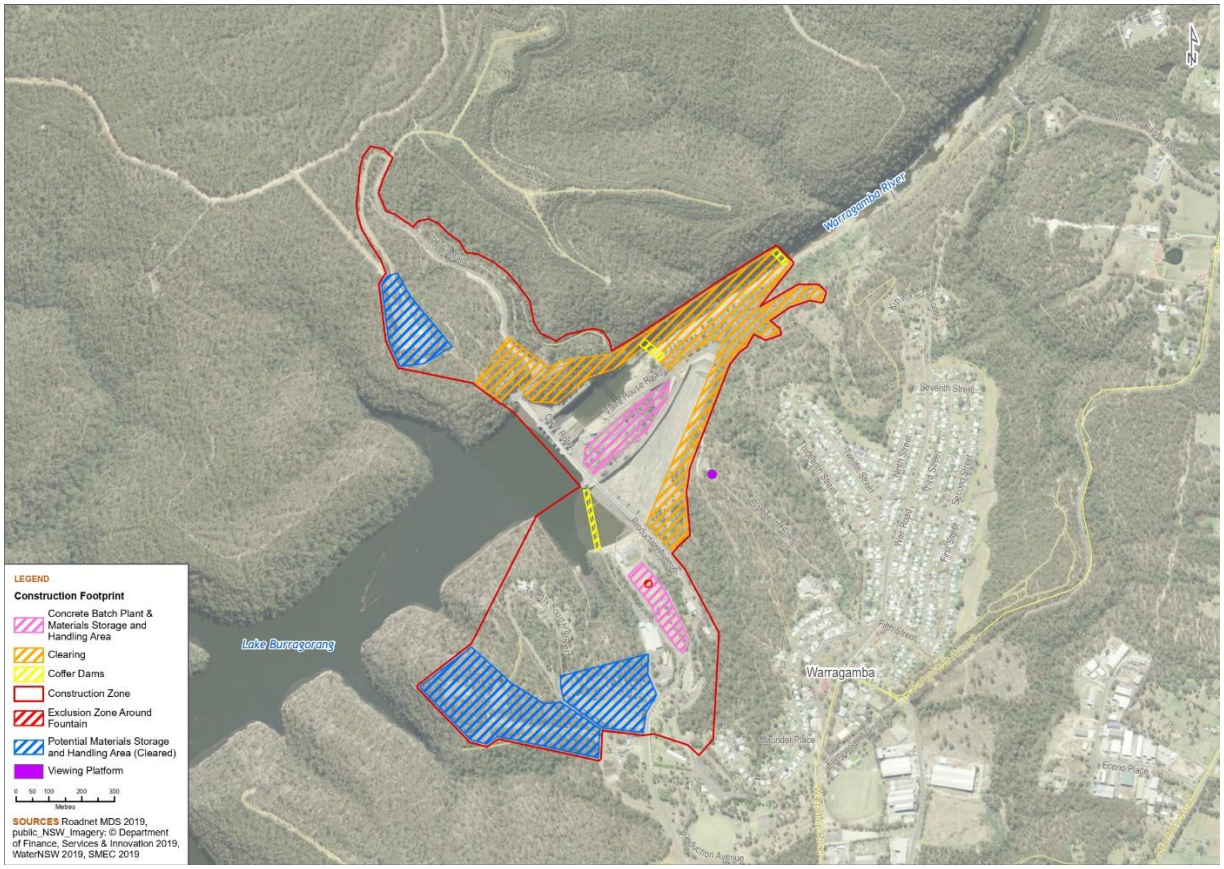
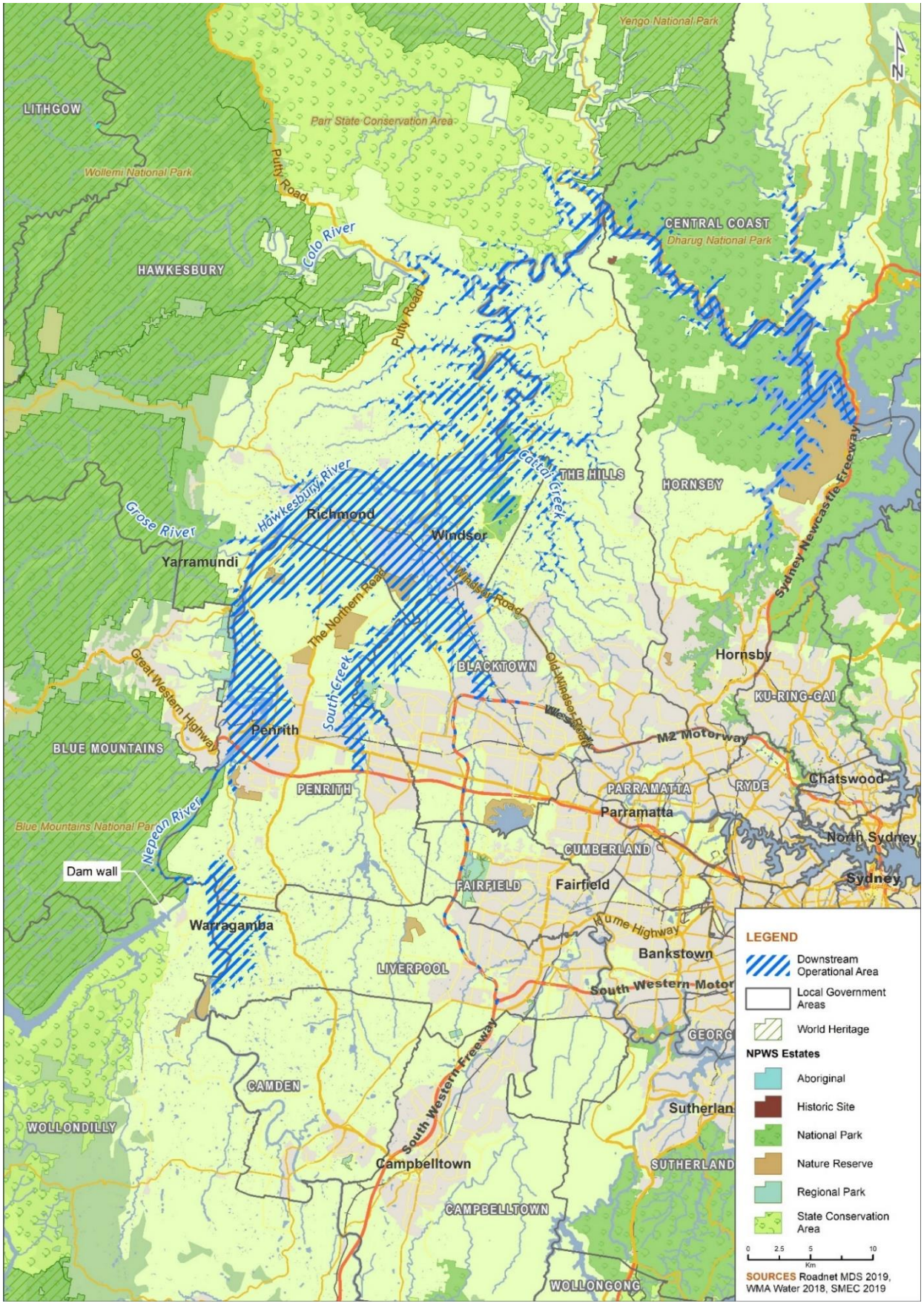


Figure 18-8. Downstream study area



18.2 Methodology

18.2.1 Scope and objectives

The ACHA was undertaken in accordance with the SEARs (see Table 18-1) and the following regulations and guidelines:

- Legislation:
  - *Environmental Planning and Assessment Act 1979*
  - *National Parks and Wildlife Act 1974*
  - *Wilderness Act 1987*
  - *Environment Protection and Biodiversity Conservation Act 1999*
- **Gundungurra Indigenous Land Use Agreement (20 June 2014**: An Indigenous Land Use Agreement (ILUA) exists between the Gundungurra and the NSW Government including WaterNSW. The Agreement provides a framework for consultation and participation of the Gundungurra people in the management of the ILUA area, which incorporates the Project Area
- Guidelines:
  - Draft guidelines for Aboriginal cultural heritage impact assessment and community consultation (Department of Environment and Conservation (DEC) 2005a)
  - *Aboriginal cultural heritage consultation requirements for proponents 2010* (ACHCRs) (Department of Environment, Climate Change and Water (DECCW) 2010a)
  - *Code of practice for archaeological investigation of Aboriginal objects in New South Wales* (DECCW 2010b)
  - *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010c)
  - *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (Office of Environment and Heritage (OEH) 2011a)
  - The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Australia International Council on Monuments and Sites (ICOMOS) 2013)
  - *Engage Early, Guidance for proponents on best practice Indigenous engagement for environmental assessments under the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth Government, 2016)
  - National Parks and Wildlife Regulation 2019 (NPW Regulation).

The aim of the study is to identify whether evidence of Aboriginal sites, objects or places are present within the Project Upstream Impact Area (PUIA) and if present, determine whether these would be impacted by the proposed works and provide appropriate mitigation and management recommendations. Study objectives were to:

- identify and describe Aboriginal objects located within the PUIA
- identify and describe the sensitivity (in relation to cultural heritage) of different landforms present within the PUIA
- identify and describe the cultural heritage values, including the significance of the Aboriginal objects that exist across the whole area that will be affected by the Project, and the significance of these values for the Aboriginal people who have a cultural association with the land
- describe how the requirements for consultation with Aboriginal people have been met
- present the views of those Aboriginal people regarding the likely impact of the Project on their cultural heritage, including a copy of any submissions received and a response as necessary
- identify and describe the actual or likely harm posed to Aboriginal objects or declared Aboriginal places from the Project with references to the cultural heritage values identified
- provide a description of any practical measures that may be taken to protect and conserve those Aboriginal objects
- provide a description of any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm, or if this is not possible, to manage (minimise) the harm
- provide documentation of discussions with the Aboriginal stakeholders regarding commitments from WaterNSW related to social, economic and/or conservation gains to offset any loss of cultural heritage.

18.2.2 Study specialists

The ACHA was prepared by Niche Environment and Heritage in accordance with the SEARS (See Table 18-1 - Performance outcome No. 3), the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b) and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011a). The specialists were assisted by members of the Registered Aboriginal Parties (RAPs) during both the field assessment and collation of the cultural values assessment components of the ACHA.

ACHA study specialists and individuals who assisted with studies are provided in Appendix K (ACHA, Appendix 1).

The CVAR was prepared by Waters Consultancy to inform the ACHA and forms Appendix 2 to the ACHA.

18.2.3 Information sources

Information sources were available from Heritage registers, and previous archaeological investigations. These are summarised in Table 18-2.

Table 18-2. Information sources

No.	Information sources
1	Aboriginal Heritage Information Management System (AHIMS)
	Upstream study area A total of 31 sites are recorded on the AHIMS. **Construction study area** One previously registered site Foleys Creek is registered on AHIMS as being located within the construction footprint. However During the field survey, its registration location was identified as being incorrect and as a result it has been removed from all final site counts for this assessment. **Downstream study area** The Project would potentially benefit Aboriginal cultural heritage downstream of Warragamba Dam through reducing flood depths and extents on the floodplain. The downstream area is included in the data synthesis for an understanding of Aboriginal Objects and sites within the general area. A total of 888 sites are recorded on AHIMS. There are some limitations to the AHIMS dataset, including: ▪ the absence of reports identifying the survey coverage for a number of the previous surveys ▪ duplication of site recordings ▪ some datum and locational errors within the AHIMS dataset ▪ a number of Aboriginal sites which are known to be present within the Subject Area that were not yet added into the AHIMS database at the time of the search. Where possible, corrections to site locations have been made and a revised Aboriginal site dataset for the Project was created.
2	Aboriginal Place nomination
	Most of the study area has been nominated by the Gundungurra Aboriginal Heritage Association Incorporated to be considered by the Minister for gazettal as an Aboriginal Place. The Aboriginal Place nomination was submitted to the then Office and Environment and Heritage on 18 July 2018. The 'Journey of Guringatch and Mirrigan' is the central focus for the nomination. In addition to the published account of the story, Mathews recorded other notes regarding this and other stories which he collected from Gundungurra people (Mathews n.d.). A determination on this nomination has yet to be determined by the Minster for the Environment.
3	Previous local archaeological investigations
	Archaeological investigations are mainly associated with dam infrastructure developments that have been previously undertaken. These include: ▪ PMF Inundation of Archaeological Resources Warragamba EIS (Brayshaw 1988) ▪ Warragamba Dam – Archaeological study sample investigation of areas upstream to be affected by increased water retention (Brayshaw 1989) ▪ Warragamba Dam EIS – Spillway archaeological survey for Aboriginal sites (Brayshaw 1992)

No.	Information sources
	▪ Archaeological Survey at Jerry 's Creek Bridge, near Wallacia, Southern Cumberland Plain, NSW (Barton & McDonald 1995) ▪ Warragamba Dam Spillway. Archaeological Survey for Aboriginal Sites (Brayshaw 1999) ▪ Warragamba STP Effluent Discharge Pipeline, Aboriginal Impact Assessment (AHMS 2005).
4	Regional archaeological investigations
	The study area falls within the Blue Mountains Plateau and the Hawkesbury and Nepean River systems, which include the Coxs River and Wollondilly River systems. Archaeological investigations relate to the high frequency of sandstone rock shelters. There have also been numerous archaeological investigations across the Cumberland Plain due to urban developments. These large data sets have enabled analysis of past spatial and occupational patterns, and behaviour of Aboriginal people within the region.
5	Cultural values assessment
	The cultural values assessment prepared for the Project was based on the following information sources: ▪ discussions with RAPs during community information sessions. ▪ discussions with Registered Aboriginal Parties (RAPs) during field surveys ▪ background resources including previous cultural value studies for the Blue Mountains region ▪ historical research Additional points of input to the cultural values assessment were via a combination of the following: ▪ review and responses to the proposed methodology ▪ attendance at the field surveys ▪ community information sessions and meetings to discuss the ACHA methodology and draft report ▪ site inspections of the study area ▪ through review and responses to the Draft Aboriginal Cultural Heritage Assessment report ▪ through telephone and face to face meetings with individual RAP groups. These points of consultation provided the opportunity for the RAPs to have direct input into the management of Aboriginal cultural heritage values – both tangible and intangible – in the study area, as required by the SEARs, the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011a). In accordance with this guideline further details relating to this consultation is presented in Appendix K (ACHA, Section 3)

18.2.4 Field survey

18.2.4.1 Sampling strategy

Survey approach

The sampling strategy is detailed in Appendix K (ACHA, Appendix 1, Section 9.1) and follows the:

- Aboriginal Cultural Heritage Consultation requirements for proponents (DECCW 2010a)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010b)
- Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011a).

Field surveys focused on areas of spiritual and historical importance as identified by the RAPs, areas that would be disturbed by construction works and areas potentially affected by upstream inundation such as rivers, creek lines and large sandstone rock platforms, boulders and ridgelines. Previously registered sites of high archaeological sensitivity that fall within the study area were relocated (where possible) and recordings updated from their original site cards. To assist with targeting survey areas, a slope gradient analysis was undertaken as described below.

Environmental context, slope gradient analysis and predictive modelling

Appendix K (ACHA, Appendix 1, Section 6) provides a broad overview of the environmental setting of the study area, which is summarised in Section 18.5. The nature and distribution of Aboriginal cultural heritage sites are closely related to the environmental context. Soil landscapes, when considered with the levels of past land use and modification, are a useful tool in identifying environmental proxies for the likely preservation and burial of Aboriginal objects in a landscape, and resources that may have been available to Aboriginal people in the past. Examples include the presence of rock outcrops to provide surfaces for art or to sharpen and prepare implements, stone for the manufacture of stone tools and plant species.

The landscape and archaeological context of the study area are addressed in Section 18.5.1. These were assessed to provide predictive statements about the likelihood and nature of archaeological evidence and included consideration of previous archaeological surveys, the distribution and patterning of known sites, landform units and landscape context, and previous known land uses in the area. The areas below the FSL of Warragamba Dam have been heavily impacted, however most of the study area has been exposed to limited disturbance or modification, having been protected as either a national park/state conservation area and a water catchment Special Area. This landscape is most likely to contain Open Camp Sites and Isolated Artefacts around the lake's shore and Rock Shelters that were used for occupation shelter and for art. Sandstone platforms located within the rivers, tributaries and adjacent to swamps are most likely to contain Axe Grinding Grooves. The expectation from the Project is as follows:

- Aboriginal cultural heritage sites within the study area are likely to be located on slopes from 0-30 percent with higher densities of Aboriginal sites located on slopes from 0-18 percent.
- AHIMS sites within the PUIA cluster on slopes from 0-18 percent but are represented on slopes up to 30 percent with none located on slopes over 35 percent. It can therefore be concluded that Aboriginal sites within the Metropolitan Special Area cluster on slopes from 6-18 percent but are represented mostly on slopes from 6-30 percent
- the expectation from the Project was that Open Camp Sites, Isolated Artefacts and Scarred Trees are mostly likely located on slope classes from 0-18 percent. Sandstone overhangs with archaeological deposits, art, midden and/or artefacts can be expected to be located on slope classes from 18-30 percent.

18.2.4.2 Survey team

The survey team comprised two archaeologists and between one and three representatives from the RAPs. Important features were noted and archaeological sites GPS located and recorded. Surveys were undertaken over 73 days between May 2018 and June 2019.

18.2.4.3 Survey extent

Detailed information relating to survey coverage across slope class and landscape categories is provided in Appendix K (ACHA, Appendix 1, Section 9). The survey focused on those areas that may receive the most impact by the Project and were predicted to be the most archaeologically sensitive, such as creek lines, flats and slopes from 0-30 percent. Survey coverage was also focused on areas outlined by the RAPs as being connected to the creation story, and ridge and creek lines that have archaeological potential. The survey therefore focused on:

- areas that have potential for Aboriginal objects in the PUIA
- previously recorded sites that are of high and very high significance
- areas of cultural significance to the indigenous community.

The survey extent includes:

- a total of 2,655 ha was surveyed on foot as part of the Aboriginal heritage assessment activities. Most of this area is within the study area (between FSL and the Project PMF); this included 465 hectares within the PUIA
- consistent with consultations from the RAPs, an additional 1,219 hectares surveyed was outside the upstream study area (above the Project PMF) and below the FSL. Survey below the FSL was possible due to the low levels of water within the dam and the exposure of Aboriginal objects.

SEAR's requirement 10 (1) relates to Section 3.1 of the OEH (2011) Guide for investigating, assessing and reporting on Aboriginal cultural heritage in NSW. Further to this, Section 2.4 outlines the requirement of an ACHA is an understanding of the potential cultural heritage values of the study area, and not to document every object within the study area. Given the types of harm that may potentially affect Aboriginal cultural heritage sites within the PUIA, the above coverage presents a strong representative sample of the landscape and is considered adequate.

A summary of survey coverage by slope classes and soil landscape categories across the study area is provided in Table 18-3 and Table 18-4, and shown on figures provided in Appendix K (ACHA, Appendix 1).

Table 18-3. Survey area by slope class for subject area (PUIA)

Slope class	Slope degrees	Area of slope class surveyed (ha)	Proportion of surveyed area (%)
Flat or very gently inclined	0-2	114	8.1
Gently inclined	2-6	374	26.7
Moderate	6-18	538	38.4
Steep	18-30	263	18.8
Very steep	30-45	103	7.3
Very very steep	>45	10	0.7
Total (rounded)		**1,402**[1]	**100**

1. The total slope class area differs slightly due to mapping assumptions made in determining slope classes.

Table 18-4. Survey coverage across the PUIA by soil landscape

Soil landscape	Soil landscape in PUIA (ha)	Soil landscape in survey area (ha)	Soil landscape in survey area (%)	Aboriginal cultural heritage sites within the soil landscape
Cedar Valley	141	40	29	3
Coxs River	31	2	6	0
Emu Island	10	5	55	0
Faulconbridge	0	0	100	0
Gymea	0	0	0	0
Hassans Walls	274	89	33	9
Hawkesbury	5	2	43	0
Jooriland Range	50	23	46	4
Kanangra Gorge	128	17	13	7
Kedumba	172	73	42	8
Martins Flat	206	56	27	3
Martins Flat variant a	177	103	58	1
Round Mount	44	20	45	2
Warragamba	50	6	12	3
water	36	4	11	2
Wollondilly River	77	25	32	1
Total (rounded)	**1,401**	**465**		**43**

18.2.5 Cultural values assessment

A specialist Aboriginal Cultural Values Assessment report has been prepared to inform the ACHA (provided as Appendix 2 to Appendix K). The concept of cultural significance encompasses all the cultural values and meanings that could potentially be associated with a place. The cultural and natural values of a place are generally indivisible in the context of Aboriginal cultural heritage. The cultural values and meanings in a place can be both tangible and intangible.

Cultural significance is embodied in the place: in its tangible or physical form; in the wider cultural landscape that it is located in; in the ways in which the place is used or interacted with; and in the associations, stories, and meanings of the place to the people and community it holds significance for:

> *"Aboriginal cultural heritage consists of any places and objects of significance to Aboriginal people because of their traditions, observances, lore, customs, beliefs and history. It provides evidence of the lives and existence of Aboriginal people before European settlement through to the present… For Aboriginal people, cultural heritage*

and cultural practices are part of both the past and the present and that cultural heritage is kept alive and strong by being part of everyday life."

The concept of cultural significance is used in Australian heritage practice and legislation to encompass all the cultural values and meanings that might be recognised in a place. Cultural significance is often defined as the sum of the qualities or values that a place has with reference to the five values that are listed in the Burra Charter: aesthetic, historic, scientific, social and spiritual.

The three key values in relation to Aboriginal cultural heritage assessments are:

1) **Social or cultural value** refers to the associations that a place has for a particular community or cultural group and the resulting social or cultural meanings that it holds for them. It can encompass traditional, historical, or contemporary associations.
2) **Spiritual value** is often subsumed within the category of social or cultural value. It refers more specifically to the intangible values and meanings that are embodied or evoked by a place to a specific cultural group and that relate to that group's spiritual identity or traditional practices.
3) **Historic values** refer to the associations of a place with an individual person, event, phase, or activity that has historical importance to a specific community or cultural group.

The methodology used to undertake the cultural values assessment was to:

- consult with Aboriginal cultural knowledge holders, as identified by the registered Aboriginal parties (RAPs), regarding historical and cultural values within the study area
- documentary research in a range of national, state, and local institutions to provide the historical and ethnographic context for the assessment.

18.3 Aboriginal community consultation

18.3.1 Aboriginal Cultural Heritage Assessment consultation process

18.3.1.1 Scope of consultation

Consultation was undertaken in compliance with the SEARs. The main objective was to consult the Aboriginal community about the cultural heritage values of Aboriginal objects and places, and to ensure that Aboriginal people have an opportunity to improve ACHA outcomes by:

- providing relevant information about the cultural significance and values of Aboriginal objects and/or places
- influencing the design of the method used to assess cultural and scientific significance of Aboriginal objects and/or places
- contributing to the development of cultural heritage management and mitigation options and recommendations for any Aboriginal objects and/or places within the proposed study area
- commenting on draft assessment reports before they are submitted by the proponent to the DPIE.

The *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a) presents a four-stage consultation process and outlines the roles and responsibilities of the OEH, Aboriginal parties (including local and State Aboriginal Land Councils), and proponents. The consultation process is described in Appendix K (ACHA, Section 3) and summarised in Table 18-5.

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Table 18-5. ACHA consultation process

Consultation stage	Consultation requirements	Consultation activities
Stage 1 Notifications and registration	This stage of the consultation process is used to identify, notify and register any Aboriginal people or groups who may have a cultural interest in and/or possess cultural knowledge relevant to determining the cultural significance of Aboriginal objects or places within the study area.	A total of 22 RAPs participated in the consultation process. Project notifications were sent on 9 October 2017 to: ▪ Blacktown City Council ▪ Blue Mountains City Council ▪ Camden Council ▪ Central Tablelands Local Land Service ▪ Deerubbin Local Aboriginal Land Council ▪ Gandangara Local Aboriginal Land Council ▪ Greater Sydney Local Land Services ▪ Hawkesbury City Council ▪ The Hills Shire Council ▪ Illawarra Local Aboriginal Land Council ▪ Liverpool City Council ▪ Metropolitan Local Aboriginal Land Council ▪ Native Title Services Corporation Limited (NTS Corp Limited) ▪ Oberon Council ▪ Office of Environment and Heritage ▪ Office of the Registrar, Aboriginal Land Rights Act 1983 ▪ Penrith City Council ▪ Pejar Local Aboriginal Land Council ▪ South East Local Land Services ▪ Tharawal Local Aboriginal Land Council ▪ Wollondilly Shire Council ▪ National Native Title Tribunal (NNTT).

Consultation stage	Consultation requirements	Consultation activities
Stages 2 and 3 Presentation of Project Information and gathering information about cultural significance	Project information and proposed study methodology were provided to RAPs and information sessions held to discuss the Project and any issues raised. Detailed records and comments raised about the study methodology are provided in Appendix K.	Three information sessions were held for the proposed Project methodology. The first was at Berry St, North Sydney on 20 March 2018 and the second was held at the Warragamba Visitors Centre on 4 April 2018. In addition, an information session was held with the Indigenous Land Use Agreement Committee (ILUA) consisting of the Gundungurra Aboriginal Heritage Association Inc. and Gundungurra Tribal Land Council Aboriginal Corporation on 27 March 2018 at the NSW National Parks and Wildlife Service (NPWS) Katoomba office. At the information sessions, a representative of WaterNSW and Infrastructure NSW provided a presentation on the nature and scale of the Project, an overview of the impact assessment process, critical timelines and milestones for the completion of assessment activities and delivery of reports, a discussion of the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information. The information session also provided RAPs with an opportunity to raise any cultural issues or comments/perspectives and assessment requirements (if any) regarding the Project or the proposed methodology. A copy of the proposed methodology was provided to all RAPs for their review and comment on 5 March 2018, with comments requested by 9 April 2018, allowing for a minimum of 28 day review period. Due to the second information session falling outside the minimum 28 day project information consultation period, it was extended by a further seven days to allow for sufficient time for the RAPs to provide comments from the information session and the methodology. All RAPs were invited to participate in the field survey and to complete a *Field Survey Engagement Application Form,* which sought responses on: ▪ cultural, social and historical connections to the study area ▪ traditional knowledge of the study area ▪ previous experience in ACHA survey ▪ completion of required inductions ▪ copies of current insurances. Completed questionnaires and insurances were received from 12 RAPs, who were subsequently invited to participate in the field surveys. Survey details and representations are provided in Appendix K (ACHA, Appendix 1)).
Stage 4 Review of Draft Report	In accordance with the Consultation Guidelines, a draft ACHA report was provided to all RAPs for review and comment on 4 July 2019. A prior meeting was held to discuss the nature of information that would be released with the draft ACHA report.	As part of the review process RAPs were offered individual meetings to discuss the draft report and aspects of the Project. RAPs also attended an information session at the Tharawal Local Aboriginal Land Council on 22 July 2019. The closing date for comments was 5.00 pm, 16 August 2019. Subsequent to the review of the initial draft ACHA report, Project updates were sent to the RAPs on 16 April 2020, 21 September 2020, 11 February 2021 and 31 March 2021 to ensure the groups were kept up to date with the Project assessment process. On 16 December 2020, WaterNSW facilitated a site visit to provide RAPs with the opportunity to visit the Warragamba Special Area since the bushfires and for RAPs who may not have had access consents. Due to the catchment being closed following a rainfall event the visit was rescheduled to 6 February 2021. The revised draft report incorporating the CVAR was made available to all RAPs on 29 April 2021. Comments were accepted beyond the 28 day period provided for in the consultation guidelines. A meeting was held at Warragamba Dam Visitors Centre on 1 June 2021 to discuss the revised draft report.

18.3.1.2 Comments received on draft reports and their consideration

Comments were received from the following RAPs:

- Corroboree Aboriginal Corporation
- Cubbitch Barta Native Title Claimants
- Darug Custodian Aboriginal Corporation
- Darug Land Observations
- Gundungurra Aboriginal Heritage Association Inc.
- Illawarra Local Aboriginal Land Council
- Koolkuna Elders
- Muragadi Heritage Indigenous Corporation
- Murra Bidgee Mullangari Indigenous Corporation
- Kazan Brown and Taylor Clarke

Comments received and relevant Aboriginal heritage consultant responses are documented in Appendix K (ACHA, Appendix 1). A total of 186 comments were received, which broadly covered issues related to the adequacy of the ACHA in meeting SEARs and regulatory requirements, reinforcement of the importance of the study area to Aboriginal people, potential impacts that the Project would have on the area's cultural significance, and adequacy of proposed management measures.

A copy of the final ACHA report was made available to the RAPs by WaterNSW prior to the public exhibition period of the EIS. During this exhibition period, all RAPs will have the opportunity to review and provide additional comment on the final ACHA report as well as any other part of the EIS (for example, including the ecological and water assessments).

18.3.2 Cultural Values Assessment Report consultation process

18.3.2.1 Scope of consultation

The CVAR consultation is summarised in Table 18-6.

Table 18-6. CVAR consultation

Date	Consultation
19 October 2020	Email sent to the 22 RAPs for the Project, which included the proposed cultural values assessment methodology for review and comment by 2 November 2020. One verbal and six written responses to the proposed cultural values assessment methodology were received and these were addressed in the finalised methodology.
4 November 2020	Email sent to all RAPs that included a summary of the comments provided on the proposed cultural values assessment methodology, the finalised cultural values assessment methodology as an attachment, and a request for nomination of Aboriginal cultural knowledge holders by 13 November 2020.
12 November 2020	Email sent to all RAPs acknowledging NAIDOC Week and extending the timeframe for the nomination of Aboriginal cultural knowledge holders to 20 November 2020.
13 January 2021	Email sent to all RAPs advising that the CVAR was due to be produced and that if they, *"… would like to contribute to the assessment process by sharing knowledge regarding the cultural values of the area that would be very welcome. I respect and understand concerns regarding control of cultural knowledge and that people may wish to only make a statement at a broad level."*

Date	Consultation
19 October and 13 January 2021	Multiple telephone and/or email contact was made with the RAPs with conversations occurring in relation to the proposed cultural values assessment methodology, the nomination of Aboriginal cultural knowledge holders, and wider concerns regarding the assessment process and the Project. Although several individuals were nominated as Aboriginal cultural knowledge holders, these individuals have chosen not to participate now due to the wider concerns regarding the Proponent and the assessment process.
6 April 2021	Draft CVAR provided to all RAPs for review.
1 June 2021	RAPs invited to face-to-face meeting at Warragamba Dam Visitors Centre.

18.3.2.2 Comments received

Most RAPs declined to nominate Aboriginal cultural knowledge holders on the basis that they did not trust the intent of the Proponent or the assessment process. Despite the decision not to actively engage with the assessment process, it is important to note that most the RAPs expressed their high level of concern regarding the potential impacts of the Project and their understanding of the Project as situated within a cultural landscape with a very high level of significance in relation to both intangible and tangible cultural values.

The CVAR is primarily concerned with the identification of intangible cultural sites that are not identifiable through archaeological investigation. However, the nature of cultural significance is such that it is an ongoing process that must allow for the attachment of cultural values and significance to known and emerging archaeological sites. The archaeological record, that is tangible material objects themselves, hold significant cultural value to Aboriginal people and this value has been expressed during discussions with the RAPS.

18.4 Aboriginal context within Project area

Various aspects of Aboriginal life in the Burragorang Valley around Warragamba Dam are detailed in Appendix K (ACHA, Appendix 1 and Appendix 2). The themes discussed include places where people lived and worked, as well as the stories and places important to Aboriginal culture.

The study area spans the traditional country of the Darug, Gundungurra and Tharawal Aboriginal peoples. Their distribution and interactions are generally described by Tindale (1940, 1974), Attenbrow (2010) and SA Museum (n.d.).

- **Darug**: Occupied the Cumberland Plain between Appin in the south, the Hawkesbury River in the north, west of the Georges River and Parramatta
- **Gundungurra**: Occupied the Nattai and Burragorang Valley and the ranges as far west as Bathurst
- **Tharawal**: Ranged from the south side of Botany Bay, the Georges River to the Liverpool and Campbelltown Area.

These people have regularly communicated, moved, traded, and participated in ceremonies between their country and neighbouring areas. It is likely that family groups or clans would intermingle and interact along both physical and social boundaries. Aboriginal context of the study area and its surrounds are summarised below:

- The name Warragamba comes from the Aboriginal words Warra and Gamba meaning water running over rocks. William Russell or 'Werriberrie', a Gundungurra man born in 1830 near the banks of Monkey Creek, provided an important insight into the social life of Aboriginal people living in the Warragamba region. He mentioned Bents Basin to the south of Warragamba, which was known as 'Gul-guer' meaning falling or shooting down or swirling around causing the water to form a hole or whirlpool (Williams 1914). This was considered the lurking place of the Gurangatch, a 'Rainbow serpent', believed to live in the water holes (Smith 2008).
- RH Matthews in 1905 collected a large body of information about the language, ceremony, mythology and social organisation of the Darug, Gundungurra and Tharawal people. Gatherings of small and large numbers of people are likely to have taken place for ceremonial reason and/or to share seasonally abundant resources. Occasions for large gatherings may have included predictable seasonal events such as bird migrations. Such interaction between groups are likely to have varied with the seasons and the availability of resources,

technology, and knowledge. This is reflected in the relatively homogenous cultural features observed in the Sydney region (McDonald 1997).

- Aboriginal hinterland groups were largely dependent on freshwater and terrestrial animals and plants. The inhabitants of the hinterland areas were hunters, gathers and fishermen. Animals such as wallabies, kangaroos, possums, flying foxes as well as parrots, water birds, reptiles, freshwater fish and yabbies would have made up part of the diet of the inland dwelling hinterland groups. Due to the abundance of permanent water sources in the area, there would have been plentiful resources to sustain multiple campsites.
- The arrival of the First Fleet in Sydney Cove in 1788 was followed the next year by a smallpox epidemic, which spread to the neighbouring regions and, although the exact effects are not known, it killed over half the Aboriginal population of the areas affected (Organ 1990).
- Early in the nineteenth century European graziers began taking land in the south of the Cumberland Plain and the coastal plains around Wollongong, with cedar clearing being conducted in the narrow northern coastal plain and rainforest areas of the escarpment (DEC 2005a). Access to traditional and everyday resources (such as water) and clearing the land of trees would have had a major impact on the ways in which Aboriginal people were living. This also caused significant social disruption between Aboriginal groups and pressure between Aboriginal people and the growing European population.

  Drought began and the competition for resources between the Europeans and the Aborigines led to several years of conflict. Organ (1990) documents the various skirmishes, killings and reprisals between Europeans and the Aborigines during the 1814 – 1815 period in the Cowpastures, Camden and Appin districts. This sporadic bloodshed led to larger scale conflict, with Governor Macquarie implementing a sustained punitive action against the Aboriginal population in the district. This resulted in the Appin Massacre of 17 April 1816, in which Aboriginal people were shot and driven over steep cliffs, likely near Broughtons Pass. By 1877 only 60 Gundungurra people were known to have survived the contact period and were relocated to the St Joseph's settlement, founded by Rev. Dillon of Camden. The settlement was located at the junction of the Cox's River and the Warragamba Gorge in the Burragorang Valley.
- Despite the massive changes that were so quickly brought to the Aboriginal people of the region, they maintained a sense of community, traditional customs and practices, cultural knowledge and continued to care for significant sites and the land in general. Today there are many thousands of Aboriginal people living in the Cumberland Plain and the Blue Mountains. They continue to be custodians of the land, whilst traditional owners maintain cultural knowledge (DEC 2005a).
- The study area has survived close to its original condition; and the native flora and fauna holds specific cultural significance to the Gundungurra people. In particular, plants of traditional or historic value to the Aboriginal community highlight one part of the natural environment that demonstrates the Aboriginal cultural affiliation with the landscape (Purcell 2002). Merriman (2009) compiled a detailed list of food sources available to Aboriginal people of the wider Blue Mountains region; many of these resources, particularly those located in the higher country that is now above the water level of the Warragamba Dam, would have been available to the Aboriginal inhabitants.

Important Aboriginal cultural values are summarised as follows:

- The landscape surrounding Warragamba Dam holds deep cultural values for the Aboriginal people. These values derive from both traditional knowledge and from social and historic associations with places, stories and cultural resources such as plants, animals and water. The most significant Aboriginal places were those associated with Aboriginal spiritual resources such as mythology, art and ceremony, and information about these is contained in the stories told by the Gundungurra people set in the dreaming (gunyunggalung). Dreaming stories are also used to explain the origin, behaviour and appearance of many native animals and plants in Gundungurra country (Smith 2016). Cultural values are further detailed in RAP responses (Appendix K, Appendix 1 and Appendix 2)).
- Aboriginal people have a proud but sometimes unacknowledged history of contribution to the agricultural and pastoral development in NSW. The Warragamba River and Burragorang Valley contain a diverse and valuable record of this history.
- Despite control and suppression, Aboriginal communities have maintained and nurtured a strong connection to place. Most of Burragorang Valley was inundated in the 1950s during the filling of Lake Burragorang, but stories explaining its creation and important cultural places still exist. The connection and association with the country is maintained in this case because successive generations continued to visit the same places. WaterNSW now facilitates access to the area and particularly during drought when sites below the FSL are revealed.

18.5 Upstream landscape

18.5.1 Regional character and predictive model

18.5.1.1 Synthesis of regional character and Aboriginal land use

The study area is located within the Burragorang physiographic subregion of the Sydney Basin. Landform comprises rugged sandstone ridgelines and escarpments, with flats to very steep slopes and narrow incised valleys and creeks surrounding Lake Burragorang. The material traces of past land use within the Burragorang and Blue Mountains landscapes reflect the importance of geology, topography and hydrology associated resources in determining occupational patterns (Johnson 1979; Bowdler 1981; Conyers 1985; McIntyre 1990). Past studies of the broader Burragorang physiographic region have highlighted the distribution of site types within these landscapes.

While there is early evidence that the Sydney region has been occupied for over 35,000 years (Williams et al. 2014), archaeological research indicates the earliest evidence for occupation in the eastern Blue Mountains is 12,000 years Before Present (BP) from Walls cave, Lyre Bird dell and Kings Table. Previous researchers have indicated that the occupation of these shelters is around 12,000 years BP and was consistent with a pattern of earlier but not very intensive occupation. Occupation evidence continues to be sporadic up until about 5000-4500 BP where an increasing and continued use of shelters has been identified (Attenbrow 1981).

The archaeological evidence highlights the utilitarian use and occupation of the ridgelines and sandstone shelter formations within the Burragorang Valley. This occupation is highlighted by the number of Shelters with Art, Deposit, Axe Grinding Grooves as well as Open Camp Sites containing stone artefacts and Scarred Trees that are by products of the manufacture of items which were not preserved- such as containers and canoes, or were discarded in the location used or elsewhere, such as stone tools for hunting, cutting, cleaning and processing foods (as outlined in Section 2) and making of other or wooden implements. Based on the stories highlighted in the CVAR (ACHR, Appendix 2) and archaeological evidence suggests that the Aboriginal people of the valley conducted utilitarian activities such as axe sharpening and grinding and camping but also practised ceremonial and other socially important aspects of life such as artistic expression; as outlined in the number of shelters in where the remains of this expression is still present, which may have also been used for ceremonial or other social and cultural purposes, such as education and for the passing down of the story Gurrangatch- Mirrigan Dreaming Track (further highlighted in ACHR, Appendix 2).

- A review was undertaken of AHIMS sites and a study (Biosis Research (2007) and Niche Environment and Heritage (2018)) of a similar landscape to the Warragamba Special Area (Metropolitan Special Area; this study was located within the Avon and Cordeaux Dam catchment areas approximately 67 kilometres south east of the current study area and shows that Aboriginal sites are most likely to occur on slopes from 0-30 percent, with higher site densities on slopes from 0-18 percent. Open camp sites, isolated artefacts and scarred trees are likely to occur on slope classes from 0-18 percent. Sandstone overhangs with archaeological deposits, art, midden and/or artefacts can be expected to occur on slope classes from 18-30 percent. This indicates that Aboriginal cultural heritage sites within the PUIA will be located on slopes from 0-30 percent with higher densities of Aboriginal sites located on slopes from 0-18 percent.
- AHIMS sites within the PUIA cluster on slopes from 0-18 percent but are represented on slopes up to 30 percent with none located on slopes over 35 percent. It can therefore be concluded that Aboriginal sites within the Metropolitan Special Area cluster on slopes from 6-18 percent but are represented mostly on slopes from 6-30 percent
- the expectation from the Project was that Open Camp Sites, Isolated Artefacts and Scarred Trees are mostly likely located on slope classes from 0-18 percent. Sandstone overhangs with archaeological deposits, art, midden and/or artefacts can be expected to be located on slope classes from 18-30 percent.

With respect to the Cumberland Plain, past Aboriginal Cultural heritage sites in quaternary fill sequences within creek and river valley context, specifically on floodplains, terraces, dunes, levees and lower slopes are strongly represented throughout the Cumberland plain region (McLaren et al 2019).

Some predictive models concerning Aboriginal occupation and settlement of the Cumberland Plain have been formulated and refined based on archaeological assessments undertaken in the region (e.g. Smith 1989, AMBS 1997, White and McDonald 2010). Based on current understandings, the most common Aboriginal site types found on the Cumberland Plain are open camp sites (i.e. open artefact scatters), scarred trees and isolated Artefacts. This pattern is reflected in the AHIMS data relating to the PUIA (ACHA, Table 3). The following predictions for the nature and distribution of Aboriginal sites have been established for the wider Cumberland Plain region:

- Aboriginal sites can be expected to be identified over the Cumberland Plain (i.e. across all topographic units) with the possible exception being areas prone to flooding such as the banks of creeks and rivers
- the density of Aboriginal sites is expected to be higher (Smith (1989) suggests by around 10 percent) in the northern areas of the plain due to the concentration of raw material sources in the north
- Aboriginal sites will occur more frequently in proximity (i.e. within 200 meters) of creek lines and other water sources
- the density of Aboriginal sites will be higher in open forest contexts compared to woodland communities. Sedgeland communities will be associated with relatively high site densities
- larger numbers of Aboriginal sites will be identified in areas characterised by good surface visibility
- integrity of archaeological sites located within the PUIA will relate directly to past land use practices and the level of disturbance resulting from such activities.

The PUIA is likely to contain a mixture of patterns reflective of the Burragorang physiographical region and the Cumberland Plain.

18.5.1.2 Predictive model

A predictive model for the PUIA is discussed in Appendix K (ACHA, Appendix 1). The predictive model included consideration of previous archaeological surveys and assessments in the local area and wider surrounds, the distribution and patterning of known sites, landform units and landscape context, and previous known land uses.

Colluvial soils landscapes cover most of the study area with areas on gently inclined foot slopes, simple slopes, ridges and crests which are all suitable areas for Aboriginal occupation. Erosional soil landscapes cover a large percent of the PUIA with gently inclined to steep slope with rock shelters suitable for Aboriginal occupation and transient use across the landscape. Alluvial soil landscapes cover a small part of the PUIA. Alluvial plains, floodplains and terraces in close proximity to water would have been suitable areas for Aboriginal occupation. Alluvial deposits have a high significance within the PUIA, as they have the potential for deep stratified deposits preserving in situ evidence of occupation including repeated occupation over many thousands of years.

A summary of the known Aboriginal heritage site types listed in the AHIMS database is provided in Section 4.1.1. The predictive model developed for the PUIA is as follows:

- Open Camp Sites and Isolated Artefacts form the most common class of site type or feature, accounting for 80 percent of the AHIMS registered sites:
  - the identification of this type of site depends on ground surface visibility, as site extent and artefact numbers are only visible on the surface. This is due to the vegetation cover of the PUIA as this type of site type may be difficult to relocate. Areas of open ground surface will be assessed for such site types
  - most site types will occur on level to gently inclined alluvial plains, floodplains, terraces, foot slopes, simple slopes, ridges and crests
  - most sites will occur within 200 meters of temporary or permanent water sources
  - most sites will occur on alluvial and transferral soil landscapes, which are present within the PUIA.
- Scarred Trees are the second most likely represented class of site type, accounting for 11 percent of the AHIMS registered sites:
  - Scarred Trees are a site type that is formed from the removal of bark from a tree for use in the manufacture of canoes, shields, shelters and containers for sorting or carrying items
  - most of the PUIA has been protected from large scale timber felling operations due to its use as a water catchment area, significantly increasing the likelihood of survival of this site type.
- Axe Grinding Groove sites are one of the most common site types, making up approximately 5 percent of the AHIMS registered sites:
  - Axe Grinding Groove sites will most likely occur on sandstone outcrops associated with drainage lines, swamps, creek lines and riverbeds
  - the bulk of Axe Grinding Groove sites will contain fewer than 50 grinding grooves
  - grooves will generally be between 25 cm and 50 cm in length, 5 cm to 8 cm in width and between 2 cm and 5 cm in depth and represent the sharpening or preparing of ground edge hatchets or fire hardened points.

- Although not previously recorded in high numbers, sandstone shelters, boulder or rock overhangs with archaeological deposits, art, midden and/or artefacts will be one of the most common sites identified within the PUIA. The geological characteristics are consistent with those required for sandstone shelters.
- There is a potential for Waterholes to be present within the PUIA. This site type was not only a critical resource within the environment but played a significant role in ceremonies and as a place for the community to meet and pass down stories from one generation to another.
- Rock Engravings may be present within the PUIA due to the presence of sandstone in close proximity to water. Rock Engravings may consist of carefully incised images of people, animals, or symbols, in the sandstone.
- Burials, an uncommon site type, are present within soft aeolian and alluvial sediments, caves, or hollow trees in NSW. Such sites are more commonly located within the sand dunes of the coastal region; however, it is not completely unlikely that this site type will occur within the PUIA.
- Stone arrangements are rare in the local area. This type of site can include mounds of rocks for burial, or markers, mythological sites, or areas of spiritual connection. There are no stone arrangements previously identified within the PUIA.
- Ceremonial grounds are sites where initiation ceremonies, marriage alliance ceremonies, tribal meetings and other important social functions were held. They are places of great significance to Aboriginal people. There are no Ceremonial grounds previously identified in AHIMS within the PUIA.
- Aboriginal places are places of cultural significance to Aboriginal people. No Aboriginal places have been declared within the PUIA (February 2019) or listed on AHIMS: (http://www.environment.nsw.gov.au/conservation/AboriginalPlacesNSW.htm). However, an Aboriginal Place nomination has been made for the PUIA and is further discussed in Section 4.4.

The following predictions were made regarding the distribution of Aboriginal cultural heritage sites in relation to slope gradient:

- Aboriginal cultural heritage sites within the PUIA will be located on slopes from 0-30 percent with higher densities of Aboriginal sites located on slopes from 0-18 percent.
- AHIMS sites within the PUIA cluster on slopes from 0-18 percent but are represented on slopes up to 30 percent with none located on slopes over 35 percent. It can therefore be concluded that Aboriginal sites within the Metropolitan Special Area cluster on slopes from 6-18 percent but are represented mostly on slopes from 6-30 percent.
- The expectation from the Project was that Open Camp Sites, Isolated Artefacts and Scarred Trees are mostly likely located on slope classes from 0-18 percent. Sandstone overhangs with archaeological deposits, art, midden and/or artefacts can be expected to be located on slope classes from 18-30 percent.

Following the field survey the predictive model was further evaluated and an assessment made of additional potential Aboriginal sites within the study area. This is addressed in Section 18.6.3.3.

18.5.2 Geology

The study area is dominated by recent geologies of Permian and Triassic sandstone, and siltstone in the northern, eastern and central areas. Landscapes have typically formed into tablelands with cliff features above broad, moderately steep escarpment slopes. The cliff lines generally indicate the break in geology with Triassic sandstones above and the more weatherable Permian sandstone, shale and siltstone below.

Aboriginal site types within this geological region are likely to include sandstone shelters, rock overhangs or boulders with archaeological deposits, art, midden and/or artefacts, Axe Grinding Groove sites and Scarred Trees. Geologically older rocks form the main strata in the western and south-western parts of the study area. The Devonian, Ordovician and Silurian aged substrates form similar shallow infertile soils where underlying rock is often exposed. Quartzite's, siltstones, clay stones and shales are dominant. These older sediments have generally formed more incised, narrower valleys without dominant cliff lines. The Coxs Valleys is an example of these metasediments. Aboriginal site types associated within this geological region consist of Open Camp Sites and Isolated Artefacts.

18.5.3 Soil landscapes

There are 17 soil landscapes present within the study area, which are defined by Hazelton and Tille (1990). These formations are divided into alluvial, colluvial erosional, transferral and residual landscapes, and are shown on Figure 18-9 and summarised in Table 18-7.

As can be seen from Table 18-7, a range of archaeological site types have the potential to occur across all of the soils landscapes. Open camp sites, isolated artefacts, and potential archaeological deposits (PADs) are highly likely to occur in all soil landscapes with the exception of colluvial soil landscapes.

Apart from the area around Warragamba Dam, most of the study area has been protected as National Park and water catchment Special Areas. Land disturbance is therefore relatively limited and is mainly attributed to:

- construction of Warragamba Dam and flooding of Lake Burragorang
- installation of services (for example power lines and pipes)
- historical underground coal mining
- installation and maintenance of fire trials and roads
- farming and agricultural practices.

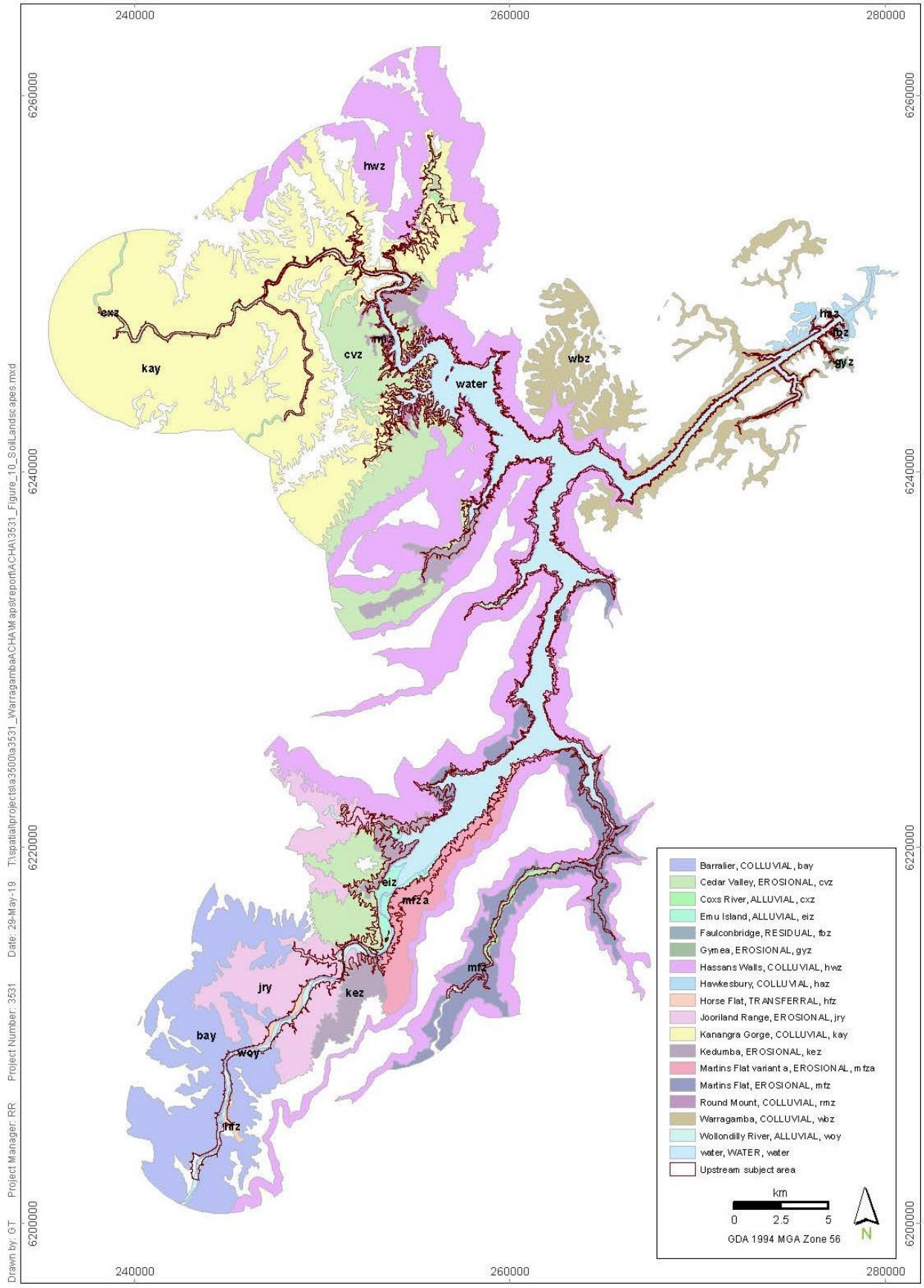
Table 18-7. Soil landscapes (Hazelton & Tille 1990) and potential for archaeological sites

Soil landscape	Characteristics	Potential archaeological sites
Alluvial soil landscapes are formed by deposition along rivers and streams and include floodplains and alluvial deposits. Typical landform elements include those found in meandering plains, including bars, back plain, scroll plains, flood-outs, ox-bows, levees, terraces and prior and current stream channels. Site types would likely include Isolated Artefacts, Open Camp Sites and Potential Archaeological Deposits.		
Coxs River	Characterised by swamps within alluvial plains and terraces on quaternary alluvium (alluvium). Local relief ranges from 2-20 m with slopes from 0-5% and nil rock outcropping. Soils include brown earths and alluvial soils.	Archaeologically sensitive with the possibility for deep alluvium, providing the accumulation of archaeological deposits. The soil landscape has gentle slopes and is associated with water ways. These factors make the presence of open camp sites, isolated artefacts, and potential archaeological deposits (PAD) highly likely.
Emu Island	Characterised by alluvial plains on quaternary alluvium (alluvium and silt). Local relief ranges from 0-5 m with slopes from 0-2% and nil rock outcropping.	Archaeologically sensitive with the possibility for deep alluvium, providing the accumulation of archaeological deposits. The soil landscape has gentle slopes and is associated with water ways. These factors make the presence of open camp sites, isolated artefacts, and potential archaeological deposits (PAD) highly likely
Wollondilly River	Characterised by alluvial plains and terraces on quaternary alluvium (alluvium). Local relief ranges from 0-15 m with slopes from 1-6% and nil rock outcropping. Soils include yellow/brown alluvial deposits	Archaeologically sensitive with the possibility for deep alluvium, providing the accumulation of archaeological deposits. The soil landscape has gentle slopes and is associated with water ways. These factors make the presence of open camp sites, isolated artefacts, and potential archaeological deposits (PAD) highly likely
Erosional soil landscapes are characterised by areas where soil and rock are being removed at a rate greater than they can be transported and deposited from other locations. Mechanisms for erosion include wind and water; both through rain and stream wash. Site types would likely include isolated artefacts, open camp sites and where suitable geology occurs, axe grinding groove sites and rock shelters.		
Cedar Valley	Characterised by narrow convex crests and ridges with moderately to steeply inclined side slopes away from sandstone escarpments. Narrow, deeply incised valleys are characteristic of this soil landscape. Slope gradients are 15 –60% with a local relief of 50 –150 m. Soils vary from yellow brown loamy sands to medium clays.	Archaeologically sensitive. The moderately inclined slopes from 15-30% are where Aboriginal sites may be located. Slopes up to 15% with loamy sands have the potential for open camp sites, isolated artefacts, PADs and scarred trees.
Gymea	Characterised by undulating to rolling rises and low hills on Hawkesbury Sandstone, with broad convex crests, moderately inclined side slopes with wide benches, localised rock outcrop on low broken scarps (Hazelton & Tille 1990). Local relief ranges between 20 – 80 m, with slopes between 10-25%. Soils are noted as including yellow earths, earthy sands, siliceous sands, gleyed podzolic soils, yellow podzolic soils and leached sands (Hazelton & Tille 1990).	Archaeologically sensitive. The moderately inclined slopes from 10-25% are where Aboriginal sites maybe located. Slopes from 10-15% within sands have the potential for open camp sites, isolated artefacts, PADS and scarred trees.
Jooriland Range	Characterised by low hills and hills on Bindook Porphyry (quartz porphyry). Slope gradients are 2 - 33% with a local relief of 10-90 m.	Archaeologically sensitive. The very gently inclined to moderately inclined slopes from 2-30% are where Aboriginal sites maybe located. Slopes from 2-15% have the potential for open camp sites, isolated artefacts, PADs and scarred trees.

Soil landscape	Characteristics	Potential archaeological sites
Kedumba	Characterised by broad ridges and valley flats comprised of undulating to rolling rises. Slopes are waning with slope gradients ranging from 5 – 15% with a local relief up to 30 m. Soils are generally dark brown loamy sands, bleached sands and blocky clays.	Highly archaeologically sensitive. Open camp sites, isolated artefacts, PADs and scarred trees are likely.
Martin Flat	Characterised by hills on Permian Shoalhaven Group (siltstone/mudstone). Slope gradients are 5-30% with a local relief of 20-150 m.	Archaeologically sensitive. Slopes from 5-15% have the potential for open camp sites, isolated artefacts, PADs and scarred trees.
Martin Flat Variant A	Characterised by hillslopes and foot slopes within low hills on Permian Shoalhaven Group. Slope gradients are 5-25% with a local relief of 20-90m.	Archaeologically sensitive. The moderately inclined slopes from 5-25% are where Aboriginal sites may be present. Slopes from 5-15% have the potential for open camp sites, isolated artefacts, PADs and scarred trees.
Colluvial soil landscapes are characterised by mass movement (rock fall) with steep slopes, rock outcrops and shallow stony highly permeable soils. Site types would likely include isolated artefacts, open camp sites and where suitable geology occurs, axe grinding groove sites and rock shelters.		
Barralier	Characterised by cliffs and scree within mountains on Bindook Porphyry (quartz porphyry). Local relief ranges from 200-500 m with slopes from 25-50% and abundant rock outcropping.	Slopes are generally too steep for rock overhangs suitable for Aboriginal sites. However, on more moderately inclined slopes from 25%-30%, Aboriginal sites may occur.
Hassan Wall	Characterised by precipitous sandstone cliffs, formed above steep to very steep colluvial side slopes. Local relief is 100 - 500 m with slopes generally greater than 40% becoming gentler on lower slopes and narrow drainage flats. Soils include loamy sands, sands and pedal clays.	Slopes are generally too steep for rock overhangs suitable for Aboriginal occupation. The gentler lower slopes, narrow drainage flats and soils consistent with Hassan Wall would be suitable for open camp sites, isolated artefacts and axe grinding grooves.
Hawkesbury	Characterised by rugged, rolling to very steep hills on Hawkesbury Sandstone, with narrow crests and ridges, narrow incised valleys, steep side slopes with narrow rocky benches, broken scarps and boulders. Local relief ranges between 100m - 200 m, with slopes generally greater than 25%. Soils include lithosols/siliceous sands, earthy sands, yellow earths, yellow and red podzolic soils and siliceous sands.	Archaeologically sensitive as the blocks and weathered scarps provide suitable overhangs to be used for shelter. Within these overhangs there is often suitable surfaces for art, as well as floor space for the accumulation of archaeological deposit.
Kanangra Gorge	Characterised by steep to very steep hills and mountains. Small narrow, convex crests occur above steep to very steep (occasionally precipitous), deeply incised valleys. Occasional areas of rock land occur on some slopes with small cliffs evident on some upper slopes. Slopes are generally greater than 30% with a local relief greater than 300 m. Soils include brown clay loam and reddish-brown clays.	Slopes are generally too steep for rock overhangs suitable for Aboriginal sites. However, on more moderately inclined slopes Aboriginal sites may be located.
Round Mount	Characterised by steep to very steep hills and mountains with narrow and convex crests. Small rocky cliffs are present on some slopes. Slope gradients are generally greater than 35% with a local relief less than 400 m. Soils include brownish black loamy sands to bright brown clays	Slopes are generally too steep for rock overhangs suitable for Aboriginal sites. The soils within this landscape would not be suitable for Open Camp Sites or Isolated Artefacts.

Soil landscape	Characteristics	Potential archaeological sites
Warragamba	Characterised by moderate to very steep slopes, sloping narrow ridges with narrow sandstone and colluvial benches occurring on the slopes which contain sandstone boulders. Local relief ranges from 80–130 m with slopes generally greater than 25%. Soils include dark brown loamy sand, dark reddish-brown clayey sand and pedal clay.	Slopes are generally too steep for rock overhangs suitable for Aboriginal sites. However, on more moderately inclined slopes from 25-30% Aboriginal sites may be located.
Transferral soil landscapes are deep deposits of mostly eroded parent materials washed from areas up slope. Stream channels are often discontinuous, and slopes are generally concave. Transferrable landscapes include foot slopes, valley flats, fans, and piedmonts.		
Horse Flat	Characterised by fans on quaternary alluvium (alluvium, colluvium and unconsolidated). Slope gradients are 2-25% with a local relief of 20-60 m.	Archaeologically sensitive with the possibility for deep alluvium. All slopes within this soil landscape have the potential for Aboriginal sites. Moderately inclined slopes, 2-15%, have a high potential for open camp sites, isolated artefacts, PADs and scarred trees.
Residual soil landscapes are characterised by areas where soils are derived from the long term, in-situ weathering of parent materials. Examples of these types of soil landscapes are flats, plains, and plateaus with poorly defined drainage lines.		
Faulconbridge	Characterised by hillcrests within plateaus on Hawkesbury Sandstone (sandstone-quartz and siltstone/mudstone). Slope gradients are 0-5% with a local relief of 0-20 m.	Highly archaeologically sensitive with likely open camp sites, isolated artefacts, PADs and scarred trees.

Figure 18-9. Upstream soil landscapes



Source: Appendix K, Appendix 1

18.6 Survey results

18.6.1 Downstream

The Project would potentially benefit Aboriginal cultural heritage downstream of Warragamba Dam through reducing flood depths and extents on the floodplain. However, the downstream area is included in the data synthesis for an understanding of Aboriginal Objects and sites associated with the Hawkesbury-Nepean River catchment. A total of 888 sites were recorded and a full listing is provided in Appendix K (ACHA, Appendix 1).

18.6.2 Construction area

One previously registered site Foleys Creek is registered on the AHIMS as being located within the construction area, however, its registration location is incorrect and as a result it has been removed from all final site counts for this assessment.

18.6.3 Upstream

The upstream survey identified the following:

- 334 sites were identified during the survey, which comprised:
  - 31 previously recorded sites
  - 303 newly recorded sites, most of which are Open Camp Sites (196)
  - a total of 447 features were identified.
- 43 sites were identified within the PUIA
- 183 sites were identified within the EUIA
- 45 creation story locations, of which 31 locations were visited during the survey
-

A summary of identified sites is given in Table 18-8. Features found at surveyed Aboriginal sites and creation story locations are given in Table 18-9 and Table 18-10 respectively. Tributaries identified as having archaeological potential are given in Table 18-11.

More details are provided Appendix K (ACHA, Appendix 1 figures).

Table 18-8. Summary of Aboriginal sites identified

Site type (See Appendix K, Appendix 1 figures)	Number recorded				Frequency of site type (%)
	EUIA	PUIA	Other	Total	
Aboriginal Ceremony and Dreaming	1			1	<1
Aboriginal Resource and Gathering	2	1	1	4	1
Axe Grinding Grooves	3	4	1	8	2
Isolated Artefact	9	6	6	21	6
Open Camp Site	136	23	36	195	58
Open Camp Site with Axe Grinding Grooves	1			1	<1
Open Camp Site with Axe Grinding Grooves and Isolated Artefact	1		1	2	1
Open Camp Site with Axe Grinding Grooves and Scarred Tree			1	1	<1
Open Camp Site with Scarred Tree	5		3	8	2
Scarred Tree			5	5	2
Shelter with Art		1	2	3	1
Shelter with Art and Artefacts	2			2	1
Shelter with Art and Axe Grinding Grooves			3	3	1
Shelter with Art, Artefacts and Axe Grinding Grooves	1		1	2	1
Shelter with Artefacts and Axe Grinding Grooves	1			1	<1
Shelter with Axe Grinding Grooves			1	1	<1
Shelter with Deposit	1	1	4	6	2
Shelter with Deposit and Art	1		2	3	1

Site type (See Appendix K, Appendix 1 figures)	Number recorded				Frequency of site type (%)
	EUIA	PUIA	Other	Total	
Shelter with Deposit and Artefacts	8	4	11	23	7
Shelter with Deposit and Axe Grinding Grooves	1		6	7	2
Shelter with Deposit and Isolated Artefact	1		1	2	1
Shelter with Deposit, Art and Artefacts	3		7	10	3
Shelter with Deposit, Art and Isolated Artefact			3	3	1
Shelter with Deposit, Art, Artefacts and Axe Grinding Grooves			8	8	2
Shelter with Deposit, Artefacts and Axe Grinding Grooves	1	1	3	5	2
Shelter with Deposit, Artefacts, Axe Grinding Grooves and Tool Marks	1			1	<1
Shelter with Deposit, Axe Grinding Grooves and Isolated Artefact	1	1		2	1
Shelter with Isolated Artefact	1			1	<1
Stone Arrangement		1	1	2	1
Water Hole	1		1	2	1
Water hole and Aboriginal Ceremony and Dreaming	1			1	<1
Total	**183**	**43**	**108**	**334**	100

Table 18-9. Features found at surveyed Aboriginal sites

Types of features found in the PUIA	Number of sites with this feature	Occurrence at sites as a % of sites surveyed
Axe Grinding Grooves	42	13
Engravings	1	<1
Isolated Artefacts	30	9
Artefact Scatters	248	74
Rock Shelters	84	25
Scarred Trees	6	2
Rock Art	31	10
Stone Arrangement	2	1
Water Hole	3	1

Table 18-10. Creation Story locations within and adjoining the study area

Gundungurra cultural landscape item name See Appendix K (ACHA, Appendix 1, figures).	Surveyed	Within PUIA
1. Birrigooroo Water Hole	Yes	No
2. G's Journey	No[1]	No
3. Kedumba Water Hole	Yes	No[2]
4. Rock Art	Yes	No[3]
5. G's Journey	Yes	Yes
6. Hayes	No[1]	No
7. Apple Tree Flat	No[1]	Yes
8. Karrangatta Water Hole	No[1]	No
9. Kowmung	No[1]	No
10. Big Fight	No[1]	No[3]
11. Alum Springs Medicinal	Yes	No
12. Burial	Yes	No[3]

Gundungurra cultural landscape item name See Appendix K (ACHA, Appendix 1, figures).	Surveyed	Within PUIA
13. Billagoola Water Hole	No	No[2]
14. Illagoola	Yes	No[2]
15. Warrumba	Yes	Yes
16. Cunnark Water Hole	Yes	No[2]
17. Rock Art	Yes	No
18. Cooba	Yes	No[2]
19. Gung Gaung Water Hole	Yes	No[2]
20. Gusabung	No	No[2]
21. Gaung Water Hole	No	No[2]
22. St Josephs	Yes	No
23. Muggaroon	Yes	No
24. Gogongolly	Yes	Yes
25. Junda Water Hole	Yes	No[2]
26. Kouroong	Yes	No[2]
27. Ripple Creek	Yes	No[3]
28. Werriberrie	Yes	No
29. Gurrabulla Water	No	No[2]
30. Boonbat Water Hole	No	No[2]
31. Bulla Mullar	No	No[2]
32. Gunnadarel	No	Yes
33. Mullindar Water Hole	Yes	No[2]
34. Kweeoogang Water Hole	Yes	No[2]
35. Burials	Yes	No[2]
36. The Black Water Hole	Yes	No[2]
37. Sheeys Creek	Yes	No
38. Nattai	Yes	No
39. Goorit Water Hole	Yes	No[2]
40. Woonaggaree	Yes	No[2]
41. Burrogorang	Yes	No[2]
42. Gunarlook Water Hole	Yes	No
43. Jumping Woman	Yes	No
44. Big Fight	Yes	Yes
45. John Riley Burnt	No[1]	No[3]

1. Not accessible
2. Below FSL
3. Outside upstream study area

Table 18-11. Tributaries identified as having archaeological potential

Tributaries of archaeological potential	Assessment details
Spring Creek	Partially surveyed within the PUIA
Fern Creek	Partially surveyed within the PUIA
Kedumba River	Partially surveyed within the PUIA
Water Fall Creek	Partially surveyed within the PUIA
Cedar Creek	Partially surveyed within the PUIA
Singajjingwell Creek	Not surveyed as part of this assessment
Reedy Creek	Partially surveyed within the PUIA
Cox River	Partially surveyed within the PUIA
Kowmung River	Partially surveyed within the PUIA
Lake Burragorang	Partially surveyed within the PUIA
Tollbar Creek	Not surveyed as part of this assessment

Tributaries of archaeological potential	Assessment details
Horse Arm Creek	Partially surveyed within the PUIA
Alum Spring Creek	Partially surveyed within the PUIA
Oaky Creek	Partially surveyed within the PUIA
Ripple Creek	Partially surveyed within the PUIA
Werriberri Creek	Partially surveyed within the PUIA
Butchers Creek	Partially surveyed within the PUIA
Green Wattle Creek	Partially surveyed within the PUIA (South)
Green Wattle Creek	Partially surveyed within the PUIA (North)
Fitz's Creek	Not surveyed as part of this assessment
Black Coola Creek	Not surveyed as part of this assessment
Bob Higgins Creek	Not surveyed as part of this assessment
Blossom Lodge	Not surveyed as part of this assessment
Dunns Gully	Not surveyed as part of this assessment
Ranger Creek	Not surveyed as part of this assessment
Tonalli Creek	Partially surveyed within the PUIA
Nattai River	Partially surveyed within the PUIA
Gillians Creek	Not surveyed as part of this assessment
Little Creek	Partially surveyed within the PUIA
Jooriland River	Partially surveyed within the PUIA
Wollondilly River	Partially surveyed within the PUIA

Table 18-12. Tributaries identified as having archaeological potential in the methodology

Tributaries of archaeological potential identified in the methodology	Assessment details
Spring Creek	Partially surveyed within the study area
Fern Creek	Partially surveyed within the study area
Kedumba River	Partially surveyed within the study area
Water Fall Creek	Partially surveyed within the study area
Cedar Creek	Partially surveyed within the study area
Singajingwell Creek	Not surveyed as part of this assessment
Reedy Creek	Partially surveyed within the study area
Cox River	Partially surveyed within the study area
Kowmung River	Partially surveyed within the study area
Lake Burragorang	Partially surveyed within the study area
Tollbar Creek	Not surveyed as part of this assessment
Horse Arm Creek	Partially surveyed within the study area
Alum Spring Creek	Partially surveyed within the study area
Oaky Creek	Partially surveyed within the study area
Ripple Creek	Partially surveyed within the study area
Werriberri Creek	Partially surveyed within the study area
Butchers Creek	Partially surveyed within the study area
Green Wattle Creek	Partially surveyed within the study area (South)
Green Wattle Creek	No surveyed as part of this assessment (North)
Fitz's Creek	Not surveyed as part of this assessment
Black Coola Creek	Not surveyed as part of this assessment
Bob Higgins Creek	Not surveyed as part of this assessment
Blossom Lodge	Not surveyed as part of this assessment
Dunns Gully	Not surveyed as part of this assessment
Ranger Creek	Not surveyed as part of this assessment
Tonalli Creek	Partially surveyed within the study area
Nattai River	Partially surveyed within the study area
Gillians Creek	Not surveyed as part of this assessment
Little Creek	Partially surveyed within the study area
Jooriland River	Partially surveyed within the study area
Wollondilly River	Partially surveyed within the study area

18.6.3.1 Aboriginal ceremony and dreaming sites

One (1) site was recorded that relates to an Aboriginal Ceremony and Dreaming site. It is located outside of the PUIA. Details are provided in Appendix K (ACHA, Appendix 1, Table 19 and Appendix 8).

Photo 18-1. Landform at Warragamba-226 showing area associated with Guringatch's Journey

Photo 18-2. Landform at Warragamba-226

18.6.3.2 Aboriginal resource gathering sites

Four (4) Aboriginal Resource Gathering sites were recorded. One (1) site is within the PUIA. These include three new sites recorded as part of this survey. They comprise of two medicinal gathering sites, and a post-contact farm site with a continuous connection to the area dating back 100 years before the encroachment of Lake Burragorang in the 1950s. Details are provided in Appendix K (ACHA, Appendix 1, Tables 20 & 21 and Appendix 8).

Photo 18-3. General view of Gunguarlook Farm post-contact site at Warragamba-75

Photo 18-4. Detail of medicinal spring at Warragamba-233

18.6.3.3 Engraving site

There is one site that features engravings identified within the study area. This site was not located, as the original positioning information was not accurate. Details are provided in Appendix K (ACHA, Appendix 1, Table 25 and Appendix 5).

18.6.3.4 Axe grinding groove sites

Nine (9) axe grinding groove sites were recorded across a variety of landforms. Three (3) sites are within the PUIA. Details are provided in Appendix K (ACHA, Appendix 1, Tables 22, 23 & 24 and Appendix 5).

Photo 18-5. Detail of axe grinding grooves at Jooriland Creek (AHIMS ID#52-1-0045)

Photo 18-6. Detail of axe grinding grooves at Warrragamba-228

18.6.3.5 Isolated artefacts

Twenty-one (21) Isolated Artefact sites located were recorded. Five (5) sites are within the PUIA. Many of these sites were characterised by poor exposure and a number have potential to contain additional artefacts. Details are provided in Appendix K (ACHA, Appendix 1, Table 26, 27 & 28 and Appendix 5).

Photo 18-7. General view of landform at Warragamba-64, Isolated Artefact site

Photo 18-8. Detail of isolated artefact found at Warragamba-90

18.6.3.6 Open camp sites

One hundred and ninety-six (196) open camp sites were recorded. Twenty-five (25) sites are within the PUIA. These sites are usually identified by artefact scatters but could also be associated with Scarred Trees. This site type is the most prevalent found in this survey, with many of these sites located on flatter landforms which command views of the surrounding terrain. These sites would have been much higher relative to the water levels in each valley in antiquity. Details are provided in Appendix K (ACHA, Appendix 1, Table 29, 30 & 31, and Appendix 5).

Photo 18-9. Detail of artefacts found in situ at Green Wattle Point (AHIMS #52-01-0136)

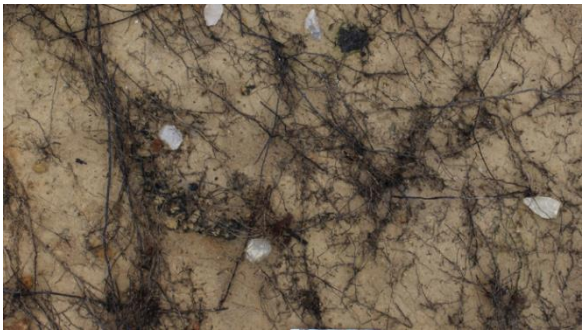


Photo 18-10. General view of landform at the open camp site Warragamba-230

18.6.3.7 Scarred tree sites

Five (5) sites were recorded that comprised only of scarred trees and were not associated with another feature. There are no sites within the PUIA. Details are provided in Appendix K (ACHA, Appendix 1, Table 32 & 33; and Appendix 5).

Photo 18-11. General view of scarred tree at Tonalli Cove 2 (AHIMS ID#52-1-0131)

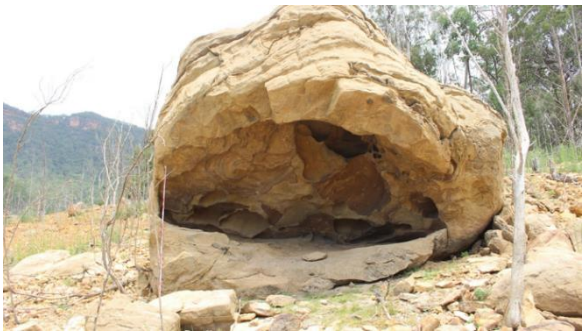
Photo 18-12. General view of scarred tree at Warragamba-91

18.6.3.8 Rock shelter sites

Eighty-three (83) shelter sites were recorded. Nine (9) sites are within the PUIA. These shelter types comprise Shelter with abrasion patches, shelter with art, shelter with art and deposit, shelter with art, deposit, and axe grinding grooves, shelter with deposit, and shelter with deposit and artefacts. Details are provided in Appendix K (ACHA, Appendix 1, Table 34, 35 & 36; and Appendix 5).

Photo 18-13. General view of rock shelter found at Warragamba-61

Photo 18-14. General view of rock shelter formed by an isolated boulder at Bimlow PAD (AHIMS ID#45-4-0997)



18.6.3.9 Stone arrangement sites

Two (2) stone arrangement sites were recorded. One (1) site is within the PUIA. Details are provided in Appendix K (ACHA, Appendix 1, Table 39 & 40; and Appendix 5).

Photo 18-15. General view of landform at Warragamba-80

Photo 18-16. Detail of stone arrangement found at Warragamba-92

18.6.3.10 Water hole sites

Three (3) Water Hole sites were recorded within the current dam full supply level. There are no sites within the PUIA. These sites are associated with Aboriginal Dreaming and Open Camp sites. Details are provided in Appendix K (ACHA, Appendix 1, Table 41 & 42; and Appendix 5).

Photo 18-17. General view of landform at Warragamba-63, submerged water hole site

Photo 18-18. General view of landform with water hole at Warragamba-133

18.6.4 Analysis and discussion

18.6.4.1 Site distribution and predictive model

Detailed analysis of recorded sites is provided in Appendix K (ACHA, Appendix 1, Section 10).

Aboriginal site distribution by slope class is given in Table 18-13 and shown on Figure 18-10. It was generally found that sites displayed a similar pattern outlined by the predictive model, which predicts where Aboriginal cultural heritage sites are likely to be located based on previous assessments within proximity to the current study area and slope gradient analysis. Due to the rugged nature of the landscape, most sites suitable for Aboriginal occupation and transient use comprise of sandstone overhangs. A summary of sites within the PUIA is provided as follows:

- **Artefact Assemblage**: Raw material selection was found to be consistent with other projects across the region. The PUIA did contain a wider range of technologies, including ground edge, grinding, bipolar, anvil rested and percussion flaking.
- **Aboriginal Resource Gathering**: There were four Aboriginal Resource and Gathering sites located during the survey. Three of these sites comprise of limestone features within proximity to the FSL of the current Dam (EUIA). It has been suggested by Michael Jackson (pers. Comm during the survey) that these are potential medicinal sites, and that the water contains medicinal properties used to heal an individual of ailments from this limestone spring. The final resource and gathering site is Gungalook Farm within the PUIA. This site has post contact significance to the Aboriginal community as the Riley family has over 100 years of historical

association with the land until they were required to leave due to the rising waters of Lake Burragorang in the 1950s. The Riley family has continued their connection to the area through maintaining cultural traditions and custodianship. Remains of the family home and ashes of family members remain here. A further three stone tools were also observed at this location.

- **Axe Grinding Groove sites**: The PUIA contained three Axe Grinding Grooves sites. The limited number of axes grinding groove sites can be attributed to the water levels at Lake Burragorang during this assessment, as well as several suitably sized platforms for such practices being covered in silt and or vegetation. These sites hold significance to the local Aboriginal community as evidence of past occupation and use of the PUIA, as well as an educational tool for younger generations.
- **Scarred Trees**: The PUIA contains trees that have been assessed as culturally modified trees (i.e. the source of scarring is considered to be the result of Aboriginal cultural activities in the past) and trees that have been deemed to be 'Possible Culturally Modified Trees' (i.e. the source of scarring is uncertain). The clear identification of culturally modified trees of Aboriginal cultural origin in the PUIA is challenging due to its long history of occupation and clearance for the development of Warragamba Dam. An independent arborist assessment should be sought to determine if trees are of a suitable age and assess the likely cause of trauma to these trees. For the purposes of the ACHA these trees have been conservatively assessed as being culturally modified trees and have therefore been included in the impact assessment.
- **Rock Shelter sites**: Of the 334 Aboriginal cultural heritage sites identified as part of this assessment, 31 comprise sandstone shelter sites that have either one or a combination of art, deposit, grinding grooves, abrasion patches and/or potential archaeological deposit. The Permian and Triassic sandstone and siltstone landscapes within the PUIA lends themselves to this site type to be used by past Aboriginal peoples for artistic expression, occupation and transient use. Like axe grinding grooves, these site types are significant to the local Aboriginal community as they evidence the past occupation of the area and can be used as an educational tool for younger generations. There were 33 Shelters identified during the survey, with 32 Shelters having a high proportion of multi-component archaeological records indicative of intensive, or repeated occupation, with combinations of art, artefacts, axe grinding grooves and deposit. Eight Rock Shelters sites are within the PUIA.
- **Rock Art**: A detailed assessment of rock art is provided in Appendix K (ACHA, Section 10.6.4). A review of rock art in the region and in similar landscapes was also undertaken. The images depicted within the shelters of the PUIA are 'part of a regional style that stretches from the southern rim of the Hunter Valley in the north, to the Woronora Plateau in the south, and as far west as the Blue Mountains- basically the extent of the Hawkesbury sandstone.' (Attenbrow 2002:146). While the PUIA is not large enough to detect major trends in motif types, a number of the motif types have previously been observed during assessment within the Blue Mountains region. These motif types comprise Men, Anthromorphic figures, zoomorphic figures, Anthromorphic figures with radiating lines, a snake, six hand stencils, circles, complex non-figurative and zig zag lines.
- **Water hole sites**: Three (3) water hole sites were recorded. These were each recorded in conjunction with limestone deposits that have been interpreted to be used for medicinal purposes. Water Holes within the Burragorang Lake have also been associated with the creation story as highlighted in the CVAR and with past Aboriginal stone tool development and resource gathering practices.

In summary, the study area contains a range of archaeological and cultural sites that provide information about past Aboriginal land use and settlement of the area. The types and locations of sites can be interpreted to provide an insight into what events took place in the past, and how the landscape was used in the past. Key results are:

- the sites present a range of activities and events, such as living places, stone artefact manufacture, the grinding of stone axes, the use of flaked stone artefacts to prepare foods and utilitarian items, the grinding of plant foods to produce flour and the removal of bark and cambium from trees for utilitarian items such as shelters and coolamon style dishes. Justine Coplin of the Darug peoples further states that:

  '*While people were living the traditional lifestyle song, dance, art and ceremony was and is a big part of daily life. People read the land and signs similar to reading maps today. There were signs left in the landscape showing tribal areas, ceremonial places, sacred places, burials, women's places, and resources. The Warragamba Dam area contains evidence of these ceremonial places, sacred places, women's places and resource area that have been recorded during the Project*.'
- the locations of Aboriginal cultural heritage sites are dependant in many cases on the natural environment – grinding grooves only occur where there are suitable stone platform outcrops, and sandstone shelters only occur in areas where there are suitable rock formations, which generally occur on moderate and steeply inclined slopes. However, within this framework of the landscape Aboriginal people will have used the land in

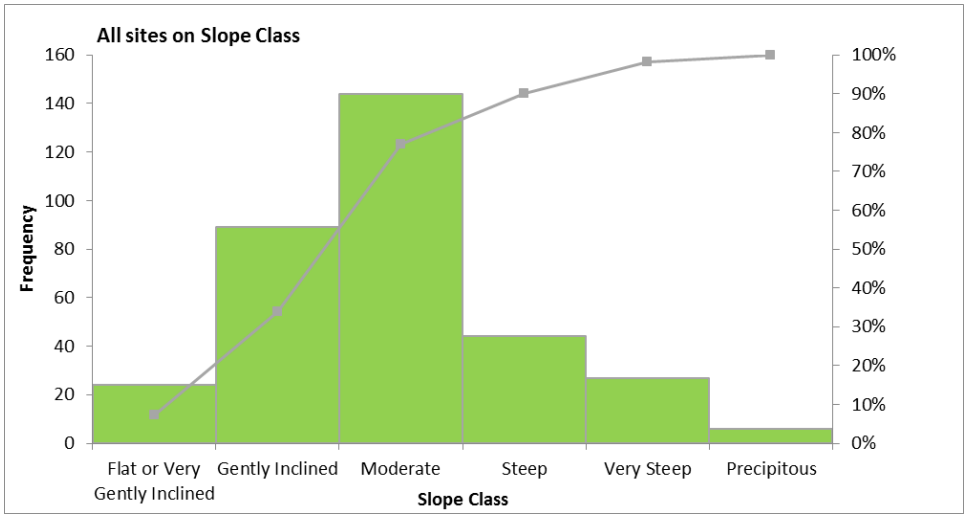
different ways, at different times and for different purposes – dictated by both utilitarian and non-utilitarian influences and objective

- resource rich areas such as creeks and rivers may have been a focus of occupation when resources were abundant or readily available, and hence archaeologists expect to find more Aboriginal cultural heritage sites in association with these landforms. On the other hand, the nature and timing of occupation will also have been dictated by non-utilitarian objectives such as ceremonies, rituals and gatherings
- some of the largest Aboriginal cultural heritage sites identified are close to Lake Burragorang, which would have provided abundant and reliable resources.

Table 18-13. Aboriginal site distribution by slope class

Site features	Flat – very gently inclined (0-2%)	Gently inclined (2-6%)	Moderate (6-18%)	Steep (18-30%)	Very steep (30-45%)	Precipitous (>45%)
Aboriginal ceremony and dreaming		1	2			1
Aboriginal resource and gathering	2	2	4			1
Axe grinding grooves	1	7	10		3	
Isolated artefact	12	66	100		17	1
Open camp site	1					
Open camp site with axe grinding grooves	1					
Open camp site with axe grinding grooves and isolated artefact			1			
Open camp site with axe grinding grooves and scarred tree		1				
Open camp site with scarred tree	1	2	3		1	
Scarred tree		3	1		1	
Shelter with art		1			1	1
Shelter with art and artefacts	1				1	
Shelter with art and axe grinding grooves			1		1	1
Shelter with art, artefacts and axe grinding grooves	1				1	1
Shelter with artefacts and axe grinding grooves			1			
Shelter with axe grinding grooves				1		
Shelter with deposit		1	2			3
Shelter with deposit and art			1		1	1
Shelter with deposit and artefacts		3	7	3	6	4
Shelter with deposit and axe grinding grooves			2	4	1	
Shelter with deposit and isolated artefact	1			1		
Shelter with deposit, art and artefacts	1	1	2	1	2	3
Shelter with deposit, art and isolated artefact					2	1
Shelter with deposit, art, artefacts and axe grinding grooves			4		1	3
Shelter with deposit, artefacts and axe grinding grooves		1	1		2	1
Shelter with deposit, artefacts, axe grinding grooves and tool marks					1	
Shelter with deposit, axe grinding grooves and isolated artefact					1	1
Shelter with isolated artefact	1					
Stone arrangement	1		1			
Water hole	1		1			
Water hole and Aboriginal ceremony and dreaming			1			
Total	**25**	**89**	**144**	**10**	**43**	**23**

Figure 18-10. Number of sites per slope gradient class



Key

- Flat or very gently inclined (gradients between 0° and 1°)
- Gently inclined (gradients between 1° and 6°)
- Moderately inclined (gradients between 6° and 18°)
- Steep (gradients between 18° and 30°)
- Very Steep (gradients between 30° and 45°)
- Precipitous (gradients between 45° and 72°)

18.6.4.2 Re-evaluation of the predictive model

A predictive model was presented in Section 18.5.1. Following the survey the predictive model was re-evaluated and the revised results are presented in Table 18-14. Extrapolating Aboriginal cultural heritage site data from surveyed soil landscape and slope information, is predicted that an estimated 1,122 Aboriginal cultural heritage sites fall within the study area (this includes new Aboriginal cultural heritage sites that have been identified during field surveys) and an estimated 174 sites falling within the PUIA.

A comparison of the original and revised predictive model is given in Table 18-15.

Table 18-14. Archaeological landscape predictive analysis

Soil landscape	Outside of Subject Area		Within Subject Area			
	EUIA[1]		PUIA		Above PUIA	
	Open sites	Rock shelters	Open sites	Rock shelters	Open sites	Rock shelters
Barralier	0	0	0	0	0	0
Cedar Valley	5	3	7	6	20	11
Coxs River	0	0	2	0	13	0
Emu Island	4	0	0	0	0	0
Faulconbridge	0	0	0	0	0	0
Gymea	0	0	0	0	0	0
Hassans Walls	34	3	41	5	89	8
Hawkesbury	0	0	0	3	0	1
Horse Flat	0	0	0	0	0	0
Jooriland Range	1	0	3	1	13	1
Kanangra Gorge	9	4	13	5	47	23
Kedumba	7	2	12	7	24	8
Martins Flat	7	1	14	3	28	5
Martins Flat variant a	7	1	13	2	25	2
Round Mount	6	3	8	8	20	9
Warragamba	0	4	0	4	0	9
Water	377	88	2[2]	7[2]	3	1
Wollondilly River	1	0	2	0	4	0
Subtotal[3]	**458**	**109**	**117**	**51**	**285[4]**	**80[4]**
Other known sites	11		6		5	
Total	**578**		**174**		**370**	

1. Includes the area below FSL hence large number of predicted sites.
2. Soil mapping for the PUIA has some areas mapped as 'Water'.
3. Includes known sites.
4. The predictive model generates results as decimal numbers and these (and the numbers above) have been rounded from the original results.

Table 18-15. Comparison and revisions to the archaeological model for the Project

Predictive statements	Survey results (this assessment)
Stone artefact scatters and isolated stone artefacts are the most common class of site type or feature within the Subject Area:	Open Camp Sites are the most prevalent site type with 207 discovered, accounting for most of sites surveyed. Artefact Scatters were present as a feature at 73.81% of sites.
The identification of this type of site depends on ground surface visibility, as site extent and artefact numbers are only visible on the surface. Due to the vegetation cover of the Subject Area type of site type may be difficult to relocate. Areas of open ground surface will be assessed for such site types.	During this survey many artefacts were in areas of disturbance. These areas include the eroded shore of the stored water, the dripline of shelters, and other types of disturbance such as wombat holes. These areas were assessed to gain an understanding of adjacent areas with vegetation cover which are on the same landform. This method of re-location was successful in obtaining indicative samples of the density of artefacts scatters, given the continual erosion and movement of surface deposits occurring across the flooding impact zone
Most of these types of site occur on level to gently inclined alluvial plains, floodplains, terraces, foot slopes, simple slopes, ridges, and crests..	These landform elements where the majority of sites are located were Moderate, followed by Gently Inclined slope classes. It was more likely that sites were to be found on Steep slope classes than Flat, and just as likely that sites were found on Very Steep terrain as Flat or Gently inclined slope classes. It was more likely that Open Camp Sites were located in more level sloping terrain. In the case of Rock Shelter sites, these were located in areas of steep sloping terrain at a greater frequency than predicted. It is also unlikely that surface scatters would remain on steeper landforms, and there were no artefact scatters found on this terrain type that were not also associated with Rock Shelters.
The majority of sites will occur within 200 m of temporary or permanent water sources.	The majority of sites located as part of this survey were located within the flooding impact area. All sites in this area are within 200 m of a temporary or permanent water source.
The majority of sites will occur on alluvial and transferral soil landscapes, which are present within the Study area.	While the Study area contains alluvial soil landscapes, these only accounted for 2.08% of sites found. Most sites were found in colluvial soil landscapes (41.96% of sites) with the second most frequent category being erosional soil landscapes (40.18% of sites). Four sites were located in transferral soil landscapes. There were a substantial percentage of sites (13.99% of sites) which were indicated as below the full supply level (soil landscape affected by water).
Scarred Trees is the second most likely represented class of site type in the Study area, accounting for 11% of registered sites:	The second most likely site type was Shelter Sites, not Scarred Trees. The ratio of scarred trees located was less than expected and only 1.79% of sites had this feature. Sites consisting of only Scarred Trees accounted for only 1.49% of sites.
Scarred trees are a site type that is formed from the removal of bark from a tree for use in the manufacture of canoes, shields, shelters and containers for sorting or carrying items.	The most common type of scarred trees had bark removed in a size which indicates use for coolamons (containers for sorting or carrying items) but were not large enough for the manufacture of canoes or shields.
The majority of the Subject Area has been protected from large scale timber felling operations due to its use as a water catchment area, significantly increasing the likelihood of survival of this site type.	Large scale timber operations were carried out as part of the building of the Warragamba Dam, and yet culturally modified trees were found in areas which were already cleared as part of the Dam's creation. It is unclear whether these were created during the logging process as markers by Aboriginal members of the logging crews, or if they were deliberately not logged when the valley was flooded due to their cultural significance.

Predictive statements	Survey results (this assessment)
	Scarred trees were found in areas not yet subject to large scale timber felling, however it is unclear if the restriction on logging in the post dam era has increased the survival of this site type to a significant degree. There are several other threats to scarred tree sites such as bushfires which are not reduced in severity by the restriction on logging.
Grinding groove sites are one of the most common site type within the area, making up approximately 5% of the AHIMS registered site numbers:	Sites containing only axe grinding grooves accounted for 2.38% of sites surveyed, however as a feature they were more frequent, with 12.50% of sites having related Axe Grinding Groove.
Axe grinding groove sites will most likely occur on sandstone outcrops associated with drainage lines, swamps, creek lines and river beds.	Axe grinding grooves were more commonly associated with shelter sites, with only eight sites out of 42 sites containing this feature not associated with a shelter. Some of the Axe Grinding Grooves were on detached sandstone boulders.
The bulk of grinding groove sites will contain fewer than 50 grinding grooves.	Most sites of this type did not contain above 50 grooves, with under 10 grooves per site the most common distribution.
Grooves will generally be between 25 cm and 50 cm in length, 5 cm to 8 cm in width and between 2 cm and 5 cm in depth and represent the sharpening or preparing of ground edge hatchets or fire hardened points.	Most grooves found fit the predicted dimensions, however many grooves were shallower than expected, and were often found weathered by inundation by the stored water at full supply level, or by water wash from runoff. Most grooves were associated with ground edge hatchets in the accompanying artefacts scatter, as only eight sites which contained grooves did not also have artefacts as well.
Although not previously recorded in high numbers, sandstone shelters or rock overhangs with archaeological deposits, art, midden and/or artefacts will be one of the most common sites identified within the Study area. The geological characteristics of the Study area are consistent with those required for sandstone shelters.	There were many Shelter sites, with 83 located, accounting for 25% of sites surveyed. These types of sites were more commonly associated with steeper slopes and ridgelines, in contrast to other site types such as Open Camp Sites.
There is a potential for water holes to be present within the study area. this site type was not only a critical resource within the environment but played a significant role in ceremonies and as a place for the community to meet and pass down stories from one generation to another.	There were only three water hole sites located in the survey area, accounting for only 0.89% of sites. The location of many of these sites is difficult to establish since the flooding of the Warragamba valley during the building of the dam. This is primarily due to the fact that these sites would have been associated with river systems which have since been inundated by the stored water. The low frequency of these sites, therefore, is not indicative of their significance, and their impact on and use in cultural practises is difficult to re-assess.
Rock engravings may be present within the Subject Area due to the sandstone present within close proximity to water. Rock engravings consisting of carefully drawn images of people, animals, or symbols, in the sandstone.	There were no sites containing rock engravings found in the Subject Area. There was one AHIMS site which recorded an engraving as present, however this could not be re-located during this survey. This was predominately because the location was not recorded on this site card with accuracy, and the probable location was found to be inundated at the time of the building of Warragamba Dam.
Burials, an uncommon site type, are present within soft alluvial sediments, caves or hollow trees. Such sites are more commonly located within the sand dunes of the coastal region. It is highly unlikely that this site type will occur within the Subject Area.	There were no human burials identified within the Subject Area. There was some evidence of animal remains in the soft mud which exists at the edge of the stored water, but this was not indicative of any human activity.

Predictive statements	Survey results (this assessment)
Stone arrangements are rare in the local area. This type of site can include mounds of rocks for burial, or markers, mythological sites or areas of spiritual connection. There are no stone arrangements previously identified within the Subject Area.	While there was some indication of stone arrangements, with evidence for two sites found, this remains a rare site type, making up only 0.60% of site types found.
Ceremonial grounds, these are sites where initiation ceremonies, marriage alliance ceremonies, tribal meetings, and other important social functions were held. They are places of great significance to Aboriginal people. There are no Ceremonial grounds previously identified in AHIMS within the Subject Area.	There was one site identified as being associated with Aboriginal ceremony and dreaming in the study area, however this is still only 0.30% of all sites surveyed during this survey.
Aboriginal places are places of cultural significance to Aboriginal people. No Aboriginal places have been declared within the study area (February 2018) or listed on AHIMS.	While no Aboriginal places have been declared in the study area, there is a current nomination for creation of an Aboriginal Place for the entirety of the Burragorang Valley.

18.7 Cultural values assessment

A separate CVAR has been prepared to inform the Aboriginal cultural heritage assessment and a summary of the report is provided in Appendix K[1]. The CVAR addresses the potential impact of the Project on intangible Aboriginal cultural heritage values within the PUIA.

Six strands of distinct but interrelated cultural values were identified within the study area:

- **Gurrangatch-Mirrigan Dreaming Track**: nineteen (19) distinct locations are indicatively mapped. Their locations map the journey of the Ancestral Beings which created this Country, illuminating the Aboriginal cultural perspective that the landforms and waterways themselves embody culture and hold cultural value
- **Buru (Kangaroo) Dreaming Story Places**: Two (2) distinct locations are indicatively mapped. Their cultural values highlight the significance of the cultural association of the Project area with the Buru (Kangaroo)
- **Living Places (history of occupation and use):** Ten (10) distinct locations are mapped. They illustrate the range of locations that carry cultural values related to the history of occupation of the Project area by Aboriginal people traditionally and historically.
- **Cultural Places (ritual life):** fourteen (14) distinct locations are mapped. They hold cultural value for their representation of aspects of the social, religious, and ritual life of Aboriginal people in the Project area
- **Archaeological Sites**: tangible record of traditional occupation and use.
- **Waterways**: the Wollondilly, Nattai, Warragamba, and Coxs Rivers and their tributaries.

These six elements highlight different aspects of the cultural values of the study area and illustrate the understanding in all Aboriginal societies, traditional and contemporary, that landscape or Country is inherently cultural, having been formed and animated by the actions of mythological beings and maintained by the ongoing actions and interactions of Aboriginal people over many generations. A summary of cultural values is provided in Table 18-16.

Table 18-16. Summary of cultural values

Item	Description	Cultural Significance
Gurrangatch - Mirrigan Dreaming Track	A Dreaming Track following the movements of Gurrangatch and Mirrigan; the associated Story tells of the creation of the Wollondilly and Coxs River valleys.	The Gurrangatch-Mirrigan Dreaming Track as a whole is considered to be of Very High Significance.
Buru (Kangaroo) Dreaming Story Places	Buru (Kangaroo) Dreaming Story Places and associated resource sites for their maintenance as an important traditional resource.	The Buru (Kangaroo) Dreaming Story Places and the associated resource sites are considered to be of High Significance.
Living Places	A range of places which hold cultural value, including locations linked to Dreaming Stories, art and ceremonial sites, and burials.	The Cultural Places reflect the complex social and religious life of the Aboriginal people of the region and are considered to be of High Significance.
Archaeological Sites	The material evidence of Aboriginal occupation and use of the area, including art sites, grinding grooves, scarred trees, open campsites, and artefacts.	The Archaeological Sites that reflect the traditional occupation and use of the area by Aboriginal people are as a whole considered to be of High Significance.

[1] The Cultural Values Assessment Report is not provided in the public version of Appendix K due to cultural sensitivities.

18.8 Scientific values and significance assessment

18.8.1 Assessment process

18.8.1.1 Assessment framework

The Burra Charter (Australia ICOMOS 2013) defines the basic principles and procedures to be observed in the conservation of important heritage places. It provides a primary and 'best-practice' framework within which decisions about the management of heritage sites in Australia should be made. The Burra Charter and the OEH policy Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011) define cultural significance as being derived from the four values, which are presented in Table 18-17.

Table 18-17. Definition of heritage values of the Burra Charter (Australia ICOMOS 2013)

Value	Description
Aesthetic	This value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.
Historic	This value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.
Scientific	The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information.
Social	This value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

18.8.1.2 Grading values and significance

Where a site or zone satisfies at least one criterion, grades have been applied to provide a measure of the values/significance for Aboriginal objects identified within the PUIA, and to provide an overall assessment of the significance of each of the zones used that define the PUIA. Grades of values and significance are given in Table 18-18.

Table 18-18. Grades of values and significance

Grade of value	Description of grade
Low	The site or object contains only a single or limited number of features, and has no potential to meaningfully inform our understanding of the past beyond what it contributes through its current recording (that is, no or low research potential). The site or object is a representative but unexceptional example of the most common class of sites or objects in the region. Many more similar examples can be confidently predicted to occur within the study area, and in the region.
Moderate	The site or object derives value because it contains features, both archaeological and contextual, which through further investigation may contribute to our understanding of the local past. These features include, but are not limited to: the relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a relatively large assemblage of stone artefacts. The presence of a diverse artefact and feature assemblage, and connectedness with landscape features and other notable sites provide relatively higher representative and rarity values than sites of low significance.
High	The site or object has value because it contains archaeological and/or contextual features which through further investigation may significantly contribute to our understanding of the past, both locally and on a regional scale. These features include, but are not limited to: Aboriginal ancestral remains; the site's relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a very large assemblage of stone artefacts associated with other features such as oven remains or shell midden. Such sites will be relatively rare, and will be representative of a limited number of similar sites that make up this class; hence they derive high representative and rarity values.

18.8.1.3 Scientific (archaeological) significance assessment of Aboriginal heritage sites

The categorisation into aesthetic, historic, scientific and social values is one approach to understanding the concept of cultural significance. However, more precise categories may be developed following a better understanding of a specific place. The Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011) outlines two main themes in the overall Aboriginal cultural heritage significance assessment process, namely, the identification of the cultural/social significance of Aboriginal objects and/or places to Aboriginal people and the identification of the scientific (archaeological) significance to the scientific/research community. These themes encapsulate those aspects of the Burra Charter that are of relevance to Aboriginal objects and places.

The Guidelines specify that information about scientific values will be gathered through archaeological investigation carried out according to the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010b). The Code of Practice itself does not specify criteria for assessment of Aboriginal objects, but rather suggests to "identify the archaeological values and assess their significance." The assessment must be supportable, and the assessment criteria must reflect best practice assessment processes as set out in the Burra Charter.

The scientific values described in the Burra Charter (Section 18.8.1) were considered further by the then NSW National Parks and Wildlife Service in their Aboriginal Cultural Heritage Standards and Guidelines Kit (DEC 1997), which is summarised in Table 18-19.

Table 18-19. Criteria for assessing scientific significance

Scientific value	Description
Research potential	It is the potential to elucidate past behaviour which gives significance under this criterion rather than the potential to yield collections of artefacts. Matters considered under this criterion include the intactness of a site, the potential for the site to build a chronology and the connectedness of the site to other sites in the archaeological landscape.
Representativeness	As a criterion, representativeness is only meaningful in relation to a conservation objective. Presumably all sites are representative of those in their class or they would not be in that class. What is at issue is the extent to which a class of sites is conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole. The conservation objective which underwrites the 'representativeness' criteria is that such a sample should be conserved.
Rarity	This criterion cannot easily be separated from that of representativeness. If a site is 'distinctive' then by definition, it will be part of the variability which a representative sample would represent. The criteria might best be approached as one which exists within the criteria of representativeness, giving a particular weighting to certain classes of site. The main requirement for being able to assess rarity is to determine what is common and what is unusual in the archaeological record, but also the way that archaeology confers prestige on certain sites because of their ability to provide certain information. The criterion of rarity may be assessed at a range of levels including local, regional, state, national, and global.
Educational potential	This criterion relates to the ability of the cultural heritage item or place to inform and/or educate people about one or other aspects of the past. It incorporates notions of intactness, relevance, interpretative value and accessibility. Where archaeologists or others carrying out cultural heritage assessments are promoting/advocating the educational value of a cultural heritage item or place it is imperative that public input and support for this value is achieved and sought. Without public input and support the educative value of the items/places is likely to not ever be fully realised.
Aesthetics	In relation to heritage places, aesthetic significance is generally taken to mean the visual beauty of the place. Aesthetic value is not inherent in a place but arises in the sensory response people have to it. The guidelines provide no expectation for archaeologists to consider aesthetic values, it is often the case that the aesthetics including the physical setting of an archaeological site or a landscape contributes to its cultural heritage significance. Examples of archaeological sites that may have high aesthetic values include rock art sites or sites located in environments that evoke strong sensory responses.

Scientific significance also considered:

- the number of objects/and or art motif type and number and diversity of motifs. This is further outlined in Appendix K (ACHA, Appendix 1)

- the research potential of each Aboriginal cultural heritage site, and what the artefacts, or Potential Archaeological Deposit (PAD), art assemblage or other archaeological features could potentially indicate to future researchers regarding how Aboriginal people lived within the landscape of Lake Burragorang
- isolated Artefacts, individual or low numbers of axe grinding grooves and instances where art was charcoal indeterminate and where the artefacts, features or art had no distinctiveness or uniqueness. These were given a low scientific (archaeological) significance rating due to the limitation of further scientific information being gleaned from these sites.
- Aboriginal cultural heritage sites comprising of high numbers of axe grinding grooves, artefacts in high numbers and densities and assemblages of art with high numbers of well-preserved motifs and/or a diversity of motifs, media and application techniques. These were given a moderate to high scientific (archaeological) significance rating due to the ability of future research to be carried out regarding artefact development and site use over time. Likewise, sites that comprised of multiple site features (a shelter with art, deposit and grinding grooves, for example) and characteristics such as shelters with undisturbed deposit, high density artefact scatters, axe grinding grooves and art that has been layered indicating extended use of the site over a longer period of time, that has also been well preserved through environmental processes were also given a high (archaeological) significance assessment due to the further understanding they would provide to future researchers. It should be noted that in some cases, such as a hatchet with hafting resin still present, or an artefact with distinctive use-wear, or a particularly unique art motif individual or isolated features can be of high or moderate scientific significance.

There were no observations or finds made at any previously recorded sites that would alter their previously determined significance.

Educational potential and aesthetic values are not considered to be criteria against which scientific values and significance can be assessed. Aesthetic values should be considered as a distinct category (rather than a criterion that contributes to scientific value) in accordance with the Burra Charter and the Guide to investigating, assessing, and reporting on Aboriginal cultural heritage in NSW (OEH 2011). Educational potential is a criterion that contributes to social value, rather than scientific value, and hence this is considered in the overall cultural significance assessment and CVAR (Appendix K - ACHA, Appendix 2).

18.8.2 Statement of significance

A Statement of Significance has been prepared which incorporates comments received from the RAPs during the consultation process, including those comments relating to the cultural significance of all sites and the interrelationships between the cultural and spiritual values with the natural landscape. A full Statement of Significance is provided in Appendix K (ACHA, Appendix 1) and summarised below.

Social significance

The study area is of social significance to the Aboriginal community because it contains landscapes, sites and resources that contribute to the identity of the community. The social significance is derived from the spiritual connection and associations of the physical places – story and dreaming places, places with cultural resources and archaeological and historical sites. The study area forms part of the Gundungurra Creation story and therefore contains high social values associated with the remembering, maintenance, knowledge, and enhancement of the story through the continuance of traditional access by the Gundungurra to the study area. The study area, and Warragamba in general are powerful symbols of dispossession for the Gundungurra. Many families have experience and maintain knowledge and history of dam building and dispossession in the twentieth century in the study area and surrounds, contributing social value via direct personal and historical association.

Aesthetic significance

The aesthetic values of the study area and its surrounds are demonstrated by the area's environmental intactness. This intactness can be attributed to the area forming part of the Greater Sydney drinking water catchment where public access and activities are restricted to protect water quality in these areas. The striking setting of the Aboriginal sites and objects located within this landscape further adds to the strong sense of beauty, place, and Aboriginal connectivity to this landscape.

Historic significance

The Aboriginal community has a strong connection to the historic values of the area via strong associations to the shared-history of the pastoral period, and subsequent agricultural intensification period. Many Aboriginal community

members either lived or have family members that lived within the Burragorang Valley prior to it being flooded, and families relocated.

The landscape surrounding Warragamba Dam holds deep cultural historical values for the Aboriginal people in the area. These values derive from both traditional knowledge and from social and historic associations with places, stories and cultural resources such as plants, animals and water. The most significant Aboriginal places were those associated with Aboriginal spiritual resources such as mythology, art, and ceremony — information about these is contained in the stories told by the Gundungurra people set in the dreaming (gunyunggalung) (Smith 2016). Despite suppression and dispossession, the community have maintained and nurtured a strong connection to landscape and place.

Scientific (archaeological) significance

A list of Aboriginal sites in the survey area and PUIA, their scientific significance rating and a statement of significance is presented in Appendix K, Appendix 1 and provided in Table 18-20.

The Scientific (Archaeological) value of the region and the Aboriginal objects contained within it is demonstrated by the 334 identified Aboriginal archaeological and cultural heritage sites, including: Aboriginal Resource and Gathering, Axe Grinding Grooves, Isolated Finds, Open Camp Sites, Scarred Trees, Stone Arrangements and Water Hole sites are predominately of low scientific (archaeological) value (approximately 82 percent of known, and relocated sites), with 20 sites of moderate (archaeological) value (approximately seven percent of known sites). There are a further 38 sites of high (archaeological) values (approximately 11 percent of known sites).

The sites within the PUIA are also predominately of low scientific (archaeological) significance 35 (81 percent), with three of moderate (archaeological) significance (six percent) and 5 of high (archaeological) significance (12 percent).

The PUIA has the potential to yield information that would contribute to a further understanding of the cultural history of the local area and region. In particular, the nature of past Aboriginal land-use of the Lake Burragorang valleys, and the relationship between past Aboriginal land use and the available resources including the Lake Burragorang valleys and the surrounding rivers, creeks and tributaries prior to the development of the dam as expressed through archaeological sites and their context.

Table 18-20. Scientific significance ratings for Aboriginal sites within the survey area and PUIA

Scientific significance rating	Survey area		PUIA		Sites within the PUIA
	Number	%	Number	% of sites	
Low significance	272	82	35	81	Warragamba-00 (AHIMS ID pending), Warragamba-32 (AHIMS ID pending), Warragamba-52 (AHIMS ID pending), Warragamba-54 (AHIMS ID pending), Warragamba-72 (AHIMS ID pending), Warragamba-80 (AHIMS ID pending), Warragamba-83 (AHIMS ID pending), Warragamba-93 (AHIMS ID pending), Warragamba-98 (AHIMS ID pending), Warragamba-100 (AHIMS ID pending), Warragamba-102 (AHIMS ID pending), Warragamba-103 (AHIMS ID pending), Warragamba-104 (AHIMS ID pending), Warragamba-108 (AHIMS ID pending), Warragamba-113 (AHIMS ID pending), Warragamba-132 (AHIMS ID pending), Warragamba-139 (AHIMS ID pending), Warragamba-148 (AHIMS ID pending), Warragamba-149 (AHIMS ID pending), Warragamba-150 (AHIMS ID pending), Warragamba-154 (AHIMS ID pending), Warragamba-158 AHIMS ID pending), Warragamba-159 (AHIMS ID pending), Warragamba-161 (AHIMS ID pending), Warragamba-163 (AHIMSID# pending), Warragamba-187 (AHIMS ID pending),

Scientific significance rating	Survey area		PUIA		Sites within the PUIA
	Number	%	Number	% of sites	
					Warragamba-197 (AHIMS ID pending), Warragamba-228 (AHIMS ID pending), Warragamba-229 (AHIMS ID pending), Warragamba-233 (AHIMS ID pending), Warragamba-271 (AHIMS ID pending), Warragamba-298 (AHIMS ID pending), Warragamba-300 (AHIMS ID pending),
Moderate significance	22	7	3	7	Warragamba-88 (AHIMS ID pending), Warragamba-111 (AHIMS ID pending), Warragamba-114 (AHIMS ID pending),
High significance	40	11	5	12	Policeman's Point (AHIMS ID#45-4-0186), RC 1 (AHIMS ID#45-4-0967), Joorilands Creek, Upper Burragorang (AHIMS ID#52-1-0045), Green Wattle Point OS-1 (AHIMS ID#52-1-0345), Warragamba-110 (AHIMS ID pending),
Total	**334**		**43**		

18.9 Impact assessment

18.9.1 Introduction

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011a) requires that both direct and indirect harm to Aboriginal objects and Aboriginal places be considered.

- **Direct harm** refers to occasions where an activity physically impacts a site or objects and therefore affects the heritage values possessed by the site or objects.
- **Indirect harm** refers to harm stemming from secondary consequences of the activity, and may affect sites or objects as an indirect consequence of the activity. Examples of such indirect harm are increased visitors to a site, or increased erosion in an area because of an activity.

The Project has the potential to harm Aboriginal objects and Aboriginal cultural values during the operational phase due to varied levels of water submersion between hours up to two weeks.

As required by the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), the likely impacts (and partial loss of value) to Aboriginal heritage sites because of the Project is presented in Appendix K (ACHA, Appendix 1).

18.9.2 Construction impacts

The construction site covers an area of about 105 hectares, of which about 33 hectares would be directly disturbed. Potential harm associated with surface disturbance activities could cause either a total or partial loss of heritage value, and a potential cumulative or landscape loss of values for the broader area. Activities that may potentially cause harm to Aboriginal objects or areas of cultural value may include:

- vegetation clearance and topsoil stripping
- disturbance of soil units or the ground surface with Aboriginal objects on the surface or within the soil profile
- changes to the context of a site or place that has indirect impacts to the site or place, resulting in the loss of cultural values
- excavation works and the removal and redistribution of rock and soil by heavy machinery during site regrading or development of suitable surface conditions for various construction activities.

There are no known Aboriginal cultural heritage sites or natural landscape features within the footprint of the proposed surface infrastructure and most of the construction site has been extensively disturbed due to past activities associated with the construction and operation of the existing Warragamba dam. Proposed surface infrastructure avoids all rock shelters, grinding grooves and natural landscape features, and therefore there would be no potential surface disturbance impacts to any of these site types or any sites with moderate or high scientific significance.

18.9.3 Operation impacts – Archaeological, cultural and heritage assessment report (ACHA)

18.9.3.1 Impacted sites

Flooding characteristics

Upstream operational impacts of the Project would occur in the Lake Burragorang catchment and tributaries that flow into Lake Burragorang. This includes areas of National Park, State Conservation Areas and the Greater Blue Mountains World Heritage Area.

Flooding upstream of Lake Burragorang can result from inundation as the lake level rises due to flood inflows, from local catchment runoff, or a combination of the two. Flooding due to inundation is generally restricted to the area around the lake perimeter with flooding due to local catchment runoff dominating moving further up the catchment. Flooding beyond the Project study area is due to local catchment runoff. The extent of the upstream inundation is controlled by the peak flood level at the dam wall and the upstream catchment topography. Where the Wollondilly River and Coxs River enter Lake Burragorang the terrain is relatively flat, and the inundated area and the rate of inundation are both greater than they are in the steeper terrain further upstream. Modelling undertaken for the Project looked at changes in the likely duration of inundation. Changes would be highest at the dam wall but would reduce considerably away from the dam wall and along tributaries.

The Project would result in some upstream areas experiencing a greater extent and duration of temporary water inundation when the FMZ is operational compared to the existing dam. These additional periods of inundation are predicted to last between hours and about 10 days, depending on the site location, intensity and amount of rain and corresponding size of flood mitigation that is required.

Assessment area

Project impact assessment has focused on the following areas (see Section 18.1.2):

- the PUIA covers 1,401 hectares between 119.5 mAHD and RL 126.97 mAHD. Based on historical flood records and detailed flood modelling, this is the area most likely to be impacted by the Project. It is noted that the largest flood on record was the November 1961, which was about a 1 in 50 chance in a year event and reached a height of 119.35 mAHD, nearly three metres above FSL. There is a lower likelihood that larger and infrequent flood events would impact on areas above the PUIA.
- the EUIA comprises the area below RL 119.5 mAHD, including below FSL (with all sites below FSL already impacted by the existing dam). Above the FSL (116.7 mAHD) there is potential for the Project to increase duration and depth of flooding within the EUIA.

The potential physical impacts on Aboriginal heritage sites can be divided into the following three categories:

1. Sites that are within the existing dam footprint (EUIA) –this area contains sites below the FSL (the maximum water level of Lake Burragorang which will not change with the Project) and sites between the FSL and the PUIA. Sites below the FSL experience regular and prolonged inundation as they are below the permanent maximum water level of the existing dam. Sites above the FSL experience inundation less regularly than those below FSL but more frequently than sites in the PUIA or at higher elevations. Sites in the EUIA have been given a partial degree of harm from the Project as the connection of these sites to the cultural landscape would be further impacted.
2. Sites within the PUIA – these sites have a lesser risk of being impacted by existing flooding compared to sites in the EUIA. This risk would increase with the Project and, for the purpose of the assessment, a precautionary approach has been adopted and it has been assumed there would be a total degree of harm for sites in this area.
3. Above the PUIA – these sites have a low risk of being impacted by flooding. There are also two sites outside of the construction impact zone.

Assessment

To assess the risk of inundation to identified sites, the height of each site was cross-referenced to flooding scenarios. Of note is that some large sites extend above and below the EUIA, over several hundred square meters. The number of sites in each of these categories is summarised in Table 18-21. Of the 334 identified sites, 43 sites are located within the PUIA, 184 sites within the EUIA (of which 118 sites are above the FSL and 66 sites below the FSL) and 107 sites outside of these areas.

Table 18-21. Aboriginal site types and location

Site features	Survey area			
	EUIA	PUIA	Other	Total
Aboriginal ceremony and dreaming	1			1
Aboriginal resource and gathering	2	1	1	4
Axe grinding grooves	3	4	2	9
Isolated artefact	10	5	6	21
Open camp site	133	23	40	196
Open camp site with axe grinding grooves	1			1
Open camp site with axe grinding grooves and isolated artefact	1			1
Open camp site with axe grinding grooves and scarred tree			1	1
Open camp site with scarred tree	5		2	7
Scarred tree	1		4	5
Shelter with art	1		2	3
Shelter with art and artefacts	2			2
Shelter with art and axe grinding grooves	1		3	4
Shelter with art, artefacts and axe grinding grooves		1	1	2
Shelter with artefacts and axe grinding grooves	1			1
Shelter with axe grinding grooves			1	1
Shelter with deposit	1	1	4	6
Shelter with deposit and art	1		2	3
Shelter with deposit and artefacts	8	4	11	23
Shelter with deposit and axe grinding grooves	1		6	7
Shelter with deposit and isolated artefact	2			2
Shelter with deposit, art and artefacts	3		7	10
Shelter with deposit, art and isolated artefact			3	3
Shelter with deposit, art, artefacts and axe grinding grooves		1	7	8
Shelter with deposit, artefacts and axe grinding grooves	1	1	2	4
Shelter with deposit, artefacts, axe grinding grooves and tool marks	1			1
Shelter with deposit, axe grinding grooves and isolated artefact	1	1		2
Shelter with isolated artefact	1			1
Stone arrangement		1	1	2
Water hole	1		1	2
Water hole and Aboriginal ceremony and dreaming	1			1
Total	184	43	107	334

18.9.3.2 Assessment of potential impacts

The Geomorphology assessment (Appendix N2 - Geomorphology assessment report) identified several potential risks that could impact on Aboriginal cultural heritage sites within the EUIA and PUIA. These include out of bank and shoreline

erosion, translocation of sediment features, elevated erosion of shoreline banks and cumulative bank erosion. These impacts could potentially affect Aboriginal cultural heritage sites that occur across multiple slope classes, in particular gentle slopes, moderate to steep slopes and very steep to precipitous slopes. These risks are discussed below.

- The translocation of sediment features, for example in the Coxs and Wollondilly Rivers, may result in the deposition of sediments on Aboriginal cultural heritage sites during temporary inundation events. This would affect some sites located on gently inclined slopes that are situated within the flooding impact zone. However, a proportionate amount of the sedimentation load transported during inundation events would subsequently be washed back into the main body of the lake as floodwaters recede. This would decrease the impact on Aboriginal cultural heritage sites located on gently inclined slopes. The sediment transported would consist of silts, clays, and organic matter. Dense particles such as sand and gravel are unlikely to be present as they would be deposited instead in the mouths of the inlet rivers. The main area of sediment deposition is likely to be on the existing foreshore up to the FSL, which is already denuded and contains little vegetation. Consequently, inundation events are unlikely to cause denudation across the PUIA, which decreases the risk of extensive damage to Aboriginal cultural heritage sites.
- Cumulative bank erosion due to temporary inundation events may impact on Aboriginal cultural heritage sites located on moderate to steeper slopes. Temporary inundation increases waterflow, which in turn would temporarily increase stream power resulting in attritional bank scour. This direct removal of bank materials by the physical action of flowing water and the sediment that it carries would increase the rate of erosion of banks and shorelines. The resulting bank instability could potentially affect moderate to steeper slopes where Aboriginal cultural heritage sites are located, as the prolonged wave undercutting could lead to erosion and exposure of sheer cliff faces and unstable soil. For instance, Lake Burragorang is identified as having elevated banks and terraces that have been subject to infrequent wave actions, causing bank erosion.
- Elevated erosion of shoreline banks may impact on Aboriginal cultural heritage sites located on very steep to precipitous slopes. Exposure of sheer cliff faces can result in landslides or rockfall, which could potentially affect Aboriginal cultural heritage sites located within close proximity. For instance, it is noted that along the immediate foreshores and adjacent slopes of Lake Burragorang, known landslides have occurred due to the exposure and weathering of cliff faces. However, these landslides have been directly linked to the Permian strata, which is susceptible to weathering. Therefore, the erosion of cliff faces comprised of the Permian strata are expected to continue. Areas that are comprised of steep sandstone cliffs with good riparian vegetation are less likely to be adversely affected by erosion caused by temporary inundation. This decreases the risk to Aboriginal cultural heritage sites located on very steep to precipitous slopes.

Potential Project impacts and potential harm on Aboriginal cultural heritage sites are presented in Appendix K (ACHA, Appendix 1). Impacts on Aboriginal cultural heritage sites within the PUIA (between 2.8 m above FSL and 10.3 m above FSL) relates to temporary inundation for up to 10 days. As a result of this submersion the site area may suffer varying impacts depending on site type, for example:

- stone artefact sites may be subject to changed ground conditions such as waterlogging, movement of objects or erosion
- sandstone shelter sites may be subject to altered conditions that may detrimentally effect deposits and rock art
- scarred trees may be subject to more frequent flooding
- axe grinding grooves and engravings may be more frequently submerged, altering natural conditions and possibly their preservation
- Aboriginal ceremony and dreaming sites and Aboriginal resource and gathering sites may have their accessibility altered, and physical aspects of the sites may also change.

Potential impacts for each of the surveyed sites was determined by assessing a site's location, scientific significance, cultural significance, indirect or direct harm, degree of harm (none, partial or total) and consequences of harm (none, partial or total loss of value). The RAPs have advised through the submission process that all sites have high cultural significance.

Consequences of harm definitions are:

- **total loss of value**: no heritage values will remain after the harm
- **partial loss of value**: some heritage values will remain after the harm
- **no loss of value**: there will be no harm, and no loss of value.

A full listing of surveyed sites and impact assessment is provided in Appendix K (ACHA, Appendix 1). A summary of sites located in the PUIA and EUIA is provided in Table 18-22 and Table 18-23 respectively. The Project may result in the following potential impacts:

- 120 sites in the PUIA, comprising 43 known sites and an estimated 77 sites, may experience a total loss of value
- 118 known sites in the EUIA (excluding 66 sites identified below FSL) may experience partial harm.

It should be noted that sites in the EUIA above FSL have already been affected by temporary inundation associated with past flood events where the water level in Lake Burragorang rose above FSL, and which could have resulted in a diminishment of value for sites. Further, sites in the EUIA below FSL have experienced more frequent inundation associated with operation of Warragamba dam for water supply and where fluctuations in the level of Lake Burragorang are a normal part of operation. This would likely have also resulted in a diminishment of value for these sites.

Noting the previous comments regarding how different sites types may be affected by temporary inundation associated with the Project, the assumption of a total loss of value is a precautionary position adopted for the Project.

Table 18-22. Summary of potential impacts of the Project on Aboriginal heritage sites in the PUIA

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
45-4-0186	Policeman's Point	Shelter with Deposit, Artefacts and Axe Grinding Grooves	Total	Total Loss of Value
45-4-0967	RC1	Open Camp Site	Total	Total Loss of Value
52-1-0045	Jooriland Creek, Upper Burragorang	Axe Grinding Grooves	Total	Total Loss of Value
52-1-0128	Little River 3	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-00	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-32	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-52	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-54	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-64	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-65	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-72	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-78	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-80	Stone Arrangement	Total	Total Loss of Value
Pending	Warragamba-83	Axe Grinding Grooves	Total	Total Loss of Value
Pending	Warragamba-88	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-93	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-98	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-101	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-102	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-104	Shelter with Deposit and Artefacts	Total	Total Loss of Value
Pending	Warragamba-108	Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-110	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-114	Axe Grinding Grooves	Total	Total Loss of Value
Pending	Warragamba-132	Shelter with Deposit and Artefacts	Total	Total loss of Value
Pending	Warragamba-138	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-139	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-148	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-149	Shelter with Deposit and Artefacts	Total	Total Loss of Value
Pending	Warragamba-150	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-154	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-158	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-159	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-161	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-163	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-187	Shelter with Deposit	Total	Total Loss of Value
Pending	Warragamba-193	Shelter with Art	Total	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-197	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-228	Axe Grinding Grooves	Total	Total Loss of Value
Pending	Warragamba-229	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-233	Aboriginal Resource and Gathering	Total	Total Loss of Value
Pending	Warragamba-271	Open Camp Site	Total	Total Loss of Value
Pending	Warragamba-298	Shelter with Deposit, Axe Grinding Grooves, and Isolated Artefact	Total	Total Loss of Value
Pending	Warragamba-299	Shelter with Deposit and Artefacts	Total	Total Loss of Value

Table 18-23. Summary of potential impacts of the Project on Aboriginal heritage sites in the EUIA

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
45-4-0191	Grahams Landing	Open Camp Site	Partial	Total Loss of Value
45-4-0930	CA 1; Warragamba Dam Special Area	Open Camp Site	Partial	Total Loss of Value
45-4-0931	EH 1; Warragamba Special Area	Open Camp Site	Partial	Total Loss of Value
45-4-0946	TR 1	Open Camp Site	Partial	Total Loss of Value
45-4-0997	Bimlow PAD	Shelter with Art, Artefacts and Axe Grinding Grooves	Partial	Total Loss of Value
52-1-0130	Tonalli Cove 1	Open Camp Site	Partial	Total Loss of Value
52-1-0136	Green Wattle Point	Open Camp Site	Partial	Total Loss of Value
52-1-0186	W223, Byrnes Creek	Open Camp Site	Partial	Total Loss of Value
52-1-0236	Burra Lake Flake 1	Open Camp Site	Partial	Total Loss of Value
52-1-0332	Byrnes Bay OS-1	Open Camp Site	Partial	Total Loss of Value
52-1-0345	Green Wattle Point OS-1	Open Camp Site	Total	Total Loss of Value
52-1-0352	Tonalli OS-1	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-05	Aboriginal Resource and Gathering	Partial	Total Loss of Value
Pending	Warragamba-15	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-16	Shelter with Art and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-17	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-18	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-19	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-20	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-21	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-22	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-23	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-24	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-25	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-26	Open Camp Site	Partial	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-27	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-28	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-29	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-30	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-33	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-34	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-35	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-36	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-37	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-38	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-39	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-40	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-41	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-42	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-43	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-44	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-45	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-47	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-48	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-49	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-50	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-51	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-55	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-63	Water Hole	Partial	Total Loss of Value
Pending	Warragamba-74	Water hole and Aboriginal Ceremony and Dreaming	Partial	Total Loss of Value
Pending	Warragamba-77	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-81	Open Camp Site	None	No Loss of Value
Pending	Warragamba-82	Open Camp Site	None	No Loss of Value
Pending	Warragamba-84	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-85	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-86	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-94	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-95	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-96	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-99	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-105	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-106	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-107	Open Camp Site	Partial	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-109	Open Camp Site	Partial	Total loss of Value
Pending	Warragamba-111	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-117	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-118	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-119	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-121	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-122	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-123	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-124	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-125	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-126	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-127	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-128	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-129	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-130	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-140	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-141	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-142	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-143	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-145	Shelter with Deposit, Art, and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-146	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-147	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-151	Open Camp Site with Scarred Tree	Partial	Total Loss of Value
Pending	Warragamba-152	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-155	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-156	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-157	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-160	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-164	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-167	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-168	Open Camp Site with Scarred Tree	Partial	Total Loss of Value
Pending	Warragamba-169	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-170	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-171	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-173	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-174	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-175	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-176	Open Camp Site	Partial	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-177	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-178	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-179	Aboriginal Resource and Gathering	Partial	Total Loss of Value
Pending	Warragamba-180	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-182	Shelter with Deposit, Art, and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-183	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-184	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-185	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-186	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-188	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-189	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-191	Open Camp Site with Axe Grinding Grooves and Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-192	Shelter with Deposit	Partial	Total Loss of Value
Pending	Warragamba-194	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-195	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-196	Open Camp Site with Scarred Tree	Partial	Total Loss of Value
Pending	Warragamba-198	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-199	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-200	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-201	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-202	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-203	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-204	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-205	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-206	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-207	Shelter with Deposit and Axe Grinding Grooves	Partial	Total Loss of Value
Pending	Warragamba-208	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-210	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-211	Shelter with Deposit, Art, and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-212	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-213	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-214	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-215	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-216	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-217	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-218	Open Camp Site with Scarred Tree	Partial	Total Loss of Value
Pending	Warragamba-219	Shelter with Deposit, Axe Grinding Grooves, and Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-220	Open Camp Site with Scarred Tree	Partial	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-221	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-222	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-223	Shelter with Art and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-225	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-226	Aboriginal Ceremony and Dreaming	Partial	Total Loss of Value
Pending	Warragamba-227	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-230	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-231	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-232	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-235	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-237	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-239	Shelter with Deposit and Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-241	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-242	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-244	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-245	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-246	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-247	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-248	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-249	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-250	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-251	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-252	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-253	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-256	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-258	Shelter with Artefacts and Axe Grinding Grooves	Partial	Total Loss of Value
Pending	Warragamba-259	Shelter with Deposit, Artefacts, Axe Grinding Grooves, and Tool Marks	Partial	Total Loss of Value
Pending	Warragamba-260	Shelter with Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-262	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-263	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-264	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-265	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-266	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-267	Open Camp Site with Axe Grinding Grooves	Partial	Total Loss of Value
Pending	Warragamba-268	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-269	Isolated Artefact	Partial	Total Loss of Value
Pending	Warragamba-282	Axe Grinding Grooves	Partial	Total Loss of Value
Pending	Warragamba-290	Axe Grinding Grooves	Partial	Total Loss of Value

AHIMS ID	Site Name	Site Type	Degree of Harm (Total/Partial/None)	Consequences of Harm
Pending	Warragamba-300	Shelter with Deposit and Art	Partial	Total Loss of Value
Pending	Warragamba-301	Shelter with Deposit and Artefacts	Partial	Total Loss of Value
Pending	Warragamba-302	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-303	Open Camp Site	Partial	Total Loss of Value
Pending	Warragamba-304	Axe Grinding Grooves	Partial	Total Loss of Value
Pending	Warragamba-305	Shelter with Deposit, Artefacts and Axe Grinding Grooves	Partial	Total Loss of Value

18.9.4 Operation impacts – Aboriginal cultural values assessment

Potential impacts are discussed in Appendix K (ACHA, Appendix 2). A summary of cultural places and impacts is given in Table 18-24. Potential impacts to specific cultural places within the PUIA are identified in Table 18-25. The assessment found that:

- all cultural values may be partially impacted by the Project
- cultural places that may be impacted in the EUIA include 19 fully impacted and 9 partially impacted places
- cultural places that may be impacted in the PUIA include 11 partially impacted places.

Table 18-24. Summary of Cultural Values

Item	Description	Cultural Significance	Partial Impact Yes/No
Gurrangatch - Mirrigan Dreaming Track	A Dreaming Track following the movements of Gurrangatch and Mirrigan; the associated Story tells of the creation of the Wollondilly and Coxs River valleys.	The Gurrangatch-Mirrigan Dreaming Track as a whole is considered to be of Very High Significance.	Yes
Buru (Kangaroo) Dreaming Story Places	Buru (Kangaroo) Dreaming Story Places and associated resource sites for their maintenance as an important traditional resource.	The Buru (Kangaroo) Dreaming Story Places and the associated resource sites are considered to be of High Significance.	Yes
Living Places	A range of places which hold cultural value, including locations linked to Dreaming Stories, art and ceremonial sites, and burials.	The Cultural Places reflect the complex social and religious life of the Aboriginal people of the region and are considered to be of High Significance.	Yes
Archaeological Sites	The material evidence of Aboriginal occupation and use of the area, including art sites, grinding grooves, scarred trees, open campsites, and artefacts.	The Archaeological Sites that reflect the traditional occupation and use of the area by Aboriginal people are as a whole considered to be of High Significance.	Yes

Table 18-25. Summary of identified Cultural Places and impacts

Item	EUIA Impact None/Partial/Full	PUIA Impact None/Partial/Full
Gurrangatch-Mirrigan Dreaming Track Place 1	None	None
Gurrangatch-Mirrigan Dreaming Track Place 2	None	None
Gurrangatch-Mirrigan Dreaming Track Place 3	None	None
Gurrangatch-Mirrigan Dreaming Track Place 4	None	None
Gurrangatch-Mirrigan Dreaming Track Place 5	None	None
Gurrangatch-Mirrigan Dreaming Track Place 6	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 7	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 8	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 9	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 10	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 11	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 12	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 13	Full	None

Item	EUIA Impact None/Partial/Full	PUIA Impact None/Partial/Full
Gurrangatch-Mirrigan Dreaming Track Place 14	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 15	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 16[1]	None	None
Gurrangatch-Mirrigan Dreaming Track Place 17	Full	None
Gurrangatch-Mirrigan Dreaming Track Place 18	None	None
Gurrangatch-Mirrigan Dreaming Track Place 19	None	None
Buru (Kangaroo) Dreaming Story Place A	Partial	Partial
Buru (Kangaroo) Dreaming Story Place B	Full	None
Living Place 1: Gazetted Aboriginal Reserve No.26	None	Partial
Living Place 1: Gazetted Aboriginal Reserve No.27	None	Partial
Living Place 3: Gazetted Aboriginal Reserve No.10159	Partial	Partial
Living Place 4: Gazetted Aboriginal Reserve No.14937 (Ghungarlook Farm)	Partial	Partial
Living Place 5: Gazetted Aboriginal Reserve No.40798 (Ghungarlook Farm)	Partial	Partial
Living Place 6: Gazetted Aboriginal Reserve No.17023 (St. Josephs Farm)	Partial	Partial
Living Place 7: St Joseph's School Reserve (St. Josephs Farm)	Full	None
Living Place 8: The Big Flat	Partial	Partial
Living Place 9: Burnt Flat	None	None
Living Place 10: New Yards Creek	None	None
Cultural Place 1: Tommy Bundle's Burial	Full	None
Cultural Place 2: 'Hands on the Rock'	Full	None
Cultural Place 3: Jimmy Ah-re-moy or Tarlo Jack's Burial	Full	None
Cultural Place 4: Burial Tree Site	Full	None
Cultural Place 5: 'Chief's' Burial	Full	None
Cultural Place 6: Black Waterhole	Full	None
Cultural Place 7: Red Hand Cave	None	None
Cultural Place 8: Jumping Woman Dreaming Story Site	Partial	Partial
Cultural Place 9: Kerswell Hill[1]	None	None
Cultural Places 10 & 11: Oaky Creek Site Complex	Partial	Partial
Cultural Place 12: Ripple Creek Site Cluster	Partial	Partial
Cultural Place 13: Joorilands Farm Site Cluster[1]	None	None

1 Within potential impact zone in Project's 100-year period event modelling.

18.9.5 Cumulative impacts

Aboriginal heritage of the area has been moderately impacted due to the original development of Warragamba Dam and the area being used as a water catchment for the past 60 years, as well as bushfires.

Impacts may have occurred to:

- sites around Warragamba Dam that would have been impacted by the original construction of the dam due to vegetation clearance and earthworks for the development of the existing dam wall, boat ramp, spillways, and associated infrastructure
- sites within the EUIA, which can experience flooding for long periods of time especially when the lake water levels are high.

There are also a number of sites within the study area above the EUIA. There has not been a flood event since the construction of Warragamba Dam that has affected this area. The largest flood event since construction of the dam occurred in November 1961 and reached a height of 2.79 metres above FSL. This is about the same level as the lower extent of the upstream impact area (2.78 metres above FSL). The upstream study area is defined by the PMF event with the Project. The PMF is a hypothetical flood estimate relevant to a specific catchment whose magnitude is such that there is negligible chance of it being exceeded. It represents a notional upper limit of flood magnitude and no attempt is made to assign a probability of exceedance to such an event (Ball *et al*. 2019). The PMF is unlikely to occur in nature given the size of the Warragamba Dam catchment.

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011a) defines ecologically sustainable development and inter-generational equity as follows, *'the principle of inter-generational equity holds that the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations'*.

The proposed construction works would not harm any known Aboriginal sites.

During operation of the Project:

- some 184 known sites are within the EUIA of which 66 sites are below the FSL. These sites have already been partially impacted by the current dam due to previous inundation (see Table 18-23). At some rock art sites this has seen water wear and algae growth within the shelter where art, deposit, artefacts and/or axe grinding grooves may have once been present. Artefact deposits and surface artefacts may have also suffered exposure and movement due to frequent inundation. The Project may result in a total loss of value of these sites.
- another 43 known sites are within the PUIA and these sites are not expected to have been significantly impacted due to inundation. Predictive analysis estimated that 120 Aboriginal cultural heritage sites may occur within the PUIA (discussed in Section 18.6.3.2). The Project may result in a total loss of value of these sites
- a further 107 known sites were found outside of the PUIA, of which 34 sites are within the study area.

The ACHA (Appendix K, Appendix 1) concluded that there would be no significant detrimental effect to quality or benefit that the Aboriginal history and archaeology of the PUIA may provide to future generations due to the infrequency of the rain events that will cause harm to Aboriginal objects.

However, a representative of the Darug peoples (Justine Coplin) notes in her submission that:

> *We do not agree with the raising of the Warragamba Dam. Survey of just 25 percent of the area has shown that there are many Aboriginal sites throughout the area and that it is very significant to us.*
>
> *Our culture and history are being destroyed across Western Sydney by Development and Warragamba Dam is a significant area for the Darug.*
>
> *We would like this record of our history and culture to be protected and not be flooded with water. Many of our sites have already been lost because of the dam and because of development across Western Sydney and there is an opportunity to protect this very significant area for the Darug people and future Australians.*
>
> *Many recorded and unrecorded sites would be lost or damaged by raising the dam.*

Paul Knight CEO of the Illawarra Local Aboriginal Land Council notes the following in his submission in regard to the draft ACHA:

> *Furthermore, we would contest that the impact which will be attributed to this project does not align with the cost that will be borne by the Aboriginal community in the loss of such a significant heritage area.*

The Project is seen by the RAPs as a further accumulation of impacts to Aboriginal cultural heritage that has previously been affected by the original development of the Warragamba Dam.

18.9.6 Potential impacts to Aboriginal sites in the Greater Blue Mountains World Heritage Area

The boundary of the Greater Blue Mountains World Heritage Area (GBMWHA) does not generally correspond with the boundaries of Lake Burragorang and its tributaries. In most locations around Lake Burragorang there is a 'buffer' or strip of land that is in a National Park but not part of the GBMWHA. The exceptions are:

- Along the southern bank of the Wollondilly River arm of Lake Burragorang where the GBMWHA and the Nattai National Park boundary extend down to the full supply level of the dam.

- Where the GBMWHA boundary extends to the full supply level or to the bank of a potentially impacted waterway, which include:
  - Nattai River near the Little River confluence (Nattai National Park)
  - a small reach of the Kedumba River (Blue Mountains National Park)
  - reaches of the Kowmung and Coxs Rivers about 3 km upstream of their confluence (Blue Mountains National Park)
  - some minor tributaries which flow directly into Lake Burragorang (Blue Mountains National Park).

A total of 43 Aboriginal sites were identified in the part of the GBMWHA within the upstream study area, which are summarised in Table 18-26 (sourced from Appendix J World Heritage Assessment Report). Of these:

- 20 sites are currently impacted by the dam and would experience increased flooding due to the Project with a total loss of value (noting that site values have already been diminished by inundation from the existing dam)
- 8 sites are within the PUIA may experience flooding due the Project, with a total loss of value
- 15 sites are above the PUIA and would not be impacted by the Project

Table 18-26. Known Aboriginal sites in the GBMWHA and potential impacts

Site type	Number of sites	Scientific significance	Cultural significance	Potential impact
EUIA (between FSL and RL 119.5 mAHD)				
Aboriginal Resource and Gathering	1	Low	High	Total loss of value
Open Camp Site	19	Low – 15 sites Moderate – 1 site High – 3 sites	High	Total loss of value
Subtotal	20			
PUIA (between 119.5 mAHD and 126.97 mAHD)				
Axe Grinding Grooves	1	High	High	Total loss of value
Isolated Artefact	1	Low	High	Total loss of value
Open Camp Site	6	Low	High	Total loss of value
Subtotal	8			
Other (between RL 126.97 mAHD and the upstream study area boundary)				
Open Camp Site	9	Low	High	No loss of value
Shelter with Deposit and Art	1	High	High	No loss of value
Shelter with Deposit and Artefacts	5	Low	High	No loss of value
Subtotal	15			

18.10 Management and mitigation measures

18.10.1 Conservation principles and management framework

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011a, p. 12) is founded on two important principles: ecologically sustainable development and intergenerational equity. These principles hold that *"the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations"*.

The strong emphasis, such as that described in the Burra Charter, is to quantify and understand the heritage values of a place, a site, or an object and exhaust avenues of avoiding harm to those values. If harm cannot be avoided, then there must be consideration and implementation of strategies to minimise harm (OEH 2011a, p. 13).

The hierarchy of management strategies available for surface stone artefacts and subsurface stone artefacts, and areas of archaeological potential, fall into four general categories. In order of preference these are:

- avoidance and in-situ conservation

- partial avoidance and partial in situ conservation (includes partial harm)
- harm caused with mitigating circumstances such as collection or salvage
- unmitigated harm.

Management and mitigation measures have been prepared in consideration of comments received from the RAPs during the consultation process. These comments include those related to cultural considerations surrounding salvage works and the handling of artefactual materials, as well as the cultural significance of all sites.

18.10.2 Design to avoid harm

Chapter 4 of the EIS discusses proposed alternatives that were considered for flood mitigation in the Hawkesbury-Nepean Valley. Criteria used to assess alternatives were based on reducing flood level peak, reducing risk to life, economic costs and environmental impacts. Alternatives assessed include:

- *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 lower peak levels downstream
- *combined strategies*: These combine some of the above approaches
- *design options for raising Warragamba dam*: This included provision of a flood mitigation zone by raising the dam wall by approximately 12 metres rather than 20 metres. While a larger flood mitigation zone would provide a greater reduction in flooding downstream, the greater environmental costs from the longer period and extent of upstream temporary inundation were a major factor in discounting this alternative.

Other alternatives and options either did not achieve sufficient flood mitigation or had unacceptable economic or environmental costs. One of the objectives of the discharge protocol for the flood mitigation zone is to minimise the duration and extent of upstream temporary inundation. This discharge protocol will aim to avoid or minimise harm as much as possible within design and operational constraints. Depending on the site type (for example, artefact scatter or axe grinding groove) and scientific significance rating, further management measures such as archival recording and fencing may be undertaken prior to harm, in consultation with a suitably qualified archaeologist and representatives of the RAPs. This approach is consistent with the OEH requirements of ecologically sustainable development and intergenerational equity.

18.10.3 Sites that cannot be avoided

An Aboriginal Cultural Heritage Management Plan (ACHMP) should be developed by a suitably qualified archaeologist in consultation with the RAPs to develop specific management protocols for those Aboriginal cultural heritage sites that will be harmed due to the proposed Project. The Aboriginal cultural heritage sites in the following sections should be included within this ACHMP.

18.10.4 Sandstone shelter sites

All sandstone shelter sites and grinding grooves of moderate or higher significance should have baseline recording to a level which creates a detailed archival record. The baseline recording should include detailed scale drawing and photography of each site, and in some cases should include consideration of photogrammetry, giga-pixel photography and terrestrial laser scanning. As the Project spans a long operational life, this work should be undertaken progressively and the ACHMP should allow scope for the inclusion of new technologies (for both recording and mitigation) should these become available.

18.10.5 Scarred trees

Scarred trees account for five of the total number of Aboriginal sites identified during the assessment. All are considered to be of low scientific significance. Each of these trees should be assessed by a qualified arborist to determine whether the wounding observed at each tree is the result of traditional Aboriginal activities. If these scars are determined to be of Aboriginal origin, then they should be incorporated in the ACHMP and detailed recording (if not already undertaken).

18.10.6 Artefact Sites

The management recommendations made regarding artefact sites that will be impacted by the proposed development is to take no action unless they will be impacted by the proposed surface or ancillary infrastructure.

18.10.7 Warragamba-288 (AHIMS ID# pending)

Warragamba-288 (AHIMS ID #pending) which comprises a sandstone shelter with hafted hatchet, falls outside of the Project PMF. Due to its rarity and scientific significance rating of high; it is recommended that this site is included in the ACHMP and additional recording and archaeological assessment is carried out to provide additional details on the age and mastic type used by the local Aboriginal people for hafting practices.

18.10.8 Gundungurra Indigenous Land Use Agreement (20 June 2014)

An indigenous land use agreement (ILUA) exists between the Gundungurra people and the NSW Government (including WaterNSW). The Agreement provides a framework for consultation and participation of the Gundungurra people in the management of the ILUA area, which incorporates the Project area. The Gundungurra ILUA will be considered when developing and implementing Project management and mitigation measures.

18.10.9 Aboriginal cultural heritage management plan

An Aboriginal Cultural Heritage Management Plan (ACHMP) would be developed for the Project that details and schedules (for the life of the Project) the mitigation and management measures presented in this report, and any other relevant responsibilities and considerations. The ACHMP must be developed, managed, and implemented in consultation with the RAPs and relevant regulatory authorities. The ACHMP should include, but not be limited to the following:

- Protocols for the involvement of the RAPs in cultural heritage works conducted under the ACHMP. A communications protocol that describes clear methods of communication, including expectations of suitable notification and response time, between the proponent and the RAPs.
- Procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the Project.
- Warragamba-288 (AHIMS ID #pending) should be included within the ACHMP
- A regular review process for the AHMP.
- Copies of the final ACHMP should be made available to each RAP, the DP&E, WaterNSW, NPWS and the Heritage NSW.

18.11 Environmental management measures summary

The management measures developed as part of the ACHA will not remove the potential for harm to the Aboriginal sites; but are designed to provide intergenerational equity should the Project proceed. Proposed management measures identified in Appendix K are summarised in Table 18-27.

Table 18-27. Management measures

Impact	ID	Environmental management measure	Timing	Responsibility
Consultation	ACH1	WaterNSW would continue consultation and engagement with the Registered Aboriginal Parties for the duration of the Project.	Pre-construction Construction	WaterNSW
	ACH2	An independent facilitator would work with the RAPs and the wider Aboriginal community to develop an Aboriginal advisory group to guide the implementation of Recommendations 8 to 11 in the Cultural Values Assessment Report (Appendix 2 to Appendix K).	Pre-construction Construction Operation	WaterNSW
Management of impacts on cultural heritage	ACH3	An Aboriginal Cultural Heritage Management Plan (ACHMP) would be developed for the Project and implemented as part of the Construction Environmental Management Plan (CEMP). The ACHMP would be developed and managed in consultation with the RAPs and relevant regulatory authorities. The AHMP would provide specific guidance on measures and controls to be undertaken to avoid and mitigate impacts on Aboriginal cultural heritage during construction.	Pre-construction Construction	WaterNSW Construction Contractor
	ACH4	Prior to the operation of the Project WaterNSW to review its assessment processes for works within the upstream catchment to include awareness to personnel undertaking an activity on its behalf of any potential Aboriginal cultural heritage values and objects in the area.	Construction Operation	WaterNSW
	ACH5	A cultural heritage awareness and cultural competency training package would be developed and delivered to all WaterNSW staff. The training package would include a site-specific module developed in consultation with the relevant Aboriginal communities and RAPs.	Pre-construction	WaterNSW
	ACH6	The site-specific Aboriginal cultural heritage awareness training package would be delivered as part of the site induction for all employees, contractor(s) and maintenance personnel involved in the construction works and ongoing site management and activities in the catchment of Lake Burragorang.	Construction Operation	WaterNSW
	ACH7	WaterNSW would develop a formal agency-specific process and policy for undertaking cultural heritage assessments and engaging with the Aboriginal community in line with those developed by other state government agencies.	Operation	WaterNSW
	ACH8	WaterNSW would consider engaging an in-house archaeological specialist support in line with other state government agencies.	Operation	WaterNSW

Impact	ID	Environmental management measure	Timing	Responsibility
Access to Country	ACH9	WaterNSW would develop and implement a policy to improve access for Aboriginal community members to Country they have cultural connections with that are under WaterNSW management.	Prior to operation	WaterNSW
	ACH 10	WaterNSW would facilitate bi-annual on-country visits open to Aboriginal community members with cultural connections to the area.	Ongoing	WaterNSW
Site recording	ACH 11	The unsurveyed portion of the PUIA would be surveyed should the Project be approved (survey would include provision for detailed recording of all shelter sites including 3D photogrammetry, planning, detailed photography and scale drawing of any art or other features present).	Prior to operation	WaterNSW
	ACH 12	The unsurveyed portion of the area above the PUIA within the upstream study area would be sample surveyed to identify sites and places of high significance should the Project be approved (survey would include provision for detailed recording of all shelter sites including 3D photogrammetry, planning, detailed photography and scale drawing of any art or other features present).	Prior to operation	WaterNSW
	ACH 13	Further detailed impact assessment and recording of all Aboriginal cultural heritage sites and places that are located within the PUIA, sites of high significance in the area above the PUIA within the upstream study area, and all art sites within the upstream study area would be carried out. This would include 3D photogrammetry and high resolution digital photographic records and would include the landscape context of sites and site complexes to capture archaeological and cultural values.	Prior to operation	WaterNSW
Cultural values recording and education	ACH 14	WaterNSW would consult with the RAPs and the Aboriginal community with regard to carrying out a comprehensive specialist research audit of the holdings of national and international collection institutions to identify cultural materials removed from Country in the Study Area. Subject to proceeding with the audit, WaterNSW would facilitate an access visit for Aboriginal community members to any cultural materials identified in Sydney and Canberra based collection institutions.	Prior to operation	WaterNSW
	ACH 15	In consultation with the RAPs and the Aboriginal community, WaterNSW would develop interpretative materials on the Aboriginal cultural values and history of the cultural landscape of the Study Area including: a permanent exhibition at the Warragamba Dam Visitor Centre; interpretative signage and audio posts within the Warragamba Dam grounds; and facilitate the provision of Aboriginal-led cultural events (i.e. tours and talks) through the Warragamba Dam Visitor Centre.	Prior to operation	WaterNSW

Impact	ID	Environmental management measure	Timing	Responsibility
	ACH 16	In consultation with the RAPs and the Aboriginal community, WaterNSW would develop a cultural values project to record the Gurrangatch-Mirrigan Dreaming Story route through the photographic recording of specific cultural locations within the Study area (prior to any further impacts), oral history recordings with Aboriginal community members, and documentary research.	Prior to operation	WaterNSW
	ACH 17	In consultation with the RAPs and the Aboriginal community, WaterNSW would undertake a heritage study of the Aboriginal traditional and historical occupation of the Study area through photographic recording of specific sites (prior to any further impacts), historical documentary research, and oral history interviews.	Prior to operation	WaterNSW

18.12 Risk assessment

An environmental risk assessment was carried out in accordance with the SEARs, using the methodology provided in Appendix C. A Project risk matrix was developed and risk ranking evaluated by considering:

- the likelihood (L) of an impact occurring
- the severity or consequence (C) of the impact in a biophysical and/or socio-economic context, with consideration of:
  - whether the impact will be in breach of regulatory or policy requirements
  - the sensitivity of receptors
  - duration of impact, that is, whether the impact is permanent or temporary
  - the areal extent of the impact and/or the magnitude of the impact on receptors.

The likelihood and consequence matrix is shown on Figure 18-11.

Once the consequence and likelihood of an impact are assessed, the risk matrix provides an associated ranking of risk significance: **Low**; **Medium**; **High** or **Extreme,** as shown in Table 18-28**.** The residual risk was determined after the application of proposed mitigation measures.

The risk analysis for potential Aboriginal cultural heritage impacts is provided in Table 18-29. This includes the residual risk of the potential impact after the implementation of mitigation measures.

Table 18-28. Risk ranking definitions

Risk definitions	
Extreme 21 – 25	Widespread and diverse primary and secondary impacts with significant long-term effects on the environment, livelihood and quality of life. Those affected will have irreparable impacts on livelihoods and quality of life.
High 15 – 20	Significant resources and/or Project modification would be required to manage potential environmental damage. These risks can be accommodated in a Project of this size, however comprehensive and effective monitoring measures would need to be employed such that Project activities are halted and/or appropriately moderated. Those impacted may be able to adapt to change and regain their livelihoods and quality of life with a degree of difficulty.
Medium 9 – 14	Risk is tolerable if mitigation measures are in place, however management procedures will need to ensure necessary actions are quickly taken in response to perceived or actual environmental damage. Those impacted will be able to adapt to changes.
Low 1 – 8	On-going monitoring is required however resources allocation and responses would have low priority compared to higher ranked risks. Those impacted will be able to adapt to change with relative ease.

Figure 18-11. Risk matrix

		Consequence				
		Negligible	Minor	Medium	Major	Extreme
	LEGAL	No legal consequences	No legal consequences	Incident potentially causing breach of licence conditions	Breach of licence conditions	Breach of licence conditions resulting in shutdown of Project operations.
	SOCIO-ECONOMIC	Impacts that are practically indistinguishable from the social baseline, or consist of solely localised or temporary/short-term effects with no consequences on livelihoods and quality of life.	Short-term or temporary impacts with limited consequences on livelihoods and quality of life. Those affected will be able to adapt to the changes with relative ease and regain their pre-impact livelihoods and quality of life.	Primary and secondary impacts with moderate effects on livelihoods and quality of life. Will be able to adapt to the changes with some difficulty and regain their pre-impact livelihoods and quality of life.	Widespread and diverse primary and secondary impacts with significant long-term effects on livelihoods and quality of life. Those affected may be able to adapt to changes with a degree of difficulty and regain their pre-impact livelihoods and quality of life.	Widespread and diverse primary and secondary impacts with irreparable impacts on livelihoods and quality of life and no possibility to restore livelihoods.
	HEALTH	No health consequences	Accident or illness with little or no impact on ability to function. Medical treatment required is limited or unnecessary.	Accident or illness leading to mild to moderate functional impairment requiring medical treatment.	Accident or illness leading to permanent disability or requiring a high level of medical treatment or management.	Accident, serious illness or chronic exposure resulting in fatality.
	ENVIRONMENT	Localised (on-site), short-term impact on habitat, species or environmental media	Localised or widespread medium-term impact to habitat, species or environmental media	Localised degradation of sensitive habitat or widespread long-term impacts on habitat, species or environmental media. Possible contribution to cumulative impacts.	Widespread and long-term changes to sensitive habitat, species diversity or abundance or environmental media. Temporary loss of ecosystem function at landscape scale. Moderate contribution to cumulative impacts.	Loss of a nationally or internationally recognised threatened species or vegetation community. Permanent loss of ecosystem function on a landscape scale. Major contribution to cumulative effects
		A - negligible	**B** - minor	**C** - medium	**D** - major	**E** - extreme
Expected to occur during the Project or beyond the Project	**a** - expected	**13**	**14**	**20**	**24**	**25**
May occur during the Project or beyond the Project	**b** - may	**8**	**12**	**19**	**22**	**23**
Possible under exceptional circumstances	**c** - possible	**6**	**7**	**11**	**18**	**21**
Unlikely to occur during the Project	**d** - unlikely	**4**	**5**	**10**	**16**	**17**
Rare or previously unknown to occur	**e** - rare	**1**	**2**	**3**	**9**	**15**

Risk Definition (see Table 18-28)	**Low**	**Medium**	**High**	**Extreme**

Table 18-29. Aboriginal cultural heritage risk analysis

Heritage								
Key impacts	**Risk before mitigation**			**Mitigation and management**	**Risk after mitigation**			**Residual risk**
	L	**C**	**R**		**L**	**C**	**R**	
Construction								
Approximately 33 ha will be directly disturbed. Potential harm associated with surface disturbance activities could cause either a total or partial loss of heritage value, and a potential cumulative or landscape loss of values for the broader area. Activities include: ▪ vegetation clearance and topsoil stripping ▪ disturbance of soil units or the ground surface with Aboriginal objects on the surface or within the soil profile ▪ changes to the context of a site or place that has indirect impacts to the site or place, resulting in the loss of cultural values ▪ excavation works and the removal and redistribution of rock and soil by heavy machinery during site regrading or development of suitable surface conditions for various construction activities. There are no known Aboriginal cultural heritage sites or natural landscape features within the footprint of the proposed surface infrastructure and most of the construction site has been extensively disturbed due to past activities associated with the construction and operation of the existing Warragamba dam.	d	C	**10**	ACH1, ACH4	d	B	**5**	No known Aboriginal cultural heritage sites occur on the construction area, however any finds would be managed in accordance with the ACHMP. Low residual risk not requiring significant additional mitigation measures.
Operation								
Flooding upstream of Lake Burragorang can result from inundation as the lake level rises due to flood inflows, from local catchment runoff, or a combination of the two. Flooding due to inundation is generally restricted to the	a	C	**20**	ACH1, ACH2, ACH3, ACH4, ACH5, ACH6	a	B	**14**	There is a High risk to heritage values due to unavoidable harm to sites of Aboriginal heritage, and potential harm to

Heritage								
Key impacts	Risk before mitigation			Mitigation and management	Risk after mitigation			Residual risk
	L	C	R		L	C	R	
area around the lake perimeter with flooding due to local catchment runoff dominating moving further up the catchment. Flooding beyond the Project study area is due to local catchment runoff. The Project would result in some upstream areas experiencing a greater extent and duration of temporary water inundation when the FMZ is operational compared to the existing dam. These include: ▪ 184 sites in the EUIA would experience additional flooding impacts ▪ 168 predicted sites (including 43 known sites) in the PUIA would experience new flooding impacts ▪ other sites not recorded during the survey may also be affected. Submersion of a site can result in varying impacts depending on site type: ▪ stone artefact sites will be subject to changed ground conditions such as waterlogging or erosion ▪ sandstone shelter sites will be subject to altered conditions that may detrimentally effect deposits and/or rock art ▪ scarred trees will be subject to more frequent flooding ▪ axe grinding grooves and engravings will be more frequently submerged, altering natural conditions and possibly their preservation ▪ Aboriginal ceremony and dreaming sites, and Aboriginal resource and gathering sites will have their								sites that may occur in areas that have not been subject to archaeological survey. Management measures will not remove the potential for harm to the Aboriginal sites but are designed to provide intergenerational equity should the Project proceed. The residual risk is at the higher end of Medium and appropriate and sufficient resources will need to be employed to effectively manage the risk.

Heritage								
Key impacts	Risk before mitigation			Mitigation and management	Risk after mitigation			Residual risk
	L	C	R		L	C	R	
accessibility altered, and physical aspects of the sites may also change. The cultural impact assessment found that: ▪ all cultural values may be partially impacted by the Project ▪ cultural places that may be impacted in the EUIA include 19 fully impacted and 9 partially impacted places ▪ cultural places that may be impacted in the PUIA include 11 partially impacted places.								

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