



Artist's Impression

Environmental Impact Statement – Chapter 21: Socio-Economic, land use, and property

Warragamba Dam Raising

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21 Socio-economic, land use and property

21.1 Introduction

A comprehensive socio-economic impact assessment (SEIA) was completed as one of the specialist assessments informing the Project's environmental impact statement (EIS). This chapter presents key elements and findings of the SEIA. The full SEIA report is provided in Appendix M to the EIS.

The purpose of the SEIA was to identify and assess the socio-economic changes which may occur in local and regional communities as a result of the Project including how negative impacts may be mitigated and benefits can be enhanced. The definition of social impact adopted by the SEIA is 'a consequence experienced by individuals, households, groups, communities, organisations and the NSW population generally due to changes associated with project' (DPE 2017b). The SEIA was prepared to meet the relevant Secretary's Environment Assessment Requirements (SEARs).

The objectives of the SEIA were to:

- define the communities potentially affected by the Project having regard to all potential socio-economic impacts
- provide stakeholders with the opportunity to provide inputs into the SEIA, including the scope of assessment, the impacts which may be experienced in different localities and by different stakeholders and how they may be avoided or mitigated
- develop a robust socio-economic baseline against which potential changes may be assessed
- identify likely social impacts based on examination of each element of the Project and credible impact pathways, stakeholder inputs and the characteristics of those potentially affected
- provide a detailed assessment of likely socio-economic impacts and benefits and an evaluation of their relative significance
- derive mitigation and enhancement measures which serve to avoid or reduce impacts and enhance benefits.

21.2 Legislation and guidelines

The applicable statutory and planning framework is outlined in Chapter 2 of the EIS. This section describes how the SEIA addresses the SEARs as issued for the EIS, along with the applicable guidelines for the conduct of social assessment.

21.2.1 Secretary's Environmental Assessment Requirements

The SEARs provide requirements relating to the assessment of socio-economic impacts associated with the Project. They require the following key components to be included in the social impact assessment:

- identification of the affected community and other interested stakeholders, specifying in what way each may be affected or interested, and paying particular attention to vulnerable groups and potential impacts
- assistance for these people and communities in understanding the Project
- a quantitative and qualitative community profile, including values and aspirations
- identification of any diversity of views or concerns that may exist in the community/ies
- relevance of any previous, current, and anticipated relevant developments and resultant cumulative impacts
- identification and assessment of potential positive and negative impacts
- provision of mitigation actions for significant negative social impacts that cannot be avoided and strategies to secure and maximise beneficial impacts.

Table 21-1 below provides the SEARs requirements relating to the assessment of socio-economic, land use, and property impacts associated with the Project.

Table 21-1. Secretary's Environmental Assessment Requirements: Socio-economic, land use and property, and flooding

Desired performance outcome	Requirements	Where addressed
<p>14. Socio-economic, land use and property</p> <p>The Project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities.</p> <p>The Project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure.</p>	<p>1. The Proponent will undertake a comprehensive Social Impact Assessment, prepared by a suitably qualified and experienced expert, supported and informed by a comprehensive, inclusive, and participatory program of community engagement, actively seeking input from the affected community and other stakeholders, paying particular attention to engaging vulnerable groups.</p>	<p>This chapter and Appendix M to the EIS</p>
	<p>2. The Social Impact Assessment will be informed by work conducted to inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy, comprising the following components:</p> <ul style="list-style-type: none"> ▪ identification of the affected community and other interested stakeholders, specifying in what way each may be affected or interested, and paying particular attention to vulnerable groups and potential impacts on them ▪ assistance for these people and communities in understanding the Project ▪ a quantitative and qualitative community profile, including values and aspirations ▪ identification of any diversity of views/concerns that may exist in the community/ies ▪ relevance of any previous, current, and anticipated relevant developments and resultant cumulative impacts. 	<p>Section 21.4 Section 0 Section 21.6</p>
	<p>3. Underpinned by the work at point 2 above, the Social Impact Assessment will identify potential impacts (positive and negative), considering the following matters:</p> <ul style="list-style-type: none"> ▪ way of life (how people live, work, play, and interact) ▪ culture (including values, heritage, and customs) ▪ community (including cohesion and sense of place) ▪ decision-making systems (people's capacity and power to influence decisions that affect them) ▪ environment (including amenity, aesthetics, and access) ▪ wellbeing and health (physical and mental) ▪ personal and property rights ▪ justified fears and aspirations about the above matters. 	<p>Section 21.7</p>

Desired performance outcome	Requirements	Where addressed
	4. The Social Impact Assessment will assess significance of each impact based on duration, extent, sensitivity (vulnerability to change and capacity to adapt), severity, and level of community concern.	Section 21.7
	5. The Social Impact Assessment will propose mitigation actions for significant negative social impacts that cannot be avoided, and strategies to secure and maximise beneficial impacts, and monitoring, management, and reporting arrangements, including discussion of how the applicant will respond to unanticipated social impacts as part of operational community consultation procedures.	Section 21.8
	6. Where land is reserved or acquired under the <i>National Parks and Wildlife Act 1974</i> (NPW Act), the EIS must detail:	As below
	(a) Effects of accurately predicted intermittent inundation regime, and predictions of habitat, biodiversity and cultural heritage loss or change within the OEH estate	Chapters 8, 9, 10, 17, and 20
	(b) Expanded consideration of indirect effects of inundation, especially in the context of land reserved under the NPW Act	Chapters 8, 9, 10, 17, and 20
	(c) Consider impacts of the Project on visual amenity and visitor experience in land reserved under the NPW Act	Chapters 20 and 25 Section 21.7
	(d) Identification of any proposed infrastructure (including roads) proposed within the OEH estate. Additional access and recreational opportunities that may be provided by proposed roads must be considered and discussed with NPWS	Chapters 20 and 24 Section 21.7
	(e) Predictions of the time and degree of disruption to recreational and management access during construction and the mitigation measures that will be undertaken. Changes to management and visitor access and infrastructure should be identified including walking track easements and access to heritage	Chapters 8, 9, 10, 17, and 20 Section 21.7 Section 21.8
	(f) Consideration of alternative options to avoid reserved lands and justification	Chapters 4 and 20
	(g) If on-park impacts are considered unavoidable and revocation/de-listing is required, consideration of the issues identified in Revocation, Re- categorisation and Road Adjustment Policy (OEH, 2012) is required, along with justification	Chapters 18 and 20

Desired performance outcome	Requirements	Where addressed
8. Flooding The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards, or dam failure.	2. The Proponent must assess and model the impacts on flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (accounting for sea level rise and storm intensity due to climate change) including:	As below
	(b) quantify the benefits of reducing flood affectation to developments, land, properties, assets and infrastructure;	Section 21.7 Chapter 15
	(h) any impacts the development may have on the social and economic costs to the community as consequence of flooding. Specifically, events at a minimum must be assessed for the 1 in 5 year, 1 in 10 year, 1 in 20 year, 1 in 100 year and the probable maximum flood. Modelling should include flood characteristics such as extent, level, velocity, and rate of rise at a minimum. Discussion and an assessment of the flood management zone also needs to be included.	Section 21.7 Chapter 15
	6. Discussion in the assessment of the consequences of flooding on social and economic costs to the community and in the broader catchment, including up to the probable maximum flood level.	Section 21.7 Chapter 15

¹ This chapter specifically addresses SEARs 14 and 8 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).

21.2.2 Guidelines

The SEARs do not specify a guideline to be adhered to in the assessment of socio-economic impacts. However, as per accepted good practice in NSW, the SEIA has been prepared to accord with the following guidelines:

- ‘Social Impact assessment (SIA) guideline: For state significant mining, petroleum production and extractive industry development’ and the associated SIA scoping tool’ (Department of Planning, Industry and Environment (DPIE) 2017b)
- ‘Environmental planning and impact assessment practice note: Socio-economic Assessment’ (Roads and Maritime Services (Roads and Maritime) 2013).

Key aspects of these guidelines are discussed in the following sections.

21.2.2.1 SIA Guideline

The NSW Social Impact Assessment Guideline 2017 (DPE 2017b) (SIA Guideline) was published in September 2017 and is a non-statutory guideline that provides direction on assessing the impacts of state significant resource industry projects under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The SIA Guideline’s principles are relevant to infrastructure projects and are summarised in Table 21-2 along with the SEIA’s response and the applicable sections in this Chapter.

Table 21-2. SIA guideline principles

Principles	Description	SEIA Response	Where addressed
Action-oriented	SIA delivers outcomes that are practical, achievable and effective.	Mitigation/enhancement measures	Section 21.8
Adaptive	SIA establishes systems to actively respond to new circumstances/information and support continuous improvement.	Stakeholder engagement to inform the SEIA and EIS	Section 21.6
Distributive equity	SIA considers how social impacts are distributed across vulnerable groups and between current and future generations.	Consideration of local and regional impacts, over time	Section 21.7
Life cycle focus	SIA seeks to understand potential impacts at all Project stages, from pre-construction to post closure.	Assessment includes a focus on construction and operations	Section 21.7
Impartial	SIA is undertaken in a fair, unbiased manner and follows relevant ethical standards	Commitment to objective and ethical assessment	Throughout
Inclusive	SIA seeks to understand the perspectives of the potentially affected groups, informed by respectful, meaningful, tailored and effective engagement	Stakeholder engagement process	Section 21.6
Integrated	SIA uses relevant information and analysis from other assessments and supports effective integration of social, economic and environmental considerations	SEIA and EIS engagement processes and findings integrated in the SEIA	Section 21.6
Material	SIA identifies which potential social impacts matter the most, and/or pose the greatest risk to those affected.	SEIA scoping	Section 21.4
Precautionary	If there is a threat of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental (including social) degradation.	Impact assessment considers residual risks	Section 21.7
Proportionate	Scope and scale of SIA should correspond to the potential social impacts.	SEIA scoping to define potential material impacts	Section 21.4
Rigorous	SIA uses appropriate, accepted social science methods and robust evidence from authoritative sources.	Methods and evidence sources are described and justified	Section 21.3
Transparent	Information, methods and assumptions are explained, justified and accessible, and people can see how their input has been considered.	Stakeholder engagement inputs are documented and references to relevant assessment sections are drawn	Section 21.6

21.2.2.2 Roads and Maritime Services Environmental planning and impact assessment practice note: socio-economic assessment

Roads and Maritime's 'Environmental Planning and Impact Assessment Practice Note: Socio-economic Assessment' forms part of the common procedures under the Roads and Maritime environmental impact assessment (EIA) guidelines. This practice note provides a framework for assessing socio-economic impacts of road and maritime projects undertaken by or on behalf of Roads and Maritime to ensure impact assessments are carried out consistently to a high standard, and are properly integrated with other environmental assessments, design development and management processes (Roads and Maritime 2013). The SEIA has been prepared in accordance with the practice note guidance for "analysing, monitoring and managing the socio-economic consequences of development which involves identifying and evaluating changes to or impacts on communities, business and industry that are likely to occur as a result of the proposed development in order to mitigate or manage impacts and maximise benefits".

21.2.3 Summary

The following points summarise how the SEIA has been conducted in accordance with applicable legislation, the SEARs and relevant guidelines:

- completion of scoping and preliminary significance assessment at an early stage of the SEIA
- an inclusive stakeholder engagement process
- presentation of suitable indicators in relation to pre-existing socio-economic conditions
- analysis and assessment of likely impacts and benefits, including direct, indirect and cumulative impacts for all stages of the Project, including differentiation for different stakeholder groups
- collaboration with other EIS technical disciplines to ensure integration of results with a bearing on the socio-economic environment
- development of adaptive management and monitoring strategies.

The SEIA has also considered the SIA guideline's typology for social impacts and its criteria for assessing material impacts. The following section describes the methodology that was employed in conducting the SEIA, whose design was specifically tailored to meet the requirements of the SEARs.

21.3 Methodology

21.3.1 Overview

The methodology, including impact assessment criteria and definitions, aligns with local and international social impact assessment standards. In particular, the SEIA methodology aligns with the SIA Guideline (2017b) and has been specifically tailored to meet the SEARs as outlined in Section 21.2.1.

Figure 21-1 below illustrates the steps of the SEIA. Each of these steps is further described in the following sections.

Figure 21-1. Steps of an SEIA methodology



21.3.2 Scoping

Scoping is the first phase of the SEIA. Scoping was conducted to identify the elements of the natural or human environment which have the potential to be impacted by activities associated with the project, either negatively or positively (DPE 2017b). The outcomes of the scoping phase served to define the study areas for the SEIA, the parameters which would formulate the social baseline, and the subsequent assessment of potential impacts and benefits.

Overall, two core SEIA objectives were specifically informed by the scoping phase of the SEIA, including:

- identification of the area of influence (Aol) for the Project
- identification of socio-economic changes and issues generated as a result of Project activities which require further investigation in the SEIA.

The Aol or SEIA study areas for the Project were defined based upon a range of factors including:

- the Project layout and direct impact associated with the footprint
- the nature of the surrounding environment including proximity of sensitive receivers, associated facilities, and other surrounding land uses
- the scale and nature of the Project, potential direct impacts, and potential indirect impacts that may extend from the Project throughout the Project lifecycle
- who may be affected by the Project, how they may be affected, and their interests, values and aspirations
- social characteristics and trends, and sensitivities of communities
- stakeholder inputs on the scope of potential social impacts and benefits
- the settlement pattern, including infrastructure, urban/peri-urban and land use patterns.

Preliminary identification of potential social changes and issues of community concern was informed through application of the matters checklist as part of the SIA scoping tool published on the Department of Planning and Environment (DPE) website. The matters checklist presents a high level, preliminary identification of project activities which may affect, or be perceived to affect, stakeholders. It includes a generic checklist of social, environmental and economic matters. Identification of potential socio-economic changes and issues of community concern was informed by the direct engagement of key stakeholders through undertaking scoping interviews.

The completed matters checklist informs the scope of the SEIA by providing the basis of further assessment to be completed for the SEIA, recognising that further matters may emerge as more detailed investigations are undertaken. However, perceptions raised by stakeholders during scoping interviews are opinions only and not necessarily actual effects associated with the Project.

Additional details regarding the findings of the scoping phase is provided in Section 21.4.

21.3.3 SEIA baseline analysis

To provide a suitably robust baseline to assess the impacts of the Project, a description is required of all socio-economic and cultural characteristics potentially affected by the Project. The socio-economic baseline concisely documents the current state of relevant social, economic and land use characteristics within the SEIA study areas, providing a benchmark against which direct and indirect impacts can be predicted, analysed and measured.

The scope and content of the socio-economic baseline study was tailored to the specific project context and only included indicators and information that were useful and meaningful to the prediction and measurement of Project impacts. The socio-economic baseline has drawn on a range of primary and secondary information sources. Quantitative information derived through Australian Bureau of Statistics (ABS) census data and other secondary sources of information was complemented by primary information obtained through scoping interviews and other engagement activities undertaken as part of the EIS. The suite of socio-economic indicators that comprise the baseline were determined with reference to the credible impact pathways and social risks and benefits identified in the scoping phase.

The socio-economic baseline also builds on information derived through affiliated social research which has been completed to date, particularly social research which has been completed by Infrastructure New South Wales (INSW) as part of the *Hawkesbury-Nepean Valley Flood Risk Management Strategy*. The baseline also includes an overview of relevant planning and public policy directions along with demographic and housing characteristics, including future growth projections, economic and business activity, and an analysis of social infrastructure and community health and safety. The socio-economic baseline is summarised in Section 0.

21.3.4 Stakeholder engagement

A comprehensive SEIA engagement process was undertaken to ensure the SEIA was directly informed by inputs from affected and interested stakeholders. A defining feature of the Project is the extent and diversity of stakeholders, with the Aol encompassing communities local to Warragamba Dam, along with those upstream, including the Blue Mountains and Wollondilly local government areas (LGAs), and downstream, stretching to the estuary of the Hawkesbury River.

Information collected through SEIA stakeholder engagement was used to verify socio-economic baseline characteristics, to identify potential socio-economic impacts and benefits associated with the Project, and to assess how such impacts may be avoided, mitigated or managed, or benefits enhanced. The SEIA has been informed by both engagement activities specifically undertaken as part of the SEIA, as well as the community engagement program

associated with the EIS. The SEIA was further informed by engagement activities undertaken by INSW as part of the *Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW 2017).

SEIA stakeholder engagement commenced with the identification of stakeholders and their interests, which involved:

- review of the outcomes of INSW’s stakeholder engagement to date
- review of the outcomes of the EIS stakeholder engagement to date
- desktop analysis of social infrastructure provision and management in the Aol
- identification of communities affected and other stakeholder groups (such as government agencies) with an interest in the SEIA.

SEIA engagement activities sought to identify and substantiate potential impacts and benefits and how they may manifest in local areas. This was achieved by engaging local organisations throughout all areas potentially affected by the Project: upstream, downstream and specifically the communities of Warragamba and Silverdale. Direct forms of engagement included scoping interviews, a phone-based survey, web-based survey and business survey.

Community and stakeholder feedback informing the SEIA is summarised in Section 21.6 and is incorporated throughout the assessment as referenced.

21.3.5 Impact assessment

Impact identification and assessment were undertaken in accordance with the methodology, assessment criteria and definitions described in the SIA Guideline (DPE 2017b). The definition of social impact adopted by the SEIA is “a consequence experienced by individuals, households, groups, communities, organisations and the NSW population generally due to changes associated with project” (DPE 2017b). The International Association for Impact Assessment further define social impact as something that is experienced or felt in either a perceptual or physical sense (Vanclay *et al.* 2015). As such, this SEIA considers how individuals, households groups, communities, organisations and the NSW population generally might experience and perceive social impacts through application of social science expertise and judgement, and informed by outcomes of stakeholder engagement.

Social impacts vary in their nature. Impacts can be:

- positive or negative
- tangible or intangible
- direct, indirect or cumulative¹
- directly quantifiable, indirectly or partly quantifiable
- only able to be described and assessed in qualitative terms
- experienced differently by different stakeholders or at different times and stages of the Project (DPE 2017b).

Impacts of this SEIA were identified and described using data triangulation of multiple sources of information to identify and verify impacts. Sources of information to inform impact identification include primary and secondary data. The primary data included the feedback generated through a broad range of engagement activities as described in Section 21.6. Secondary data informing the SEIA included:

- project description information
- social research undertaken to inform the *Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW 2017)
- demographic, health and other data available from ABS, government agencies and local government
- government-authored strategic policies, plans and documents (such as Local Environmental Plans, Regional Plans, and local social and economic development strategies)
- EIS assessment of air quality, noise and vibration, traffic impacts, visual amenity and water quality, Aboriginal cultural heritage, and non-Aboriginal heritage

¹ Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of the activities on society, the economy and the environment. They can arise from a single activity, multiple activities or from interactions with other past, current, and foreseeable future activities. They can be ‘sink’ impacts arising from the outputs of activities (that is dust, noise, saline water), or ‘source’ impacts resulting from drawing upon and using the same resources as other industries (DPI 2017b).

- desktop research of websites, databases, high-quality 'grey literature' as referenced (such as government reports, issue papers, conference papers, articles and research reports).

The overarching impact categories identified, defined and assessed in the SEIA were:

- property and land use
- environment including effects on amenity, aesthetics, and access
- community health and wellbeing, including effects on community safety, recreation, access to and use of infrastructure, services and facilities, and psychological and physical health
- culture and heritage including effects on values, heritage and customs
- way of life including effects on community cohesion, housing and accommodation and local economic conditions (employment and businesses).

Across each of these categories, consideration was also made of decision-making systems and the capacity and power of stakeholders to influence decisions which affect them.

The assessment of impacts is undertaken across four key sequential steps which are summarised as follows:

- impact prediction: to predict the nature and scale of potential social impacts associated with the Project
- impact evaluation: to evaluate the significance of the predicted impacts by considering the likelihood and consequence of the identified impacts
- mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts
- residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

The identified positive and negative impacts are evaluated to determine their relative level of significance. In accordance with the SIA Guideline (DPE 2017b), positive and negative impacts are evaluated according to:

- the consequence of the potential social impact: minimal, minor, moderate, major or catastrophic (for negative impacts) and extreme (for positive impacts). In accordance with the SEARs, specific elements considered in predicting the level of consequence of a negative impact include its duration, extent, sensitivity (receivers and vulnerability to change), and the severity and level of community concern. In terms of evaluating positive social impacts, predicting the level of consequence is adjusted so that 'severity' refers to 'scale of improvement or benefit' and 'level of community concern' equates to 'level of interest'. The consequence of the potential social impact is determined from the perspective of those expected to be affected by the positive or negative impact.
- the likelihood of the potential social impact: rare, unlikely, possible, likely or almost certain. It is important to note that impacts associated with the operational phase of the Project primarily relate to the occurrence of a flood event which also has a likelihood rating (for example, one in five chance in a year event, one in 10 chance in a year event). Applying multiple layers of likelihood becomes overly complex. Therefore, where 'likelihood' is referred to in this SEIA it refers to the likelihood of an impact occurring as a result of a flood event (i.e., it is assumed that the flood event will occur).

As outlined in Section 21.3.4, community and stakeholder engagement is an integral element of the SEIA. Feedback generated through community and stakeholder engagement is directly drawn upon in the determination of the likelihood and consequence of impacts. As a result, there may be divergence between the impact significance rating assigned in the SEIA and that ascribed in other technical studies completed as part of the EIS. For instance, whilst the Air Quality Assessment may conclude that the Project will not result in any exceedances of relevant air quality criteria and therefore assign a relatively low impact significance rating, if community and stakeholder sentiment has clearly demonstrated a high level of concern regarding air quality, then this is duly considered in the SEIA and may result in a higher impact significance rating. So as to avoid confusion, it has been indicated throughout where consideration of community and stakeholder sentiment has led to an impact significance rating in the SEIA which diverges from that assigned in a corresponding technical study (such as noise, traffic, air quality etc). While all impacts raised by stakeholders, either perceived or actual, are recognised by the SEIA, not all are considered reasonable or valid.

Based on this impact evaluation approach, the positive and negative impacts associated with the Project were evaluated to determine their significance, using the interaction between the likelihood of impacts and severity or relative importance of consequences. The likelihood of social impacts and benefits was assessed with reference to the socio-economic baseline, inputs of stakeholders and other relevant technical findings. Table 21-3 describes the criteria used to assign a level of likelihood of the negative or positive impact occurring.

Table 21-3. Likelihood criteria

Rating	Likelihood level	Description
A	Almost certain	Very likely. The event is expected to occur in most circumstances as there is a history of regular occurrence in similar environments.
B	Likely	There is a strong possibility the event will occur as there are similar incidents occurring in similar situations.
C	Possible	The event could occur, but there is no certainty of the occurrence.
D	Unlikely	The event could occur but is not expected. A rare occurrence.
E	Rare	The event may occur only in exceptional circumstances. Very rare occurrence. Unlikely that it has occurred elsewhere; if it has occurred, it is regarded as unique.

Consequence was assessed based on the severity or importance of the potential effect experienced by the community and specific stakeholders. Consequence criteria are shown in Table 21-4.

Table 21-4. Consequence criteria

Rating	Consequence level	Description	
		Negative impact	Positive impact
1	Minimal	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.	Local small-scale benefits emanating from the project which have a minimal level of community interest and/ or derive minimal relative improvement. Those affected will experience minimal enhancement to livelihoods and quality of life.
2	Minor	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.	Short-term benefits emanating from the project which have a minor level of community interest and/ or derive minor relative improvement. ² Those affected will experience minor enhancement to livelihoods and quality of life.
3	Moderate	Primary and secondary impacts with moderate effects on livelihoods and quality of life. Those affected will be able to adapt to the changes with some difficulty and regain their pre-impact livelihoods and quality of life.	Medium-term benefits emanating from the project which have a moderate level of community interest and/ or derive a moderate level of relative improvement. Those affected will experience moderate enhancement to livelihoods and quality of life.
4	Major	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.	Long-term benefits emanating from the project which have a major level of community interest and/ or derive a major level of relative improvement. Those affected will experience major enhancement to livelihoods and quality of life.

² Short-term duration is assumed to be five years (as per duration of the construction phase). Medium-term is assumed to be a duration between five years and 20 years while long-term is greater than 20 years.

Rating	Consequence level	Description	
		Negative impact	Positive impact
5	Catastrophic (for negative impacts) or Extreme (for positive impacts)	Widespread and diverse primary and secondary impacts with irreparable impacts on livelihoods and quality of life with no possibility to restore livelihoods.	Permanent benefits emanating from the project which have an extreme level of community interest and/ or derive an extreme level of relative improvement. Those affected will experience extreme enhancement to livelihoods and quality of life.

The impact significance was assessed, taking into account the interaction between likelihood and consequence. Table 21-5 presents the impact significance matrix for negative impacts.

Table 21-5. Negative impacts significance matrix

			Consequence level				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Catastrophic
Likelihood	A	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Significance of social negative impact ratings							
	Low		Moderate		High		Extreme

Table 21-6 presents the impact significance matrix for positive impacts.

Table 21-6 Positive impacts significance matrix

			Consequence level				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Extreme
Likelihood	A	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Significance of social positive impact ratings							
	Low		Moderate		High		Extreme

21.3.6 Mitigation and management

The social impact management strategies outlined in the SEIA seek to both enhance Project benefits for the stakeholders and communities and mitigate negative impacts. The SEIA also draws upon the various EIS technical studies for mitigation/management of specific impacts such as noise, air quality, visual amenity, traffic and transport, and others as specified in Section 21.8.

Impacts with a significance rating of medium, high or extreme require mitigation or management actions. Where feasible, the following hierarchy of mitigation measures will be applied to ensure that all residual impacts levels can be reduced to minor or negligible:

- changes in technology choice
- avoidance and reduction of impacts through design (embedded mitigation)
- abate impacts at source or at receptor
- repair, restore or reinstate to address temporary effects
- compensation and offsetting for loss or damage.

Consideration has also been given to the identification of enhancement measures. These measures are actions and processes that:

- create new positive impacts or benefits
- increase the reach or amount of positive impacts or benefits
- distribute positive impacts or benefits more equitably.

Residual impacts are those that remain after the application of mitigation and enhancement measures. Once mitigation and enhancement measures are declared, the next step of the impact process is to assign residual impact significance. The residual impact significance process follows the steps discussed above in Section 21.3.5, considering the assumed effective implementation of the proposed mitigation and enhancement measures.

21.4 SEIA scoping

21.4.1 Overview

The scoping process formed the basis for identifying the material socio-economic impacts to be assessed through the SEIA. The initial stage of SEIA Scoping involved the review of background materials, in particular the *Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW 2017) and the social research completed to inform it. Infrastructure NSW commissioned a variety of social research specifically relating to the floodplain and followed up with additional research regarding flood awareness and evacuation preparedness on the Hawkesbury-Nepean Floodplain in 2018.

In accordance with the SIA Guideline (DPE 2017b), scoping of potential socio-economic changes and issues was facilitated through direct engagement of key stakeholders by way of scoping interviews. This was followed by the completion of the matters checklist as part of the SIA scoping tool, which involved high level, preliminary identification of potential socio-economic changes and issues as a result of Project activities which may affect, or be perceived to affect, stakeholder groups.

21.4.2 Stakeholder engagement

In accordance with the SIA Guideline (DPE 2017b), scoping of the SEIA was informed by direct engagement with key stakeholders. Local government plays an integral role in the management of flood risk at the local level along with shaping planning and development and the delivery of social services. Each of the local councils where change associated with the Project may be experienced participated in SEIA scoping surveys, with the exception of Central Coast Council which declined to participate due to the negligible nature of potential Project related effects in its area. In addition to local government authorities, a number of other key stakeholders were invited to participate in scoping surveys, including: Hawkesbury State Emergency Service (SES), WaterNSW, Turf Australia, National Parks and Wildlife Service, NSW Police, and Cumberland Rural Fire Service (RFS). Feedback provided through the scoping interviews directly informed the completion of SEIA scoping tools.

21.4.3 SEIA study areas

The study areas for the SEIA (referred to in the DPE SIA Guideline as 'Areas of Influence') were defined according to the locations at which either the construction or operational effects of the Project may have an influence upon existing socio-economic conditions. A range of factors informed the definition of SEIA study areas, including the Project components and layout, the nature of the social environment, proximity of sensitive receivers, potential cumulative impacts, associated facilities and other surrounding land uses.

To facilitate effective identification and assessment of socio-economic impacts, the areas of influence were defined as:

- local communities

- upstream communities
- downstream communities
- estuary communities.

The SEIA study areas are depicted in Figure 21-2 and Figure 21-3. The following provides full description of SEIA study areas.

21.4.3.1 Local communities' study area

The local communities' study area is defined as the area within and in close proximity to the Project site that may potentially experience impacts from the Project construction. The Project footprint includes the dam wall, the Project components, temporary construction facilities, the areas in and around the existing Warragamba Dam as well as the local road network.

The Project footprint is geographically located in Warragamba and Silverdale in the Wollondilly Local Government Area (LGA), including the main dam site, ancillary facilities, and transportation routes. It is also located in the Blue Mountains National Park, within which there are no permanent residents. Therefore, the local communities' study area for the purpose of the SEIA is limited to the suburbs of Warragamba and Silverdale and the LGA of Wollondilly.

21.4.3.2 Upstream communities' study area

The upstream communities' study area is defined as the area to be directly influenced in the event of an increase of temporary upstream inundation related to the operation of the Project. The key impacts associated with inundation include the potential loss of natural habitats and cultural heritage of the surrounding riparian areas. Such effects may impinge upon the enjoyment of community values and may be a cause of social distress.

Potential impacts on the upstream area would occur in the Greater Blue Mountains World Heritage Area and the Blue Mountains National Park with an increased temporary inundation area around Lake Burragorang and watercourses which flow into the lake. It is noted that parts of the World Heritage Area and Blue Mountains National Park are geographically located within Wollondilly and Blue Mountains LGAs and bordered by Oberon and Wingecarribee LGAs.

The outcomes of SEIA scoping and stakeholder consultation showed that impacts from upstream inundation would be experienced predominantly in the LGAs of Wollondilly and Blue Mountains. The socio-economic changes likely to be experienced in the LGAs of Oberon and Wingecarribee are minimal. Therefore, the areas of influence associated with upstream inundation and relevant follow-on effects (such as community value, lifestyle and amenity) for this SEIA is confined to the Blue Mountains LGA, as effects occurring within the Wollondilly LGA are addressed under the local communities' study area.

21.4.3.3 Downstream communities' study area

The downstream communities' study area is defined by the area potentially affected by flood waters originating from the Warragamba catchment. The most acute form of impacts associated with flood events is direct inundation and the subsequent need to evacuate residential areas. Accordingly, the downstream communities' study area is defined by the areas affected by a probable maximum flood (PMF). Suburbs which would be affected by a PMF collectively constitute the downstream communities' study area.

Flood events also generate wider socio-economic changes, such as loss of utilities and services, community severance, effects on business and economic activities, and community health and wellbeing. Subsequently, it is necessary to understand the broader social context. LGAs which would directly experience effects associated with a PMF event collectively comprise the broader downstream study area and includes five LGAs – Liverpool, Penrith, Hawkesbury, Blacktown and The Hills. There are 74 suburbs which would be affected by a PMF – as depicted in Figure 21-3. These include four suburbs in the Liverpool LGA, 21 suburbs in the Penrith LGA, 32 suburbs in the Hawkesbury LGA, 10 suburbs in the Blacktown LGA and seven suburbs in The Hills LGA.

The affected LGAs and respective suburbs in the Project downstream communities' study area are as follows:

- Liverpool LGA: Badgerys Creek, Greendale, Luddenham and Wallacia
- Penrith LGA: Agnes Banks, Berkshire Park, Castlereagh, Claremont Meadows, Cranebrook, Emu Heights, Emu Plains, Glenmore Park, Jamisontown, Leonay, Llandilo, Londonderry, Mulgoa, North St Marys, Orchard Hills, Penrith, Regentville, South Penrith, St Marys, Werrington and Werrington County

Figure 21-2. SEIA study areas - local community and upstream LGAs

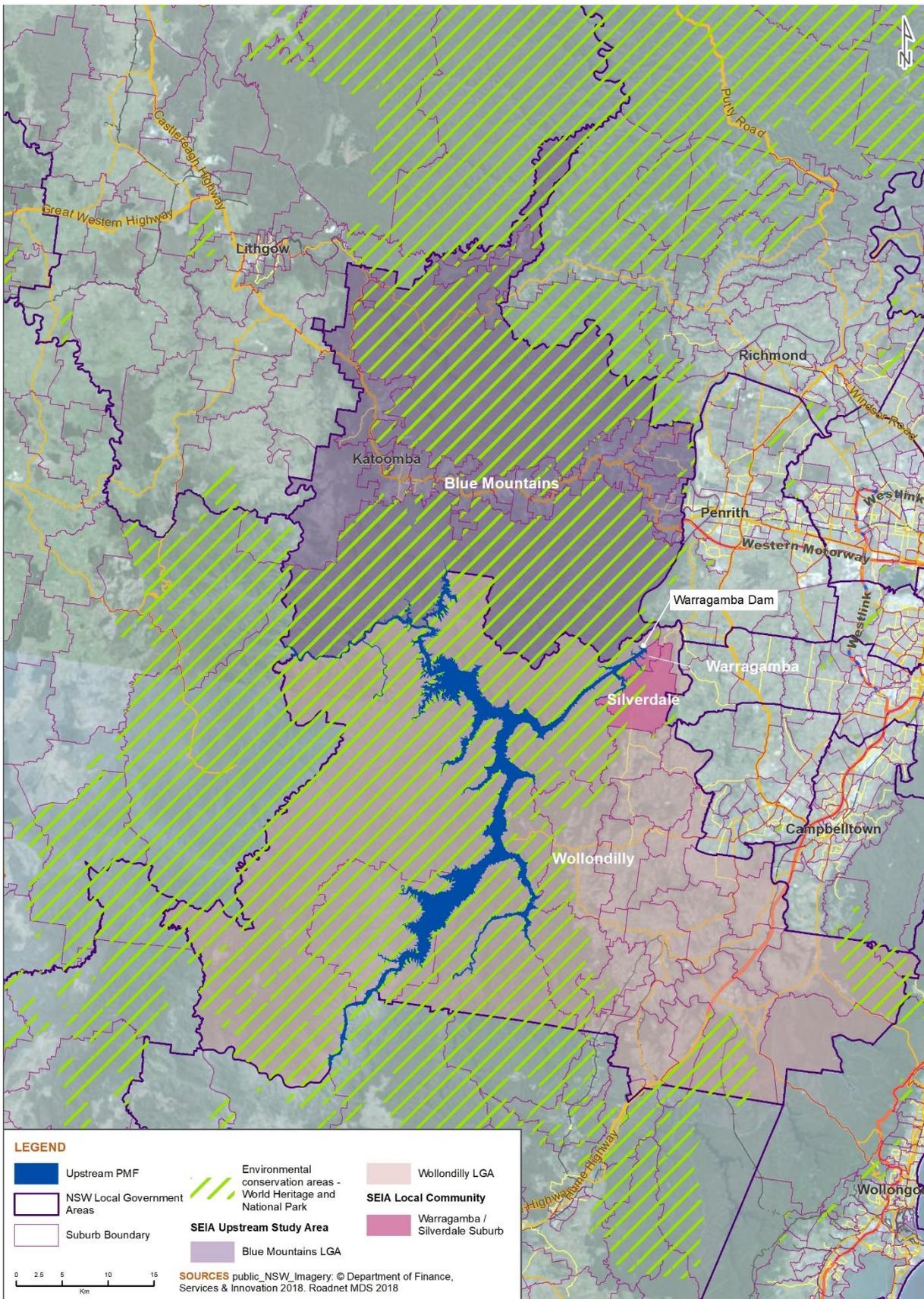
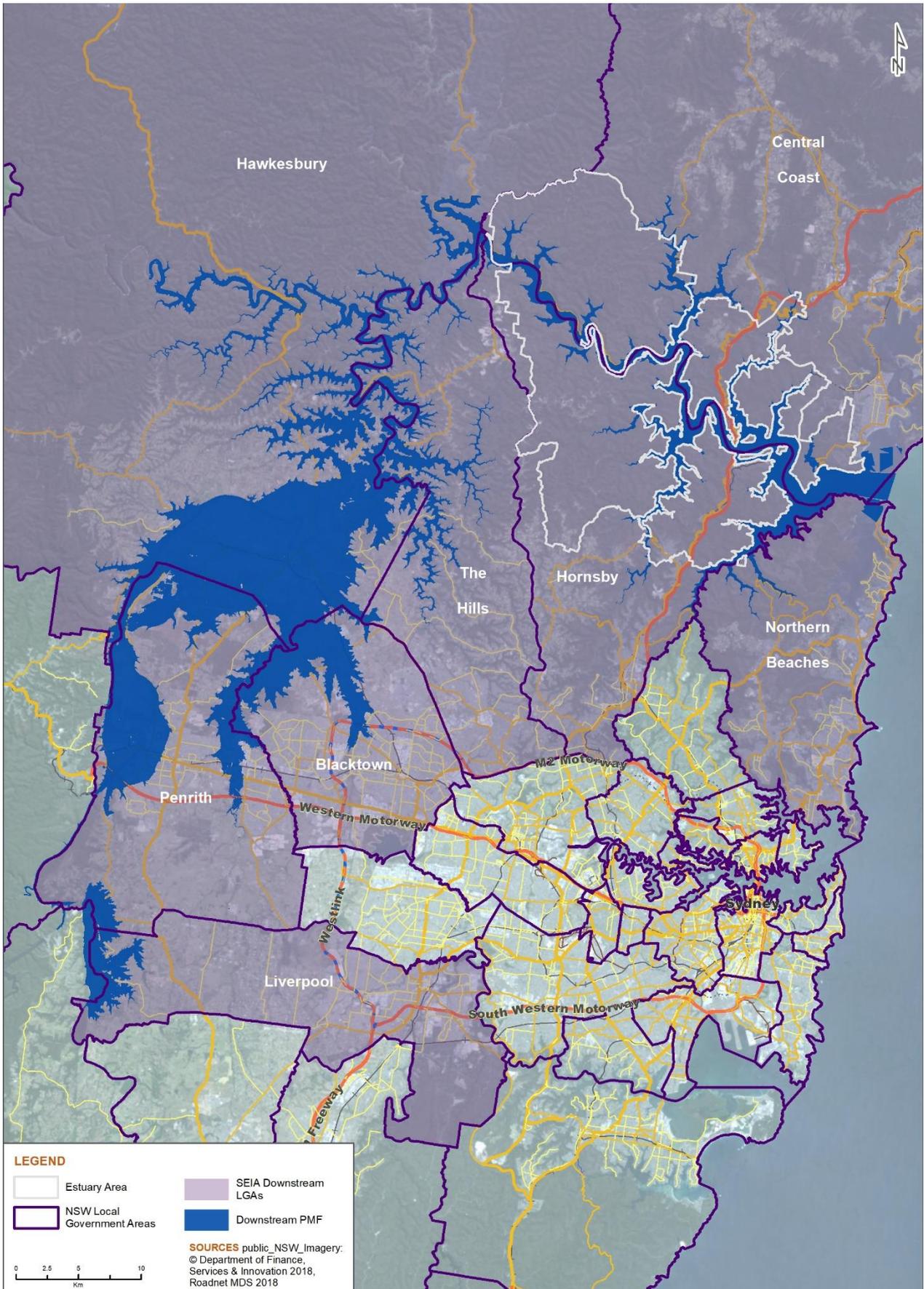


Figure 21-3. SEIA study areas – downstream and estuary LGAs



- Hawkesbury LGA: Blaxlands Ridge, Bligh Park, Central Macdonald, Clarendon, Cornwallis, Cumberland Reach, East Kurrajong, Ebenezer, Freemans Reach, Glossodia, Grose Wold, Hobartville, Lower Macdonald, Lower Portland, Maraylya, McGraths Hill, Mulgrave, North Richmond, Oakville, Pitt Town, Pitt Town Bottoms, Richmond, Richmond Lowlands, Sackville, Scheyville, South Windsor, Vineyard, Webbs Creek, Wilberforce, Windsor, Windsor Downs and Yarramundi
- Blacktown LGA: Colebee, Dean Park, Doonside, Glendenning, Marsden Park, Quakers Hill, Riverstone, Ropes Crossing, Schofields and Shanes Park
- The Hills LGA: Cattai, Glenorie, Leets Vale, Maroota, Sackville North, South Maroota and Wisemans Ferry.

21.4.3.4 Estuary communities' study area

The estuary communities' study area constitutes the estuarine area of the Lower Hawkesbury River, defined as downstream of Wisemans Ferry. Estuary communities were identified as being potentially impacted by altered dam operation and subsequent flood patterns, such as less frequent major flooding and/ or a longer duration of flooding in some circumstances. The three relevant LGAs in the estuary area are Hornsby, Central Coast and Northern Beaches within which 26 suburbs were identified and collectively constitute the estuary communities' study area. These include 11 suburbs in the Hornsby LGA, 14 suburbs in the Central Coast LGA and one suburb in the Northern Beaches LGA. The affected LGAs and respective suburbs in the Project estuary communities' study area are as follows:

- Hornsby LGA: Berowra Creek, Berowra Heights, Berowra Water, Brooklyn, Canoelands, Cowan, Dangar Island, Fiddletown, Laughtondale, Milsons Passage and Singleton Mill
- Central Coast LGA: Bar Point, Cheero Point, Cogra Bay, Gunderman, Little Wobby, Lower Mangrove, Marlow, Mooney, Mooney Creek, Mount White, Patonga Beach, Spencer, Wendoree Park and Wondabyne
- Northern Beaches LGA: Cottage Point.

21.4.4 Matters checklist

The SIA Guideline (DPE 2017b) provides a process for the preliminary identification and assessment of potential socio-economic changes and issues. Central to this process is the matters checklist as part of the SIA scoping tool which outlines key socio-economic considerations. This process was adopted by the SEIA and Table 21-7 lists the matters identified as being relevant to an assessment of socio-economic impacts and benefits for the SEIA study areas. As described in Section 21.3.2, the matters checklist was informed by scoping meetings with key stakeholders. This checklist therefore identifies socio-economic changes and issues of concern raised by stakeholders to inform the basis of further assessment for the SEIA. Perceptions raised by stakeholders in this section are opinions only and not necessarily actual effects associated with the Project.

Table 21-7. SEIA matters checklist – SEIA study areas

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream/estuary areas
Amenity	Acoustic	Construction activities would result in the generation of noise.	✓		
	Visual	Landscape characters and visual characteristics of key viewpoints in study areas would be impacted.	✓	✓	
	Odour	There may be some localised odour effects following the release of inflows.	✓		
	Micro-climate	There may be some minor effects on micro-climate localised to the areas surrounding Lake Burragorang due to alteration of the inundation area.		✓	
Access	Access to property	There may be some temporary property access changes for properties located in proximity to the project site.	✓		
		There would be reduced extent and reduced frequency of flood events affecting property. As a result, access to property and to social infrastructure would be improved. If affected by a major flood, the duration of inhibited access to some property low in the floodplain may be more prolonged.			✓
	Utilities	The risk of flood effects on utilities would be reduced as a result of reduced flood extent and frequency. If affected by a major flood, the duration of a utility being off line may be more prolonged in some instances.			✓
	Road and rail network	Project-related traffic may result in altered conditions on local roads.	✓		
		The risk of flood effects on road and rail infrastructure would be reduced as a result of reduced flood extent and frequency. If affected by a major flood, the duration of some roads low in the floodplain being cut off may be more prolonged.			✓
Offsite parking	Offsite parking could be impacted due to a large workforce.	✓			
Built Environment	Public domain	The presence of a large construction workforce in the local area may result more people utilising public spaces.	✓		
		The risk of the public domain being inundated in areas such as Wallacia, Penrith CBD, Wisemans Ferry and other public spaces would be reduced as a result of reduced flood extent and frequency.			✓
	Public infrastructure	The presence of a large construction workforce in the local area may result in more people utilising public infrastructure.	✓		
		The frequency of some recreational infrastructure being inundated would be reduced as a result of reduced flood extent and frequency.			✓
	Other built assets	The Visitor Centre and Haviland Park are likely to be closed for the duration of construction.	✓		
Built assets would be positively affected due to the reduced extent and frequency of flood events.				✓	
Heritage	Natural	The amenity of the natural environment surrounding the dam site may be affected by construction activities.	✓		
		As a result of temporary inundation, a change to flood related impacts on lands that have World, National, State and local natural heritage value.		✓	
		There may be some effects on the natural environment due to alterations to the flood regime.			✓

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream/estuary areas
	Cultural	The Project may have a positive influence by re-invigorating celebration of the cultural history of the community.	✓		
		As there are strong environmental cultural underpinnings in community, loss of natural heritage is perceived as a cultural loss.		✓	
	Aboriginal cultural	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.	✓		
		The Project would result in some upstream areas experiencing a greater extent and duration of temporary water inundation when the flood mitigation zone (FMZ) is operational, which would affect some items and landscapes of Aboriginal cultural heritage.		✓	
	Built	The Dam is central to the built heritage of Warragamba. This would be physically altered due to the Project.	✓		
		The risk of flood effects on built heritage would be reduced as a result of reduced flood extent and frequency.			✓
Community	Health	There would be a reduction in risk to life and to negative health impacts as a result of reduced flood extent and frequency.			✓
		Prolonged exposure to elevated levels of dust, noise and vibration may have a negative localised effect on health and wellbeing.	✓		
		There may be some health effects (including on mental health) associated with more prolonged periods of isolation due to prolonged duration of some flood events. However, the Project would improve access to health infrastructure by reducing flood extent and frequency.			✓
		The Project would have a positive influence on the incidence of mental disorders due to reduced experience of severe flooding events.			✓
	Housing	There may be higher demand for short-term housing throughout construction which may result in decreased availability.	✓		
		Housing would be positively affected due to reduced extent and frequency of flood events. The Project would enhance confidence in housing investment by reducing the risk posed by flood events.			✓
	Safety	Project-related traffic movements have the potential to reduce public safety in the local area.	✓		
		The Project would have a positive effect on safety by reducing the extent and frequency of flood events which pose a safety risk to people and prolonging the time which evacuation routes are operable.			✓
	Services and facilities	The presence of a large construction workforce in the local area would result more people utilising community services and facilities.	✓		
		By reducing the extent and frequency of flood events, the Project would reduce the risk of services and facilities being inundated in a flood event and enhance access to such services and facilities by keeping transport routes open for longer.			✓
		The presence of a large construction workforce may have a negative effect on the cohesion of the Warragamba community.	✓		

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream/estuary areas
	Cohesion, capital and resilience	There may be some diminished community capital through the polarisation of community sentiment regarding the Project. The Project may also foster community capital as the community unifies against a common cause.		✓	
Economic	Natural resource use	There is likely to be some restricted access to natural areas surrounding the Project throughout construction.	✓		
		There may be some diminished ability to earn income through the access and enjoyment of the environment.		✓	
		Commercial activities which rely upon river use and access would benefit from the reduction in the frequency of flood events. In some larger flood events, some natural areas may be inaccessible for a longer period following the event due to increased duration of heightened flows.			✓
	Livelihood	People visiting Warragamba to experience the Dam provide a key source of economic activity. The livelihoods of those who are reliant upon such visitors may be affected throughout the construction period.	✓		
		There may be some reduced ability to earn livelihoods generated through nature-based tourism.		✓	
		The presence of the construction workforce will provide commercial opportunities for local businesses such as those concerned with retail, food and beverage and accommodation.	✓		
		By reducing the extent and frequency of flood events which have the capacity to result in commercial loss, the Project would have a positive effect on livelihoods. For some commercial activities such as dairy farming; there may be economic losses incurred due to prolonged periods of inundation for some flood events.			✓
	Opportunity cost	The opportunity cost in Warragamba is the potential for temporary loss of livelihoods generated by tourism balanced by the presence of a large construction workforce potentially injecting wealth into the local economy.	✓		
		Potential loss of some wilderness areas which are a generator of economic wealth via tourism.		✓	
		The opportunity cost is substantially reduced risk of socio-economic harm due to the reduction in the extent and frequency of floods; against the cost of some larger flood events resulting in a longer duration of flood events.			✓
Air	Particulate matter	There may be some dust generation associated with construction activities.	✓		
	Atmospheric emissions	Truck and traffic movements generated by the Project have the potential to reduce local air quality.	✓		
Water	Hydrological flows	Potential community concern associated with alteration of existing riverine flow regime.		✓	✓

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream/estuary areas
	Water quality	Through enhanced ability to control the release of flood waters, there is the potential to positively influence water quality. If retained water was also used to improve environmental flows, there would be a further positive effect on water quality. In some (larger) flood events there may be prolonged periods of heightened water flows which will result in a longer duration of altered water quality following a flood event.			✓
		In some (larger) flood events, there may be prolonged periods of heightened water flows, which would result in a longer duration of altered water quality following a flood event.			✓
Biodiversity	Native vegetation	Disturbance to native vegetation not considered to be significant.	✓		
		Community concern and opposition to the loss of valued native vegetation (for example, Camden white gum).		✓	
		There may some effects to the native vegetation due to alterations to the flood regime, though they are not likely to be significant.			✓
	Native Fauna	Disturbance to native fauna not considered to be significant.	✓		
		Community concern as to potential negative effects on native fauna (including pest management).		✓	
		Native fauna may be affected due to alterations to the flood regime - this may include effects on fish species which are targeted by recreational anglers – a popular recreational activity on the Nepean River in Penrith and South Creek in Blacktown, as well as the Hawkesbury River.			✓
Land	Capability	Community concern relating to the land use changes associated with a larger dam footprint and an increased temporary inundation area.		✓	
	Topography	Community concern relating to the land use changes associated with a larger dam footprint.		✓	
	Stability and/or structure	There may be some erosion effects associated with longer duration of heightened flows following some (large) flood events. There is currently insufficient information on potential river bank erosion and the effect this could have on riverside infrastructure such as the Penrith River Walk and International Regatta Centre.			✓
Risks	Flood waters	Some tracks used for bushwalking may be affected by temporary flooding upstream due to the Project.		✓	
		The Project will reduce the extent and frequency of floods, which would improve the ability to evacuate residents threatened by flood risks.			✓

21.5 Socio-economic baseline

21.5.1 Overview

This section provides an overview of key baseline socio-economic conditions in each of the SEIA study areas:

- local communities' study area: the suburbs of Warragamba and Silverdale in the Wollondilly LGA
- upstream communities' study area: the Blue Mountains LGA
- downstream communities' study area: a total of 74 suburbs across five LGAs
- estuary communities' study area: a total of 26 suburbs across three LGAs.

The data and analysis presented in this section is based on the information derived from both secondary research and primary data collection. This baseline assessment adopted a range of approaches to ensure compilation of a robust and accurate socio-economic baseline profile. The approach included:

- desktop review or secondary research regarding the SEIA study areas from available and reliable published documentation as well as the results of Project-related surveys
- stakeholder engagement and consultation with different stakeholder groups to enrich the desktop information on socio-economic conditions and to confirm any unclear information found during the secondary research
- field observation through visual inspections, taking photos and navigation coordinates to triangulate information from different sources, such as published documentation and interviews.

The findings summarised in this section will be used as a baseline to assess the potential impacts of the Project on the socio-economic characteristics. Further details of the baseline study can be found in Appendix M to this EIS.

21.5.2 Local communities' study area

21.5.2.1 Land use and planning

The total area of the construction zone is approximately 105 hectares. Land use within this area and immediately surrounding the Project footprint is dictated by a designated infrastructure zoning. Other land use categories in proximity to the construction site were residential, recreational and environmental conservation. Land use profiles in and surrounding the towns of Warragamba and Silverdale indicate the predominance of environmental and agricultural uses. This strongly influences the visual character which primarily consists of natural forest, woodland, rivers, hills and rural landscape.

Land use planning for the suburbs of Warragamba and Silverdale is dictated by sub-plans within the 2016 Wollondilly Development Control Plan (Wollondilly Shire Council 2015). Substantial population growth is predicted in Wollondilly Shire over the next 30 years (Wollondilly Shire Council 2015). A key development is the Wilton Junction Master Plan which proposes to deliver 12,000 lots along with commercial and industrial development.

21.5.2.2 Demographic characteristics

According to the 2016 ABS Census, the Wollondilly LGA had a total resident population of 48,519 people. Population density in the Wollondilly LGA in 2016 was 20 persons per square kilometre, which is higher than the NSW average of nine persons per square kilometre. Warragamba had a total population of 1,241 people and recorded a density of 241 persons per square kilometre while Silverdale's population was 3,682 people with the density of 76 persons per square kilometre. Although the population density of Warragamba is considerably higher than that of Silverdale, the population density of these two towns was significantly lower than the Greater Sydney area with 390 persons per square kilometre. Between 2011 and 2016, the Wollondilly LGA experienced population growth of 12.2 percent. In line with this trend, the population of Silverdale grew by 7.1 percent while that of Warragamba slightly increased by 0.4 percent.

Persons who identify as being of Aboriginal and/or Torres Strait Islander heritage accounted for 3.2 percent of the population of the Wollondilly LGA. The proportion of the Indigenous Australian population in the LGA was more than double that of Greater Sydney (1.5 percent of the population). The percentage of Indigenous people in Warragamba (5.8 percent) was considerably higher than Wollondilly LGA and of Greater Sydney, while Silverdale recorded a lower percentage of Indigenous Australians than the wider LGA, at 2.7 percent. Between 2011 and 2016, the proportion of Indigenous Australians has significantly increased (by 49.8 percent) in Wollondilly LGA. In line with this trend, the Indigenous Australian population of Warragamba experienced growth of 84.6 percent while in Silverdale, the population increased by 33.8 percent.

Wollondilly Shire had a similar proportion of pre-schoolers and a similar proportion of persons at post retirement age to that of Greater Sydney. The median age of people in Wollondilly Shire was 37 years old while in Warragamba and Silverdale, the median age was 36 years old.

21.5.2.3 Employment and industry

According to the 2016 ABS census, the labour force participation rate in the Wollondilly LGA was 60.9 percent, which was slightly lower than that of Greater Sydney at 61.6 percent. The labour force participation rate in Warragamba and Silverdale was 63.8 percent and 71.5 percent respectively. In 2016, the unemployment rate in Wollondilly LGA (4.1 percent) was lower than in Greater Sydney (6.3 percent). Warragamba has a higher rate of unemployment (5.0 percent) than Silverdale (4.0 percent). Between 2006 and 2016, the unemployment rate differed slightly across Warragamba and Silverdale, while Wollondilly LGA's unemployment rate has remained relatively consistent over the same time period.

In Wollondilly LGA, construction was the largest industry of employment. The three most significant industry sectors were: construction (14.8 percent), health care and social assistance (9.9 percent) and retail trade (9.4 percent). These were also the key industries of employment in Warragamba. In Silverdale, the primary industries of employment were construction, education and training, and retail trade.

The occupation profile in the local communities' study area in 2016 indicated a capacity to provide labour and skills to the construction industry with the primary occupation being technicians and trade workers. The proportion of people with vocational and trade qualifications was high in the Wollondilly LGA. In Warragamba, other key occupations were machinery operators, drivers and labourers.

A majority of businesses in the local communities' study area was involved with the construction industry. In 2017, there were 1,294 registered construction businesses in the Wollondilly LGA, potentially providing a source of labour, services and equipment for the Project's construction phase.

21.5.2.4 Income and disadvantage

In 2016, the median household income recorded for the Wollondilly LGA in 2016 was \$1,871 per week, which was higher than that of Greater Sydney (\$1,750 per week). Warragamba (\$1,326 per week) had lower median weekly household income than that of the Wollondilly LGA, while median weekly household income in Silverdale (\$2,220 per week) was substantially higher.

The ABS 'Socio-economic index for areas' (SEIFA) Advantage/ Disadvantage score shows that in 2016 the Wollondilly LGA recorded a decile rating of eight with an overall score of 1,033. This indicates that across a broad range of indicators, the population displays relatively high levels of advantage, and relatively low levels of disadvantage. Warragamba differs substantially in that it recorded a decile score of two and an overall score of 911, which indicates that the population displays relatively high levels of disadvantage and low levels of advantage. The SEIFA score for Silverdale aligned with that of the Wollondilly LGA with a decile score of eight and an overall score of 1,056.

21.5.2.5 Housing and accommodation

The majority of occupied private dwellings within the Wollondilly LGA, Warragamba, and Silverdale were separate houses. In 2017, the median weekly rental cost of houses (\$453) and of units (\$330) in the Wollondilly LGA was lower than that of Greater Sydney (\$530/week for median house rental and \$520/week for median unit rental). The median weekly rental has continuously increased since 2011 in Wollondilly. In February 2019, the median weekly rental cost of houses in Warragamba was \$385/week while in Silverdale, it was \$510/week. A review of online property listings as of 27 November 2018 found a low number of rental listings in Warragamba and Silverdale. This is typical of rural localities with a limited stock of dwellings. In February 2019, there were 11 residential properties listed for rent in Silverdale and five properties listed in Warragamba. There is no short-term accommodation (such as motels and hotels) in either Warragamba or Silverdale. The closest short-term accommodation options to the Project site was a single hotel in Wallacia, followed by ten motels and hotels located in Penrith area.

21.5.2.6 Community values

Community identity is strongly linked to sense of place. A review of local planning documentation such as the Local Environmental Plan (LEP), Development Control Plan (DCP) and other publicly available information indicated that residents of Warragamba and Silverdale value a close connection with the surrounding natural and rural landscape. Within the area, there are cultural sites and recreational areas including Warragamba Dam, Warragamba River, Eugenie Byrne Park and Haviland Park.

The community's close proximity to the Blue Mountains World Heritage Area and numerous national parks provides ready access to natural landscapes which are valued by residents and visitors. Residents in the Wollondilly LGA value the rural and community lifestyle as well as the town and village atmosphere. In the Wollondilly LGA and in the townships of Warragamba and Silverdale, there is evidence of strong local networks, community connections and support networks which engender a high degree of community cohesion.

21.5.2.7 Infrastructure, facilities and services

Throughout the Wollondilly LGA, the only form of transportation is road-based, with limited public transport options. Around Warragamba, there is a network of roads and parking areas which service the Dam and associated operations, and also provide access to recreational areas. Key regional road connections include the M4 Motorway, The Northern Road and the Hume Motorway.

Education and child care facilities in Warragamba and Silverdale are limited to the primary school, Warragamba Public School, and Silverdale Childcare Centre. Warragamba Public School is located in the town centre on the corner of Fourth Street and Farnsworth Avenue, approximately 2.1 kilometres from the Project site. Silverdale Childcare Centre is located within the main residential area of the suburb and approximately 5 kilometres from the Project site.

There are a range of community and civic services available in Warragamba and Silverdale. These include churches, a neighbourhood centre, a sportsground, a swimming pool and recreation reserves. In total, there were eight community and civic services identified: seven services in Warragamba and one in Silverdale. Emergency services in Warragamba and Silverdale are limited to a police station and a fire station. The closest ambulance station is located in Penrith. There are a wide range of open space and recreational areas in Warragamba and the surrounding area.

21.5.2.8 Community health and safety

Community health

According to the 'NSW Health Wollondilly Health Needs Assessment' (Wollondilly Health Alliance 2014), residents in the LGA are more likely to rate their health as excellent, very good or good when compared to the rest of NSW. In comparison to the whole of NSW, residents of Wollondilly demonstrated higher incidences of health-related issues including:

- higher rates of overweight and obesity and higher rates of hospitalisation and deaths attributable to high body mass index
- lower levels of adequate physical activity and fruit consumption
- higher levels of alcohol consumption
- higher rates of smoking, especially during pregnancy, and deaths attributable to smoking
- higher rates of lung cancer.

Health services available in the Wollondilly LGA include general practice (GP), community health centres, pharmacies, practice nurse and allied health services. Health services are scattered across the LGA, with a particular focus in the main population centres of Picton and Tahmoor. There are no public or private hospitals in the Wollondilly LGA.

Residents of Wollondilly use facilities in adjoining local government areas, such as the Bowral District Hospital, Camden Hospital and Campbelltown Hospital. Healthcare services in Warragamba and Silverdale include the Warragamba Medical Centre and Silverdale Medical Centre. Access to GP services was reported as being constrained, with residents commonly accessing services in other local government areas, such as Penrith Community Health Centre, Narellan Community Health Centre or Hoxton Park Community Health Centre.

Community safety and security

The numbers of offences associated with malicious damage to property were highest in both Wollondilly and Warragamba-Silverdale³. This was followed by the number of crimes relating to intimidation, stalking and harassment. Crimes such as robbery, theft, or drug and liquor offences were relatively low in Wollondilly LGA, Warragamba and Silverdale. Overall, rates of crime in Warragamba-Silverdale were lower than rates for Wollondilly LGA, Greater Sydney or NSW.

³ Warragamba and Silverdale have the same post code – 2752. Therefore, crime data recorded for these two towns are merged.

Based on the Traffic and Transport Assessment (refer to Chapter 24 of EIS), traffic volumes are relatively low in comparison to the capacity of intersections, resulting in relatively performance and minimal high levels of delays. It is anticipated that majority of future northbound and southbound through traffic at Park Road and Northern Road intersection would use the new link between the Elizabeth Drive and existing The Northern Road intersection and the new The Northern Road and existing The Northern Road intersection to reach their destination. It is noted that a major upgrade of The Northern Road is planned to facilitate the development and access to the new Western Sydney Airport.

In 2016, there were 132 reported road accidents in this LGA, 69 percent of which were fatal. This proportion was lower than the Outer Sydney area average (76 percent) and the NSW average (79 percent). This suggests there is a lower risk of road accident fatalities in Wollondilly Shire than elsewhere in the Outer Sydney area.

21.5.3 Upstream communities' study area

21.5.3.1 Land use

The land use profile is dominated by environmental conservation land. According to the 2016 ABS Census, land for environmental conservation accounts for 91 percent of land use in the Blue Mountains LGA. Agricultural land made up six percent of the total land available in the LGA. Small proportions of other land use categories in the upstream communities included infrastructure, residential, recreational, commercial uses and waterways. The visual environment of the Blue Mountains LGA is characterised by mountains and valleys, covered by natural forest and woodlands, interspersed by areas supporting agricultural activities, along with small towns and villages.

21.5.3.2 Demographic profile

In 2016, the total population of the Blue Mountains LGA was 76,904 people. The population density of this LGA was 55 persons per square kilometre, which is attributed to the large amount of national park area. The population density in this LGA was much lower than that of Greater Sydney, at 390 persons per square kilometre. Between 2011 and 2016, the LGA experienced population growth of 1.3 percent, which was a slightly lower rate of population growth than Greater Sydney overall (1.5 percent).

The median age for the Blue Mountains LGA was 44 years old, which was higher than the median age for Greater Sydney (36 years old). The Indigenous Australian population in the Blue Mountains LGA was 1,823 people, which accounted for 2.4 percent of the total population. The proportion of indigenous population in this LGA was substantially higher than that of Greater Sydney (1.5 percent of the population).

21.5.3.3 Economic and employment profile

In 2016, the labour force participation rate in the Blue Mountains LGA was 59.9 percent, which was slightly lower than that of Greater Sydney (61.6 percent). The unemployment rate in the Blue Mountains LGA (4.7 percent) was lower than that of Greater Sydney (6.0 percent). The median household income in the Blue Mountains LGA was \$1,468 per week, which was lower than Greater Sydney (\$1,750 per week). The LGA had a decile rating of nine and a SEIFA score of 1,045 in the SEIFA advantage/disadvantage index. This rank indicates a population which has a relatively-high level of advantage and relatively-low levels of disadvantage. Tourism is an important industry in the Blue Mountains, which is reflected in the occupation of employment with seven percent of the workforce employed in accommodation and food services related jobs.

21.5.3.4 Housing profile

Housing in the Blue Mountains LGA is concentrated in townships and small villages accompanied by peri-urban and 'wilderness' style low-density housing. The LGA contains a total of 32,827 private dwellings, 88 percent of which were occupied, reflecting the prevalence of homes occupied occasionally during holiday periods and weekends. There were 397 State Housing Authority and 197 Community or Church-owned rentals in the Blue Mountains LGA, with social housing accounting for 2.1 percent of total dwellings. In this LGA, there were 170 recorded homeless people in 2017, which formed 0.2 percent of the total population.

21.5.3.5 Regional open space and recreational areas

The Blue Mountains National Park covers an area of 247,000 hectares, constituting 25 percent of the Greater Blue Mountains World Heritage Area (GBMWhA). The GBMWhA is listed on the World Heritage List due to its outstanding natural values representing important stages of the Earth's ongoing biological processes and biological diversity. The

value of the Blue Mountains National Park is significant due to both the natural and cultural features and its geographical setting⁴.

There are many sites and landscapes of Aboriginal significance throughout the Blue Mountains National Park.

Based on an online Google search, as of January 2019, there were 46 recorded recreational areas around Lake Burragorang and in the surrounding national parks. These recreational features include mountain bike trails, walking tracks, look-out points and campgrounds, and access to these areas may be affected by inundation. For instance, key regional open space and recreational areas in the affected upstream area include: McMahons Point, Burragorang-McMahons walking track, W5D Dallawang Ridge Trail, Birrell Lake Bush Camping Area, Fletcher's Lookout, and Dunphys Campground (refer to Appendix M to the EIS for further details).

Community values

The Blue Mountains community has well-defined values and is proud to live in the scenic area (Blue Mountains City Council 2017). Communities within the LGA are close-knit with distinct character and identity. The GBMWha and the National Parks, which cover 70 percent of the Blue Mountains LGA, are highly valued by the community for the environmental, cultural and recreational services they provide. The community values of the Blue Mountains LGA were most recently captured in the 2035 Community Strategic Plan, which was formed by Council and residents in 2017 (Blue Mountains City Council 2017). Environmental sustainability is a high priority for many community members. The community strives to minimise the urban footprint on the natural environment and to be a model for sustainable living. The environmental values of the community are further reinforced by the economic importance of the tourism industry, which is reliant upon access to and enjoyment of a pristine natural environment. The Blue Mountains LGA is also rich in cultural and built heritage. There are many sites throughout the Blue Mountains which have both cultural and historical significance to Aboriginal people. Residents are respectful of Aboriginal people as well as their values and knowledge.

21.5.4 Downstream communities' study area

21.5.4.1 Land use and planning

The total downstream land area predicted to be affected by a PMF is 438.4 square kilometres. Agricultural land accounts for the largest proportion of affected lands, followed by environmental conservation land. Significant development has occurred and is planned for in Western Sydney, including areas on the Hawkesbury-Nepean floodplain. Key growth areas in the Western Sydney region include the Western Sydney Aerotropolis and the North West Priority Area. The Western Sydney Infrastructure Plan (WSIP) commits an investment of \$3.6 billion to upgrading road infrastructure throughout the Western Sydney area (Australian Government & NSW Government 2017). The Northern Road upgrade is a key part of the WSIP and would be completed in six stages.

21.5.4.2 Demography and community values

According to the 2016 ABS Census, there were an estimated 260,511 residents in the identified 74 PMF-affected suburbs in the downstream communities' study area, noting that the entirety of suburbs would not necessarily be affected. The 21 affected suburbs in the Penrith LGA had the highest number of residents (124,409 people). This was followed by 10 affected suburbs in the Blacktown LGA (70,636 residents) and 32 affected suburbs in the Hawkesbury LGA (53,310 residents). The average population density across all 74 affected suburbs was 193 persons per square kilometre, which was significantly lower than the Greater Sydney average of 390 persons per square kilometre. The population distribution of the 10 affected suburbs in the Blacktown LGA had the highest population density (average of 719 persons per square kilometre). This was followed by the 21 affected suburbs within the Penrith LGA with 400 persons per square kilometre. The seven affected suburbs in the Hills LGA had the lowest population density, accounting for 26 persons per square kilometre.

There was a total of 9,499 Aboriginal and/or Torres Strait Islander persons recorded as living in the downstream communities' study area, which accounted for 3.7 percent of the total population. Over half of these residents (5,124 people) lived in the Penrith LGA. Between 2011 and 2016, population change in the suburbs comprising downstream communities' study area was variable. Overall, the total population of the 74 PMF-affected suburbs had increased by 9.1 percent between 2011 and 2016. This population growth rate of the downstream communities' study area was substantially higher than Greater Sydney overall (1.5 percent).

⁴ <http://www.environment.gov.au/heritage/places/world/blue-mountains>

There are a diverse range of communities in the downstream communities' study area, ranging from densely-populated and highly-urbanised to semi-rural and natural areas. These communities demonstrate a strong attachment to the area and are proud of their cultural diversity and values. A diversity of cultural backgrounds is a key characteristic of communities in the downstream communities' study area. Suburbs in the Blacktown LGA were the most culturally diverse. In terms of community cohesion, the downstream communities' study area is a diverse and fragmented population which contains pockets of tight-knit communities and groups.

21.5.4.3 Economic and employment profile

In 2016, the total size of the labour force was 133,293 people, which accounted for a labour force participation rate of 65.1 percent. The Hills LGA recorded the highest labour force participation rate at 68 percent, while Liverpool LGA recorded the lowest labour force participation rate at 57.4 percent. The unemployment rate across the downstream communities' study area was 4.5 percent, which was lower than the of Greater Sydney (6 percent). The suburbs with the highest unemployment rate were in Penrith LGA, with a collective unemployment rate of 5.2 percent. The construction industry accounted for the highest proportion of occupations.

The downstream communities' study area collectively recorded a SEIFA advantage/disadvantage decile rating of seven, indicating that a relatively high proportion of the population are experiencing levels of advantage. Suburbs with the lowest SEIFA Scores were in the LGAs of The Hills, Hawkesbury and Blacktown.

21.5.4.4 Housing profile

In 2016, there were a total of 88,822 private dwellings across the 74 PMF-affected suburbs comprising the downstream communities' study area, 92.4 percent of which were occupied. There was a total of 1,918 persons in the Penrith LGA who were recorded as being homeless which compared to 1,410 persons in the Blacktown LGA and 705 in the Hawkesbury LGA. There were no recorded homeless persons in the LGAs of The Hills and Liverpool.

Development in Western Sydney is resulting in more peri-urban areas becoming urbanised. The Western Sydney region has become an increasingly popular option for many families to access more affordable housing options which have accessibility to employment hubs such as Parramatta and the Sydney Central Business District (CBD). Sydney is predicted to be facing a housing shortage of 190,000 homes by 2024⁵. Areas within and adjacent to the downstream communities' study area are key locations for planned residential growth.

21.5.4.5 Regional open space and recreational areas

Throughout the Hawkesbury-Nepean Valley, there are a wide range of open space and recreational areas. There were 137 open space and recreation areas recorded across the downstream communities' study area including Bents Basin State Recreation Area, Mountain View Reserve Lookout, Cable Water Ski Park, Dharug National Park, Cattai National Park, Marramarra National Park, and Maroota Ridge State Conservation Area. There are also large areas of land supporting agricultural uses which contributes to the character of the area.

21.5.4.6 Infrastructure, facilities and services

There is a broad array of community infrastructure and services across the downstream communities' study area. This includes public hospitals in Penrith, Windsor and North Richmond, 25 fire stations (including Rural Fire Service), six police stations, two State Emergency Service Stations, and eight justice facilities. Provision of infrastructure and services varies substantially across the downstream communities' study area, ranging from high levels of service provision in community hubs such as Penrith to low levels in rural and peri-urban areas.

Community services across the downstream communities' study area have previously been fragmented but are moving toward greater coordination and collaboration. Western Sydney region has been experiencing significant population and economic growth. Through the Western Sydney Infrastructure Plan, the Australian and NSW Governments are investing \$3.6 billion over 10 years in major road and transport infrastructure upgrades (Australian Government & NSW Government 2017).

21.5.4.7 Evacuation routes

Evacuation routes within the Hawkesbury-Nepean Valley are designated in the updated 2020 Hawkesbury-Nepean Flood Emergency Plan 2020 (NSW State Emergency Service (SES)). The most effective means of evacuation from the

⁵ <https://www.dailytelegraph.com.au/news/nsw/sydney-housing-crisis-on-the-horizon-190000-homes-needed-over-the-next-decade/news-story/d1f1ea6431c54e5b71feaca170948890>

Valley is via road, using private vehicles and public uses, such as buses. The road evacuation routes are categorised into sector evacuation routes and regional evacuation routes. Planning and managing evacuation is shared across a variety of agencies including local government, the State Emergency Service, Police and Roads and Maritime Services.

Across the Hawkesbury-Nepean floodplain, there are 13 defined regional evacuation routes, each with differing traffic capacities and points at which they become cut in particular flood events (NSW SES 2015). The shape of the Hawkesbury-Nepean Valley has an important influence on how floodwaters inundate the landscape and affect the capacity of residents to evacuate. In the Hawkesbury-Nepean floodplain, many evacuation roads have low points that are inundated and are cut off by floodwaters before higher populated areas are flooded. This causes several inaccessible flood islands which can be completely flooded as floodwater increase (refer Figure 21-4). For example, suburbs such as Richmond, Windsor, South Windsor, Pitt Town and McGraths Hill could all become inundated flood islands during large flooding events.

Figure 21-4 Flood islands forming during the 1961 flood event in the Hawkesbury-Nepean floodplain



Source: Infrastructure NSW (Image: NSW SES)

21.5.4.8 Perceptions of flood risks

Research completed by INSW in 2014 and 2018 found that communities across the Hawkesbury-Nepean floodplain have low awareness of flood risks and recommended response measures. A key factor as to why there are low levels of flood awareness is that relatively few members of the community have experienced severe flood events since there had not been a major event in recent history. It is generally perceived that the largest flood event in living memory across the Hawkesbury-Nepean floodplain was the 1961 flood (refer Figure 21-5).

Subsequently, flood risks are perceived as a remote event which is easily dismissed. Due to low flood risk perception, the communities of the Hawkesbury-Nepean floodplain are not well prepared for a flood. As a result of low flood risk perception and a low level of preparedness for a flood, the communities in the Hawkesbury-Nepean floodplain may be highly vulnerable to devastating environmental, social, economic and psychological impacts of a major flood. It has been recognised by INSW and other agencies that there is a need for better education and awareness regarding flood risk and since 2018, INSW has undertaken community awareness-raising activities in the floodplain. Increased awareness would not only help elicit an effective response during a flood event, but also would minimise social disruption, subsequently assisting in the recovery process. While there was minor flooding in the Hawkesbury-Nepean

floodplain in February 2020, and a major flood in March 2021, communities remain highly vulnerable to the social, economic and psychological impacts of a major flood.

Figure 21-5 South Windsor during the 1961 flood event



Source: Image provided by INSW (2021).

21.5.5 Estuary communities' study area

21.5.5.1 Land use and planning

Throughout the estuarine area of the Lower Hawkesbury River, the dominant land use is environmental conservation. There are small proportions of land designated for recreational, agricultural and residential uses. The visual environment is characterised by waterways, natural forests and recreational areas with relatively-little residential development. This is due to the high levels of restriction on residential development enforced by NSW Government agencies and local government. For instance, the Hornsby LGA stipulates that any development needs to be ecologically sustainable, to protect water quality and significant native flora and fauna, and to retain the natural topography and the scenic quality of the area.

21.5.5.2 Demographic profile

In 2016, the total population across all the 26 suburbs along the estuarine area of the Lower Hawkesbury river was 9,368 people, across 2,596 households. The average population density of the entire estuary communities' study area was 145 people per square kilometre, which is substantially lower than that of Greater Sydney's 390 people per square kilometre. The population is concentrated to the southern side of the estuary in the Hornsby LGA. The Hornsby Plateau to the south of Berowra Creek is where much of the residential, industrial and commercial development is located.

There was generally lower cultural diversity recorded in the estuary communities' study area compared to the regional estuary study areas and Greater Sydney. In 2016, the percentage of residents who were born overseas in the local estuary communities' study area was 14.5 percent, which is substantially lower than that of Greater Sydney (36.7

percent). The proportion of the population which identify as being of Aboriginal or Torres Strait Island descent was also low at 1 percent.

21.5.5.3 Economic and industry profile

In 2016, the total size of the labour force across all suburbs in the estuary communities' study area was 4,866 people, accounting for a labour force participation rate of 64.6 percent. This labour force participation rate was higher than that of the Greater Sydney (61.6 percent) and of the three relevant LGAs combined which comprise the regional estuary study area (61.2 percent). The unemployment rate was relatively low at 4 percent, which compares to a rate of 6 percent for Greater Sydney.

Median weekly household incomes fluctuated across individual suburbs and ranged from only \$466 per week (in Marlow of the Central Coast LGA) to \$2,138 per week (in Berowra Heights in the Hornsby LGA). Median weekly household income across the estuary communities' study area was \$1,244/week. Suburbs in the Central Coast LGA had the lowest median weekly household income. There was considerable variation in SEIFA Advantage/Disadvantage score across the estuary communities' study area. Suburbs in the Hornsby and Northern Beaches LGAs recorded scores which indicate relatively high levels of advantage while some suburbs in the Central Coast LGA recorded scores which indicate high levels of disadvantage.

The Hawkesbury Estuary supports a variety of businesses and industries, including oyster aquaculture, commercial fishing, agriculture, recreation and tourism. Recreational boating and boat mooring are an economically important industry, particularly in the lower reaches of the estuary.

21.5.5.4 Regional open space and recreational areas

The Hawkesbury Estuary area provides a multitude of recreational areas and activities for the local community and residents of Sydney. In total, there were 95 key open space and recreational areas identified in the estuary communities' study area. Boating, canoeing, recreational fishing and swimming are all popular recreational activities. The national parks and natural areas surrounding the estuary provide opportunities for camping, bushwalking, sightseeing and birdwatching. Recreational boating in the area is facilitated not only by the multitude of boat ramps but through the availability of mooring areas. There were 43,395 boats registered in the Hawkesbury and Broken Bay region in 2009, which is projected to be 69,326 by 2026. In 2009, there were 6,106 registered moorings. NSW Fisheries estimates that approximately 150,000 recreational fishing outings occur in the Hawkesbury River per year – 82 percent on boats and 18 percent from the shore.

21.5.5.5 Estuary values

The Lower Hawkesbury Estuary is one of the most visually spectacular waterways in New South Wales. Based on the Australian Estuaries Database, the Hawkesbury River has been classified as 'high' conservation value, with a 'real' conservation threat. The fisheries value was rated 'high' and the ecological status was 'moderately affected'. Estuary values of the Lower Hawkesbury Estuary area were identified in the 2008 Lower Hawkesbury Estuary Management Plan (BMT WBM Pty Ltd 2008) and included high scenic amenity, functional and sustainable ecosystems, recreational opportunities, sustainable economic industries, cultural and heritage, and water quality to support user demands.

Identified key risks potentially affecting the estuarine area include:

- risk of water quality and sediment quality not meeting relevant environmental and human health standards
- risk of climate change
- risk of regulated freshwater inflows
- risk of inappropriate land management practices
- risk of over-exploiting the estuary's assets
- risk of introduced pests, weeds, and disease
- risk of excessive sedimentation
- risk of residents and users lacking passion, awareness and appreciation of the estuary
- risk of inappropriate or excessive foreshore and waterway access and activities
- risk of inadequate facilities to support foreshore and waterway access and activities.

21.6 SEIA stakeholder engagement

Incorporating the views, concerns, and opinions of potentially-affected communities was central to the SEIA methodology. Information generated through the engagement of Project stakeholders was used to verify baseline characteristics and to identify potential socio-economic impacts and benefits associated with the Project and mitigation development.

The SEIA was informed by both engagement activities specifically undertaken as part of the SEIA, along with the community engagement program associated with the EIS. The SEIA was further supported by engagement activities undertaken by INSW to inform the *Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW 2017). This section summarises outcomes of SEIA stakeholder engagement undertaken to date.

21.6.1 EIS engagement

21.6.1.1 Overview and summary of issues raised during EIS engagement consultation

As part of EIS engagement, a range of tools and activities were used in informing, consulting with and involving stakeholders regarding the impacts and benefits of the Warragamba Dam Raising Project. These included the following:

- **Meetings and briefings:** The project team provided briefings and held meetings with relevant Councils across the study areas, as well as local Members of Parliament (MPs), senior government executives and their support staff, and special interest groups.
- **Community information provision:** Eight pop-up information stalls were held at community events, shopping centres and community facilities across the study areas, promoted through advertisements in local newspapers.
- **Community updates:** Four community updates were produced over the period that the EIS was prepared. These updates were distributed throughout the study areas via the static displays and pop-up sessions and via email to stakeholders that had registered for project updates.
- **Consultation with Aboriginal stakeholders:** In accordance with 'Aboriginal cultural heritage consultation requirements for proponents 2010' (ACHCRs) (Department of Environment Climate Change and Water 2010a) a four-stage consultation process was undertaken with Aboriginal parties. In Stage 1 (Notifications and registration) a total of 22 Registered Aboriginal Parties (RAPs) participated in the consultation process. In Stages 2 and 3 (Presentation of the Project Information and gathering Information about cultural significance), all RAPs were invited to participate in the field survey and provide information on cultural, social and historical connections and traditional knowledge of the study areas, with 12 RAPs participating. In Stage 4 (Review of Draft Report), a draft of the Aboriginal Cultural Heritage Assessment (ACHA) was provided to all RAPs for review and comment. In addition to cultural heritage-focussed engagement, eight Aboriginal and Torres Strait Islander social service providers were invited to participate in the SEIA phone and web-based surveys.
- **Community engagement:** Consultation with landowners upstream of Warragamba Dam who would possibly be affected by temporary upstream inundation as a result of the Project was undertaken. Members of the EIS team visited properties in High Range to meet with the owners, and a letter was sent to the owners of 12 properties in the LGAs of Wollondilly, Wingecarribee and Oberon. In total, there were 590 subscribers registered to receive updates and approximately 1,700 phone calls and emails received via the free call 1800 number and Project email address. Engagement with a broad range of stakeholders was conducted, including interviews with local government and other stakeholder groups, council briefings, meetings with relevant government agencies, and briefings provided, and meetings held with three special interest groups.

All consultation that occurred on the Project was captured in a database. The EIS Stakeholder Register includes more than 3,457 consultation events and 2,861 registered stakeholders from August 2017 to January 2020. A summary of issues raised by participants during the EIS consultation from 1 July 2017 to 15 September 2019 was generated and is presented in

Table 21-8. Issues raised by participants during consultation informed the identification and assessment of both perceived and felt social impacts to understand the level of concern stakeholders had in relation to these impacts.

Table 21-8. Summary of issues raised during the EIS consultation

Category	Sub-issue category	Issue raised
Construction		
Socio-economic, land use and property	Tourism	Effects on tourism in Warragamba due to potential temporary closure of facilities such as the Visitor Centre and Haviland Park.
Noise and vibration	Construction noise	Concerns as to the noise which may be generated during construction.
Air quality	Dust generated from construction activities	Dust generated from construction activities would have a negative effect on air quality.
Traffic and transport	Construction traffic	Potential impacts of construction traffic on the road network.
Project timeline	EIS process and next steps	Enquiring about the current stages of the Project and the next steps.
Operation		
Flooding	Reduction in downstream flooding	Benefits for downstream communities, property and infrastructure (including some claims that there would be no benefit).
Flooding	Upstream inundation	Changes to the area of land upstream that would be inundated during flood events.
Biodiversity	Impacts to flora and fauna	Impacts to flora and fauna, including endangered species, from upstream inundation and changes to downstream river flows.
Protected and sensitive lands	Impacts to World Heritage	The impacts of temporary inundation of the Greater Blue Mountains World Heritage Area.
Water hydrology	Changes to tributaries and rivers	Changes to the catchment's tributaries, including wild rivers, and waterflows downstream of the Project.
Aboriginal heritage	Impacts to cultural heritage sites	Impacts to sites of Aboriginal cultural heritage from increased upstream inundation.
Socio-economic, land use and property	Development	The Project would facilitate further development on the floodplain.
Design	Water storage	The Project would also be used for additional water storage to facilitate further development.
Non-Aboriginal heritage	Items of non-Aboriginal heritage value	Potential impacts to items of non-Aboriginal heritage value from upstream inundation.
Health and safety	Reduced risk to life and safety	Queries as to whether the Project would or would not reduce the risk to life from floods.
Project development	Project approvals	Queries as to how the Project would gain planning approval.
Project development	Cost of Project	There are better ways to use the government funding allocated to the Project.
Traffic and transport	Evacuation routes	The need for improved evacuation routes in the floodplain.
Health and safety	Safety of the raised dam	The ability of the raised dam to hold additional water and vulnerability to security threats.
Soils	Sedimentation and erosion	Sedimentation and erosion of river banks upstream and downstream.

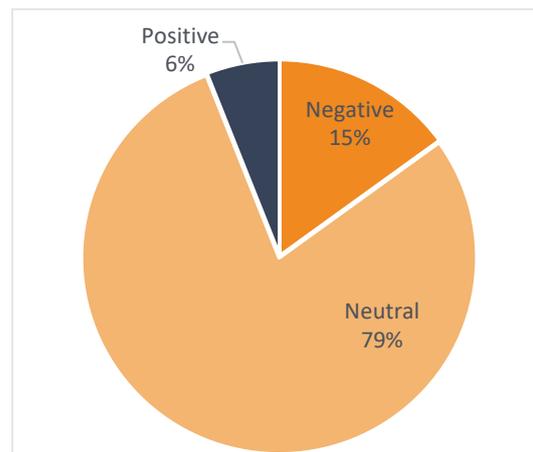
Category	Sub-issue category	Issue raised
Water quality	Negative effect on water quality	Water quality in the catchment would be impacted by construction and the retention of flood inflows.
Protected and sensitive lands	Changes to the catchment exclusion zone	Potential adjustment of the exclusion zone around the catchment.
Socio-economic, land use and property	Insurance	Effect which the Project may have on insurance provisions for properties on the floodplain.
Socio-economic, land use and property	Housing	Effect which the project may have on housing provision for residents on the floodplain
Socio-economic, land use and property	Vulnerable groups	Effect which the project may have on the most vulnerable groups of residents
Visual amenity	Visible scarring and sedimentation	Environmental damage visible from the Echo Point lookout in the Blue Mountains potentially having a negative effect on tourism.
Design	Environmental flows	Flows would need to be managed to consider both the environment and river users.
Climate change risk	Climate change related to drought and flooding	The need to be prepared for increased flood events and droughts from climate change conditions.
Sustainability	Sustainable flood management	The need to consider sustainability principles in flood management.

21.6.1.2 Stakeholder sentiment

To support the EIS development, public and stakeholder sentiments were recorded across all instances of public and stakeholder engagement. These instances covered public events, feedback emails and phone calls, and community and stakeholder meetings. To help inform the EIS development, the database captured stakeholder sentiments, either positive, negative or neutral.

Stakeholders did not express a positive or negative sentiment towards the Project in every interaction with the Project team. In this case, these events were categorised as neutral. Engagement events, where both positive and negative sentiment were expressed, have been categorised as neutral. Figure 21-6 shows the sentiments expressed as percentages of the total. While the majority of sentiment captured were neutral (79 percent), negative sentiment (15 percent) was higher than positive sentiment (6 percent).

Figure 21-6. Sentiment of events from 1 July 2017 – 15 September 2019



21.6.2 SEIA stakeholder engagement

21.6.2.1 Overview

Engagement activities undertaken specifically to inform the SEIA sought to identify and substantiate potential impacts and benefits and how they may manifest in local areas. This was achieved through the engagement of local organisations throughout all areas potentially affected by the Project: upstream, downstream and specifically the communities of Warragamba and Silverdale. Direct forms of engagement which were specifically undertaken for the to inform the SEIA included scoping interviews, a phone-based survey, a web-based survey and a business survey. A broad range of issues was raised by stakeholders across the variety of EIS engagement activities.

21.6.2.2 Scoping interviews

Scoping interviews with local government authorities and other key stakeholders were conducted to document key social trends in local areas and build an understanding of the stakeholders potentially affected by the Project. These were semi-structured interviews which allowed participants to provide detailed information of relevance to the SEIA. A total of 16 scoping interviews were undertaken, generating a valuable body of information which was subsequently used to define SEIA study areas and material socio-economic matters across different areas. A summary of key matters raised by stakeholders in scoping interviews is provided in Table 21-9 below.

Table 21-9. Summary of key matters raised during scoping interviews with key stakeholder groups

Stakeholders	Key matters raised by interviewees – scoping interviews
Blue Mountains City Council	<ul style="list-style-type: none"> ▪ Blue Mountains prides itself on being the largest city in the world within a World Heritage area. The community highly values the World Heritage listing and is vehemently opposed to any action which could threaten this listing. ▪ Community networks are very strong and there will regularly be up to 500 volunteers on a weekend supporting environmental stewardship programs. ▪ People choose to live in the Blue Mountains for the iconic natural environment. Nature-based tourism underpins the whole economy. ▪ Community opposition because of the impact of the Project on World Heritage areas, national parks and threatened species. ▪ The destruction of Aboriginal heritage is another key issue, with the loss of sacred spaces – something Aboriginal people will never forget. It is expected that there would be national and international opposition from Indigenous groups. ▪ The strong perception that the Project is all about facilitating urban development on the floodplain, and that raising the dam is not even the most appropriate way in which to reduce flood risk.
Hawkesbury City Council	<ul style="list-style-type: none"> ▪ Hawkesbury is a peri-urban area, with a relatively stable, homogenous, ageing population, drawn to lack of density and keen to preserve local character, with the Hawkesbury River featuring strongly in local culture and history and Windsor Bridge a significant local piece of infrastructure, both historically and for access purposes. ▪ Generally, there is complacency and low levels of awareness about flood risk, since the most significant shifts in population have occurred within the last 20 years. ▪ Sackville, Wilberforce, Windsor, Richmond, North Richmond and Yarramundi are considered the most flood vulnerable communities within the LGA. ▪ Effects on Yarramundi Reserve during the Project operation should be further investigated including potential effects on sand and gravel businesses. ▪ Over the past 18 months, the Mayor and Councillors have been focused on flood risk and evacuation, including forming a Floodplain Advisory Committee. ▪ The Council has established Human Services and Access and Inclusion Committees as well as Windsor Chamber of Commerce. ▪ Council is generally supportive of the Project, contingent on full environmental and social assessment. ▪ Vulnerable groups in the LGA include ageing and lower socio-economic groups. They tend to have lower mobile and internet usage, and are likely to present higher risk in a flood emergency. ▪ The Project would provide more time to evacuate and possibly more roads open, which would likely benefit these vulnerable groups in particular, as well as potentially provide more time to protect property. ▪ During the Project operation, impact on turf farms from extended inundation is considered marginal, as they would already be subject to significant damage by a severe flood regardless.

Stakeholders	Key matters raised by interviewees – scoping interviews
The Hills Shire Council	<ul style="list-style-type: none"> ▪ The position of the Hawkesbury City Council is that the Project would not lead to increased development and/or greater population density.
Wollondilly Shire Council	<ul style="list-style-type: none"> ▪ Warragamba, Silverdale and Wallacia identified as the key communities most affected by the Project. ▪ Warragamba is the most directly affected in terms of the loss of economic vitality associated with tourism along with direct amenity and traffic effect during the construction phase. ▪ The Council is concerned about the traffic effects in Wallacia, particularly in vicinity of schools, the public pool and other recreational facilities during the construction phase. ▪ Wollondilly is a relatively low growth LGA. There has been some growth in the northern parts (such as Wallacia) due to people, primarily younger couples, moving to the area to access more affordable housing. It is somewhat mixed in terms of the demographic with some very wealthy pockets interspersed with lower socio-economic areas. ▪ Warragamba is one of the lower socio-economic areas and has been declining over the last few decades. A major contributing factor has been that the traditional attraction of Warragamba as a place for Sydney residents to visit for the day and have a barbeque with the family has tapered off substantially. Fewer people come through the town but more significantly, they do not spend time and money at local establishments. The town itself is an odd shape and lacks coherency as it was never designed to be a permanent township. ▪ While there is a feeling as though Warragamba has been neglected (by Council/State), the community is well-connected and passionate about the town. ▪ Local people have been exposed to a lot of information regarding the negative elements of the Project such as the environmental effects associated with inundation, the construction impacts, such as traffic effects, and loss of tourism related income. They have received little detail on why there is a need for the Project. Without having an understanding as to why the Project is needed — such as the very real risk of loss of life and property in the event of a major flood — the broader economic benefits need to be publicised to enable people to develop a considered viewpoint. There remains a perception that the Project is all about increasing water storage to accommodate population growth. ▪ The key issues of concern to local people are the economic effects associated with construction and the associated lack of access to the Dam. The town of Warragamba has been economically declining for some time and the concern is that this Project could almost kill the town. What the Council and community really want are initiatives for how the construction can assist the town such as through procurement of local goods and services and other initiatives such as using the presence of construction machinery to open up access points for the proposed 'Iconic Walk' or recreational vehicle (RV) park. They want to engage with WaterNSW and INSW to have these sorts of initiatives agreed to and enshrined in management plans. ▪ Recommended further engagement with Councillors along with some key local representatives from business and community, including offering to facilitate a meeting/workshop and arrange venue.

Stakeholders	Key matters raised by interviewees – scoping interviews
Blacktown City Council	<ul style="list-style-type: none"> ▪ Blacktown Council has experienced transformative growth over the last 20 years and continues to be one of the fastest growing LGAs in Greater Sydney. ▪ Flood-vulnerable areas include Shane Park, Marsden Park, Riverstone and Vineyard. ▪ Very high cultural diversity which presents a challenge in terms of communication - need to work through 'community champions'. ▪ Overall, there is very low levels of flood awareness. It is not even recognised as a risk. There are some layers of vulnerability here as there are high numbers of large multiple generational households who do not speak English, are quite insular in their social networks and don't have any plan or awareness regarding flooding. ▪ Modern housing materials have low levels of flood resilience - new housing is highly vulnerable. ▪ There is a lack of understanding regarding flood insurance and there may be many houses in vulnerable areas which are not adequately covered.
Liverpool City Council	<ul style="list-style-type: none"> ▪ Liverpool is a fast growing and highly culturally diverse Shire with its population projected to be more than 350,000 in 20 years. ▪ Only the north-west portion of the LGA is viewed as relevant to the Project. These areas include Luddenham, Bringelly, Badgerys Creek and Greenbank which are very different in character; they are currently peri-urban and rural areas. ▪ The Western Sydney Aerotropolis and the Western Sydney City Deal are major influences on the future character of these areas. There is great potential for residential densities to increase rapidly. There are major job creation initiatives currently taking shape and this would drive growth and development. ▪ Friction between state led planning and local government, who feel powerless. ▪ Sensitive ecological and Aboriginal heritage values along the river systems. ▪ Potential for traffic impacts in Wallacia which would be significantly exacerbated if construction occurs simultaneously with Western Sydney Airport and associated development.
Hornsby Shire Council	<ul style="list-style-type: none"> ▪ Oyster farming is now practically non-existent as it was decimated by the Pacific Oyster Mortality Syndrome. ▪ There is a commercial estuary prawn industry (up to 30 trawlers) and the ecology of the prawns is highly dependent on the flush regime — disturbances to the flush regime could either be a benefit or detriment to the industry. ▪ There is a large recreational boating and fishing industry in the Hawkesbury Estuary which is the recreational hub of Northern Sydney. ▪ Water quality is affected by upstream uses which directly impacts on commercial and recreational activities in the Hawkesbury Estuary. ▪ There are very few residential uses along the estuary. ▪ Climate change and sea level rise needs to be taken into account by flood modelling as this would have a significant effect on the nature and extent of inundation in tidal areas.
Penrith City Council	<ul style="list-style-type: none"> ▪ Penrith has been a high growth area over the past 20 years, borne out of being a place to access more affordable detached housing. ▪ There have been numerous new release areas over the past decade (such as Jordan Springs, Glenmore Park and in Kingswood Park) and more recently growth in medium density residential development in the CBD. ▪ In terms of flood prone areas, the northern (Londonderry) and central areas (Penrith Lakes) are predominantly low-lying. The CBD is also quite prone to flooding. Emu Plains on the western side of the river has the potential to get isolated. ▪ Vulnerable groups include homeless people who use areas along the river and the elderly, with numerous facilities along the river.

Stakeholders	Key matters raised by interviewees – scoping interviews
	<ul style="list-style-type: none"> ▪ Significant infrastructure along the river includes the Great River Walk and the Sydney International Regatta Centre which is also a function centre and venue for music concerts. ▪ Ongoing traffic congestion issues on Mulgoa Road are of relevance if this is a transport route for the Project's construction traffic. ▪ The Western Sydney Aerotropolis and Western Sydney City Deal has the potential to substantially increase population growth. Council has been active in investigating South Creek and recently Council updated the South Creek Floodplain Risk Management Strategy.
Hawkesbury SES	<ul style="list-style-type: none"> ▪ Benefit: less likely to get in trouble, for example, by trying to cross flooded causeways at last minute. ▪ Need to promote awareness of evacuation routes, and other elements of the flood strategy.
Turf Australia	<ul style="list-style-type: none"> ▪ In the current event of a large flood, they stand to lose 70 percent of their stock, which takes 6-12 months to replace, as well as very expensive machinery, which is un-insurable, given they operate on a flood plain. ▪ Turf Australia and its members are very supportive of the Project, given the perceived benefits associated with the Project.
WaterNSW	<ul style="list-style-type: none"> ▪ Thirteenth, Twelfth and Nineteenth Streets and Weir Road would be most affected in Warragamba. ▪ The local community is very dependent on Dam activities for revenue and economic activity. ▪ There is far less visitation to the Dam — 1980s was the high point for visitors — the drop-off in economic activity for the local townships has been partly due to the diminishing interest in visiting the Dam. ▪ The biggest issue is that people operate on the river as if it is a weir pool — it is not a natural river system as waterflow is managed via the Dam. This has allowed the development of high levels of recreational use and there is no awareness of it as a dangerous river. ▪ Pre-releasing water ahead of a flood would create a different, more dangerous river. There is limited awareness of this — strong education component required to help people be aware that the river is not a pool. For example, WaterNSW would be generating artificially high levels of waterflow and this may produce a risk to public safety. Capacity building is required.
National Parks and Wildlife Service (NPWS)	<ul style="list-style-type: none"> ▪ If dieback occurs, it would create feral species management issues such as feral pigs and introduction of noxious weeds. ▪ Visual effects at Echo Point may affect Blue Mountains tourist trade if dieback is visible from the public viewpoint. ▪ NPWS would require a significant increase in budget to manage dieback if the Dam Raising creates permanent inundation. ▪ The Gundungurra people have strong indigenous bonds to tribal lands and oppose the Dam Raising based on anticipated further destruction of cultural heritage.
NSW Police	<ul style="list-style-type: none"> ▪ The greatest flood risks are associated with the Hawkesbury where road and bridge closures and creation of 'flood islands' present challenges in terms of evacuation and provision of emergency services. ▪ The SES and other agencies have done a lot of work on flood preparation, but how things would go in the event of a very large flood and major evacuation cannot be fully predicted. ▪ Due to a general lack of community awareness and preparation, people may take actions which run counter to evacuation plans. ▪ The Yarramundi, Richmond and Windsor Bridges are highly vulnerable to flood and are a cause of isolated flood islands, cutting people off from emergency services. The loss of power and water in flood events would exacerbate vulnerabilities in these isolated areas.

Stakeholders	Key matters raised by interviewees – scoping interviews
	<ul style="list-style-type: none"> ▪ Transport infrastructure connections makes evacuation of Penrith an easier task than Windsor or Richmond. ▪ The Project would provide extra time for evacuation which would make a big difference lowering community risk during the operation.
Cumberland RFS	<ul style="list-style-type: none"> ▪ Perceived impacts most likely to be experienced in the Warragamba and Silverdale communities are construction related: particularly heavy truck movements, noise and dust. ▪ From an emergency management point of view, increased heavy vehicle movement on less than adequate roads bring the risk of motor vehicle accidents during construction. ▪ Increased time to evacuate is likely to benefit groups such as these, as well as emergency services such as RFS who are involved in rescue efforts.

21.6.2.3 Phone-based survey

The SEIA phone-based survey sought to capture the level of appreciation of flood risk and perceptions regarding the Project. A focus of the SEIA is vulnerable groups. Accordingly, stakeholder organisations targeted to inform the SEIA were identified through the analysis of social and location specific vulnerability. Stakeholder organisations representing identified vulnerable sections of the population were targeted for engagement. A total of 352 specific organisations were identified through this process.

Stakeholders were further identified through the preliminary identification of impacts and benefits informed through the scoping interviews, review of a broad range of background materials, and the initial findings of other EIS technical studies. A final listing of participants in the phone-based survey included 310 stakeholder organisations. Contact was made with all identified stakeholder representative organisations. Of the 310 organisations contacted, 213 stated that they either could not participate at the time of calling or did not answer (multiple calls at different times). An additional 28 organisations stated they did not wish to participate. A total of 69 surveys were completed.

Feedback from the phone-based survey is summarised as follows:

- Participants from community organisations estimated the total number of members or recipients of the services provided by the organisations, with the results being:
 - local communities: 35,423 people
 - upstream: 95,098 people
 - downstream: 427,492 people.
- Approximately half of participants across all study areas agreed that further action is required to reduce the severity and impact of flooding in the Hawkesbury-Nepean Valley. The response rates include:
 - local communities: Yes (40 percent), No (30 percent), Unsure (30 percent)
 - upstream: Yes (50 percent), No (40 percent), Unsure (10 percent)
 - downstream: Yes (57 percent), No (13 percent), Unsure (30 percent).
- Participants were read a number of key predicted effects associated with the Project relating to predicted effects in different localities. They were subsequently asked to indicate to what extent they supported or opposed the raising of Warragamba Dam.
 - in downstream areas, 43 percent of respondents supported the raising of Warragamba Dam.
 - in upstream areas, 60 percent of respondents disagreed that the existing dam wall needed to be raised to reduce flood risk and that there were other options to reduce flood risk in the Hawkesbury-Nepean Valley (11 percent of respondents from the upstream area).
 - in the local communities' area, the most prevalent response was neutral (40 percent), and 60 percent raised concerns surrounding the increased traffic from the Project.
 - all respondents were asked to provide reasons for their position in either their support for or disagreement with the Project, with a majority of respondents from both upstream (80 percent) and downstream (61 percent) citing concerns with the Project, in particular environmental and cultural damage.

21.6.2.4 Web-based survey

A web-based survey was conducted to allow stakeholders to provide more detailed feedback on local perceptions of risks and benefits of the Project. The web-based survey also included the provision of a visual representation and supporting information explaining the predicted effects if a 1 in 100 chance per year flood event were to occur. This information was provided for Warragamba, Silverdale and Wallacia, along with upstream and downstream localities. Using a 'SurveyMonkey' based platform, an invitation to participate in the survey was sent to 197 stakeholder organisations. A total of 61 surveys were completed. Of these, five percent were from organisations located in the upstream, 30 percent in the downstream, and 67 percent in the local communities' study area.

Feedback from the web-based survey is summarised as follows:

- In the local communities' study area, feedback from the web-based survey is as follows:
 - Fifty percent of participants stated that limiting public access to the Warragamba Dam facilities during the construction period would affect them.
 - Participants raised their concern regarding increased traffic and increased dust, noise and vibration. The increased traffic may lead to delays and a reduction in tourism.
 - Forty-six percent of participants were unsure how to respond to the survey question: 'How do you think the impact could be reduced or benefit maximised?'
 - All participants stated that the Project should result in an increase in job opportunities for local people due to an increased workforce in the area and were hopeful that opportunities would be made available for local residents and businesses.
- In the upstream area, all those who participated in the web-survey identified potential negative effects associated with the Project including:
 - Restricted access to some bushwalking tracks.
 - Loss of vegetation potentially impacting threatened flora and fauna species.
 - Loss of culturally-significant aboriginal and non-aboriginal heritage sites.
- Fifty-four percent of upstream respondents reported that the most effective way to reduce the impacts associated with the Project was to "not raise the dam wall". A key theme in feedback provided was that the Project would facilitate further (inappropriate) development on the floodplain with comments including:
 - The wall of the Dam should not be raised to benefit the very few and to build in inappropriate downstream areas for small benefit to locals.
 - It is recommended to scrap the Project and instead freeze development on the floodplain, create viable evacuation routes and develop a better community education program.
 - Flood mitigation is only an issue if unchecked inappropriate development continues. Loss of rare remaining Cumberland Plains woodland is irreversible.
 - The landscape is designed to flood and there are benefits to the environment. If this happens, we need to stop developing in flood zone areas.
 - Other alternatives are required to be more rigorously investigated.
 - The Project would cause irreparable damage to important habitat for threatened flora and fauna.
 - The Project would cause permanent loss of Aboriginal heritage.
 - Declared wilderness areas should be protected and not threatened by development.
 - Lack of confidence that the Project will effectively mitigate flood risk.
- In the downstream area, 60 percent of respondents reported that raising the Warragamba Dam would reduce risk of damage to and loss of property. Feedback included that the Project would:
 - Reduce insurance costs.
 - Reduce flood-related anxiety for residents.
 - Reduce costs for emergency services.
 - Potentially lower the loss of life due to a major flood event being the overriding consideration.
 - Reduce damage to infrastructure.
 - Provide extra time for people to evacuate which would lower the risk of injury or fatalities and lower flood-related psychological stress for residents.

- Respondents across the downstream area identified a range of alternatives to the raising of the dam wall to mitigate flood risk. These, for example, included:
 - It is suggested using a desalination plant and lowering the water in the Dam for flood mitigation. Flood evacuation routes should be in good condition and identifiable.
 - One alternative is to influence current development plans around the area that would be impacted by flooding. Evacuation routes and flooding maps need to determine future development areas by reducing the number of people living in the impacted areas.
 - It is suggested to improve warnings, and not allow further development.
 - The Project will only reduce ‘high-end’ impact with no thought for Aboriginal significant sites. Instead of raising the dam height, it is suggested transferring the water (overflow or water level lowering in the case of massive flood surge) via canals/pipes or both - over 100 kilometres or more if necessary to better protect the heritage of the area.
 - There are other values to be considered than economic ones and these have been totally ignored. A better option is to spend the money on relocating improper development and improving infrastructure.

21.6.2.5 Business survey

A business survey was conducted by a specialist economic analysis firm HillPDA. The SEIA business survey aimed to engage businesses across the study areas to understand the perception of potential impacts in relation to the Project’s construction and operation. A total of 170 businesses were invited to participate in the business survey with a total of 50 business surveys completed.

Types of businesses that participated in the business survey included: accommodation providers, agricultural or aquaculture-related services, food and beverage, professional services, recreation or community services (such as club/chamber), retail, and tourism.

Suburbs where businesses participated in the surveys included: Richmond, Norwest, Katoomba, Sackville North, Blackheath, Jamisontown, Emu Plains, Marsden Park, Riverstone, Luddenham, Rossmore, Mortdale, Wisemans Ferry, Hornsby, South Maroota, Sackville, Richmond Lowlands, Agnes Banks, Londonderry, Silverdale, Warragamba, Wallacia, Windsor and Penrith.

Feedback from the business survey is summarised as follows:

- Businesses in the local communities’ study area (Warragamba/Silverdale):
 - Of the 20 business respondents in Warragamba/Silverdale, most recorded a neutral response as to potential effects of the Project construction with the only concern raised being the potential effect being in relation to ‘business amenity’ (50 percent of respondents reported that the Project may have a negative effect).
 - It was reported by a relatively small number of businesses (29 percent) that temporary loss of amenity and closure of the Visitor Centre, and recreational areas would have a negative effect on business revenue due to a reduction in tourism.
 - Supplier opportunities, tourism business revenue and employee customer access displayed a moderate negative bias, whereas job opportunities, the presence of workforce in the local area and the longer-term effect on business viability identified as key potential positive effects of the Project.
 - Respondents, whose businesses are highly reliant upon an effective and efficient road network, suggested that the high volume of traffic and trucks throughout construction would cause major issues in and around Warragamba. Some respondents reflected on past incidents where the road between Warragamba and Wallacia was closed (due to an accident), resulting in employees, residents and visitors being forced to take an alternate route, adding over two hours to the journey.
 - There were mixed perceptions regarding the effects on business activity during the short-term construction period. Some respondents stated that the increased worker population during construction may generate increased business revenue, however they were unsure whether this would cover the loss of tourism related income.
 - Eighty percent of business survey participants in the Warragamba/Silverdale area would welcome the provision of extra information and advice regarding business opportunities generated from construction activities in the area. Surveyed businesses identified opportunities in relation to increased sales from additional customers, suggesting that food and beverage businesses would realise the greatest benefit.

- Businesses in the upstream communities' study area (Blue Mountains):
 - Responses were only received from four businesses in the upstream catchment, all of which responded that the Project would have a negative or extremely negative effect.
 - Respondent businesses perceived that the Project would have a negative effect on employee and customer safety. Of the four businesses surveyed in the upstream communities' study area, it was reported that the Project would have an extremely negative (50 percent) or negative (50 percent) effect on business revenue from tourism.
 - Three out of the four responses indicated that the Project would have a negative effect on business revenue from recreational activities and one business considered it would be extremely negative. All participant businesses perceived that the Project would have a negative impact through further hindering customer and employee access to the business. Businesses stated that trail maintenance was already poor and believed that flooding would cause further degradation of the trails and would increase safety concerns.
- Businesses in the downstream communities' study area:
 - Twenty-six businesses participated in the business survey in the downstream area.
 - Overall, the perception of the Project's potential impacts on business operations recorded predominantly neutral responses from downstream businesses. Out of the 21 businesses that chose to respond to the question on how they thought the proposal would affect viability of the business, 43 percent of respondents stated there would be no impacts and further 43 percent stated that there would be minor impacts. Positive perceptions reported included improved employee and customer safety, customer and employee access, business revenue and sales, and distribution and supplier access. Respondents perceived that the increased evacuation time would be positive for their business, particularly in regard to employee safety. Delays to recovery time recorded the highest negative feedback with 22 percent of respondents reacting negatively to the increased duration of flood effects as a result of the Project.
 - Forty-eight percent of the downstream respondents perceived that the Project would have no notable impact on business activity and they were therefore indifferent or neutral to the Project being advanced. One issue which received an optimistic response was in relation to insurance. It was reported by most businesses on the Hawkesbury-Nepean Floodplain that flood insurance was currently either not available at all or was prohibitively expensive. It was recognised that a factor which would improve business support for the Project would be if it had a positive effect on insurance.

21.6.2.6 Stakeholder workshops

The two stakeholder workshops were held on 11 April 2019 at Warragamba Town Hall to provide an opportunity for community representatives and organisations that serve the Warragamba, Wallacia and Silverdale townships to gain an understanding of the Project and the preliminary findings from the technical studies and to gather insights into local issues and concerns. The workshops were structured under three key themes:

- local traffic and transport management
- socio-economic impacts and opportunities
- environmental management of the local area during construction.

The key stakeholder groups invited to participate comprised:

- elected local representatives
- officers from local government
- emergency services
- community service providers
- community groups
- local businesses
- members of the community.

A recommended list of 38 participants was developed and drawn from:

- people who registered their interest during the Warragamba community pop-up session
- registrants for community updates
- local community email/phone enquirers

- entities invited to participate in SEIA surveys
- relevant staff who attended the council briefing session.

Invitation letters were prepared and sent to 38 the selected participants. Of 38 invitees, 32 participants accepted the invitation. A breakdown of stakeholder groups invited to attend is as follows:

- elected local representatives: three participants from Wollondilly LGA
- officers from Local Government: five participants from Wollondilly LGA and one from Liverpool LGA
- emergency Services: four participants who service the Wollondilly LGA
- community service providers: four participants from Wollondilly LGA
- community groups: five participants from Wollondilly LGA
- local businesses: four participants from Warragamba, two from Silverdale and two from Wallacia
- members of the community: four from Warragamba, two from Silverdale and two from Wallacia.

The methodology for the workshops was a widely-used round-robin collaborative participation model, commonly referred to as ‘World Café consultation’. There were two separate workshops: one in the afternoon which primarily involved representatives of government departments and service providers and the second in the evening which involved members of local communities and interest groups. At each workshop participation was structured across the three central themes of traffic and transport, environment and socio-economic. The settings were conducive to establish inclusive, collaborative participation with round tables equipped with relevant materials to assist discussion. Participants were assigned to each table together with a project discussion facilitator/moderator who would ensure even-handed participation for all and a notetaker to record participants’ views.

Table 21-10 summarises the key matters raised during the two stakeholder workshops. All data collected from the stakeholder workshops was entered into Consultation Manager. Stakeholder feedback from the workshops was analysed to inform the SEIA.

Table 21-10. Summary of key issues raised during stakeholder workshops with local communities in Warragamba, Silverdale and Wallacia

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
Socio-economic impacts and opportunities	Economic vitality of local communities	<ul style="list-style-type: none"> ▪ Tourism infrastructure is needed to improve to attract and to maintain tourism to the Dam and Warragamba town. ▪ There needs to be greater opportunities for tourists and non-locals to spend money in Warragamba. ▪ Closure of tourist attractions in Warragamba such as the Bullen’s African Safari Lion Park, along with the bushfires in 2001-2002, has impacted tourism and business in the area. ▪ Warragamba town is largely supported by tourism and business from non-locals. ▪ Local recreational and sport facilities need to be improved to benefit locals and to attract and maintain visitors. ▪ The sports masterplan is supporting the planning and development of Warragamba.
	Influx of workers and local economic opportunities	<ul style="list-style-type: none"> ▪ An external workforce coming to Warragamba would impact on the existing infrastructure and facilities. ▪ Local employment could be utilised during the construction phase. ▪ There may be local supply opportunities during the construction phase.
	Public access to social infrastructure, services, and	<ul style="list-style-type: none"> ▪ Changes to how visitors can access and experience the Dam and the surrounding areas.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
	facilities during construction	<ul style="list-style-type: none"> Temporary closure of the Visitor Centre and closure of Haviland Park during the construction phase would have negative consequences on the community and tourism to Warragamba.
Environmental management of the local community area during construction	Noise and vibration	<ul style="list-style-type: none"> Construction activities would have noise and vibration impacts on the community. Noise would impact the primary school. Actual noise impacts are unknown until construction starts. The batch plant should be relocated to reduce potential exposure to noise, such as closer to the Dam away from the town. Noise impacts, particularly on the aged community, could be managed through communication of planned works and alternative hours of construction. The construction methodology for the Project needs to be communicated to Warragamba residents. Communication and signage will be an important aspect of the how the construction process is managed. Lots of visitors get lost trying to find the Dam and other amenities.
	Dust	<ul style="list-style-type: none"> Construction activities would have dust impacts on the community. The concern is about the impacts of dust on health (such as asthma, allergies, and psychological impacts) and cumulative impact with dust coming from the Western Sydney Airport construction. Mitigation and management of dust and construction activities should be provided (such as covering vehicles, curtaining/confining concrete batching facilities and water carting).
	Waste and contamination impacts	<ul style="list-style-type: none"> Structures containing asbestos may be disturbed by vibration from construction and remediation may be required. Hazardous materials resulting from the explosives and blasting process is a concern from the perspective of the Rural Fire Service and overall risk management.
	Community amenity	<ul style="list-style-type: none"> This Project has the potential to deliver long-term benefits that are beyond just a construction project. Construction of the wall could be accompanied by a 'thank you' gift to Warragamba, such as replacement and reinstatement of community facilities.
	Vulnerable community members	<ul style="list-style-type: none"> Construction activities may have greater impacts on vulnerable community members. Noise impacts on the aged community can result in psychological distress induced by periodic explosions. Dust impacts on the elderly community and their health. Noise during the spillway construction was particularly impactful to the elderly and families with small children.
Local traffic and transport management	Safety	<ul style="list-style-type: none"> There would be a safety risk for children travelling to and from school during the construction phase. Road safety remains a concern for the children from the public school and there is a need to ensure that increased traffic noise levels do not impact the school. There are issues related to an incoming workforce and increased construction traffic, such as animal strikes, fatigue-related accidents and driving through school zones. Community education on traffic safety should be carried out. Traffic signage should be available to increase community awareness. Truck speed limits should be introduced in the town.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
	Accident	<ul style="list-style-type: none"> ▪ Accidents are common on Silverdale Road (especially on the hill) and on the Southern route. Increased trucks would lead to accidents and increased traffic. ▪ Emergency services receive a high volume of call-outs for accidents on Silverdale Road and Baines Hill from oil spillages. On multiple occasions, there has also been road blockage associated with these accidents. Emergency response to accidents would be impacted by additional construction traffic using the road network.
	Congestion	<ul style="list-style-type: none"> ▪ There is a pinch point at Baines Hill. At Megarritys Creek, opportunities to overtake are limited. Morning peak traffic in Silverdale is already significant. Drivers cannot overtake trucks currently. There are not enough overtaking lanes and routes are over capacity. ▪ Congestion would be caused by increased light and heavy vehicle movements. Construction workers travelling to and from site would increase traffic. ▪ Delays from installing additional temporary traffic lights would occur. Impatient drivers would be even more frustrated by increased trucks. There would be potential congestion at the roundabout at Silverdale Road and Farnsworth Avenue. ▪ Suggested mitigation measures for avoiding or minimising congestion include: <ul style="list-style-type: none"> - introducing overtaking lanes - installing traffic lights at the Park Road and The Northern Road intersection - using buses for workers - carpooling - clearing road shoulders along Silverdale Road - using overhead cableways for delivering materials to site, like those used during the Dam's original construction - introducing dual carriageways - conducting road repairs during construction to repair damage created by construction trucks - creating extra access to local roads - staggering shift times for workers to avoid peak times.
	Cumulative impacts	<ul style="list-style-type: none"> ▪ Cumulative impacts from the Western Sydney Airport construction at Badgerys Creek would occur. There would be conflicts with planned road upgrades, especially Silverdale Road. ▪ Construction of new developments at Silverdale would have cumulative impacts. ▪ Coordination with the Wollondilly Council and other major project teams should be implemented.
	The two proposed Northern and Southern transport routes	<ul style="list-style-type: none"> ▪ Baines Hill and Blaxland Crossing Bridge are pinch points. The existing poor condition of roads and bridges along the routes would deteriorate. ▪ Trucks would destroy the road surfaces. ▪ Blaxland Creek Bridge is susceptible to flooding during heavy rainfall, which could make the Northern Route unusable at times.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> ▪ Recommendations were proposed including: <ul style="list-style-type: none"> - testing/investigating McGarritys Creek Road culvert as it is currently untested - upgrading Baines Hill - constructing a flood resilient bridge at Blaxland Creek, upgrading bridge and road duplication - upgrading Blaxland Crossing Bridge.
	Community amenity	<ul style="list-style-type: none"> ▪ An incoming workforce of up to 500 workers at peak construction period would pose issues for parking. ▪ Residents travel to Penrith for health services — if the route to Penrith was cut because of an accident, these residents, especially elder people, would be unable to access health services. ▪ Mitigation measures were proposed including: <ul style="list-style-type: none"> - dilapidation surveys - time of day that truck movements - community engagement - new parking areas built - Southern route preferable for community harmony - staging construction-related traffic to stop when there are community events such as sporting grand finals and Dam Fest - investments in infrastructure for future tourism.

21.6.3 Social research undertaken to inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy

Infrastructure NSW commissioned three reports which detailed public opinion of flooding, evacuation and social networks in the Hawkesbury-Nepean Valley in 2014, 2015, and 2018.

The following summarises the key outcomes of these surveys:

- 2014 survey:
 - Respondents on average had lived at their current properties for 20 years and the majority had strong connections within the local community. There was a relatively-low interest in participating in local planning for emergencies.
 - Thirty-three percent of respondents thought there was a high flood risk whereas 46 percent perceived a high risk for severe storms. However, residents within the 1 in 100 chance event flood zone were significantly more likely to perceive a flood risk.
 - Fifty-two percent of participants had experienced flooding and 21 percent experienced flooding at their current property. Flood risk concern on a scale of 1 to 10 (where 10 meant ‘extremely concerned’) was 4.6.
 - Sixty percent of participants had done nothing at all to prepare for potential flooding with more than half (60 percent) of participants believing they would have plenty of warning and do not need to prepare. Forty percent of respondents stated they would need a fair amount of help to prepare for a flood and 44 percent of respondents thought they would need assistance for evacuating. The lack of knowledge surrounding flooding in the Valley was evident with 46 percent not being able to nominate anything when asked what could be done to ensure they evacuate quickly.
 - If an evacuation order was given, 73 percent of respondents felt quite or very confident that they would know exactly what to do. Thirty-two percent of participants believed that after hearing their street was evacuating, they would leave immediately which may result in important preparations, such as turning off the power and securing belongings being missed.

- Twenty-six percent of respondents recalled seeing, hearing or reading about flood related information. The main preference for receiving general flood information was via brochures in the mail (51 percent). There was also some sense that information about flood risks and how to prepare for floods should be provided by local government.
- Respondents stated they would have a strong reliance on the State Emergency Service (SES) during a flood and in an evacuation event.
- The survey also recorded that the community finds it difficult to interpret a lot of the common terminology used for flooding.
- 2015 survey:
 - The Hawkesbury-Nepean Valley was commonly described by participants as a diverse and fragmented population which had many close-knit communities and groups. It was also described that these groups do not usually have strong links to other groups. However, the study determined that there are links between these groups and a sense that during difficult times, people band together to help and work through situations.
 - Word of mouth was the most popular channel for dissemination of local information. This was followed by social media and the local newspapers.
 - Participants were concerned about the community’s aptitude to respond correctly during a flood event. Communication of the significance and seriousness of the flood risk and the importance of preparation was emphasised by participants.
- 2018 survey:
 - Community cohesion is strong in the Hawkesbury-Nepean Valley Floodplain with 74 percent of participants claiming they often do things to help others.
 - Floods were still considered to be the lowest risk when compared to bushfires and severe storms. Eighteen percent of participants rated flood events as a perceived high risk. This could be explained by only 38 percent of participants experiencing a flood compared to 50 percent for bushfires and 58 percent for severe storms.
 - In general, the community is not prepared for a flood with 36 percent rating themselves as ‘not prepared at all’ and 11 percent rating themselves as ‘totally prepared’.
 - Seventy-nine percent of participants had done nothing in preparing for a flood.
 - Sixty-four percent of participants agreed with the statement “there is not much point preparing for a flood because the risk of flood is so low”.
 - Participants (58 percent) were generally confident that they would know what to do in an evacuation.
 - The majority of participants (82 percent) also rated themselves as being very aware of the evacuation routes.
 - Thirty-two percent of participants were aware of flood evacuation procedures and were able to identify three or more things which should be done when evacuating. After hearing an evacuation order, 25 percent of respondents said they would seek additional information before leaving and 50 percent said they would try to return home even if access was cut.

Since this research was undertaken, there has been minor to moderate flooding in the Hawkesbury-Nepean Valley, including in February 2020, and a major flooding in March 2021. While the flood in February 2020 was a relatively small event (with a likelihood of around a 1 in 5 chance per year), the flood in March 2021 was the largest flood since the early 1990s (with a likelihood of 1 in 10 to 1 in 20 chance per year). Both events caused disruption across the floodplain, including the closure of roads and bridges.

21.7 Impact assessment

This section summarises the outcome of impact identification and assessment as detailed in Appendix M to the EIS. Impacts were assessed in each identified study area and assessed according to their relative significance as per the impact assessment methodology outlined in Section 21.3 of this chapter.

21.7.1 Local communities' study area

21.7.1.1 Property and land use

The Warragamba Dam Visitor Centre and Haviland Park are situated within the Project construction footprint and would be used during the construction phase. Although there are no changes to land use types for the Project, there would be a temporary disruption of tourism and recreational uses due to the potential temporary closure of these facilities during the construction phase (four to five years). This may have a flow-on effect to local businesses and the overall economic vitality of the town.

The increased construction traffic would not result in any loss of access or any substantial delays in accessing roads from properties. However, it is anticipated that some delays would occur due to additional heavy vehicle traffic, especially at the construction peak time. Property access from Silverdale Road, Warradale Road, Mulgoa Road and Park Road would have some travel delays due to heavy vehicle movements during the construction phase.

Impacts include:

- temporary disruption of tourism and recreation uses due to the potential closure of the Warragamba Dam Visitor Centre and Haviland Park
- delayed travel time in accessing properties due to increased construction traffic.

21.7.1.2 Environment

A noise and vibration assessment was undertaken to assess potential noise and vibration impacts of the Project during the construction and operational phases (refer to Chapter 19 and Appendix L to the EIS). The outcome of the assessment shows that the Project would lead to a reduction in social amenity and impact on existing lifestyles for local communities, especially residents in close proximity to the Project construction site. The existing environment in the local communities' study area is described as a semi-rural with a relatively quiet and relaxed character. During the construction phase, noise created from construction activities and to a lesser extent, Project traffic and blasting may impact on the quiet rural amenity of the surrounding area.

Based on the outcome of the air quality assessment (refer to Chapter 7 and Appendix E to the EIS), there may be impacts on ambient air quality from dust generation and deposition during construction. Prior to mitigation, air quality was assessed as a High risk because the predicted PM₁₀ dust criterion may be exceeded at some residences, although this is expected to be a rare event. Following mitigation, the risk can be reduced to a medium risk, however mitigation would need to ensure that necessary actions are quickly taken in response to adverse weather, such as high wind conditions.

There is a network of roads and parking areas near the Dam which are directly related to the catchment or associated operations and provide access to recreational areas. Most of these roads would have public access restrictions applied such as boom gates and other security measures during the construction phase. Public access to the Visitor Centre and Haviland Park would be unavailable during the construction phase. Road and pedestrian access would be terminated at the intersection of Production Avenue and Twenty Third Street, which would also be the main entrance to the construction site. Although Haviland Park would be closed for the construction period, there are currently no plans to reduce public access to any other parks or recreational facilities in Warragamba, such as Warragamba Recreation Reserve or Warragamba Sportsground. However, the ability to enjoy natural areas surrounding the dam site would be reduced for the duration of the construction phase.

Based on the outcome of the landscape character and visual assessment (refer to Chapter 25 and Appendix P to the EIS), some of the existing Warragamba Dam elements and infrastructure would require demolition or removal to enable the Project to be built. As the result, the dam wall area and surrounds would visually be impacted due to construction works. Three popular viewpoints of the Dam would be affected, including the viewing platform at Warragamba Visitor Centre, the viewpoint from Valve House Road and the viewpoint from the Eighteenth Street Lookout. New infrastructure would be delivered as part of the Project including various modified and new structures. This would result in a higher, more visually prominent dam wall and more extensive downstream infrastructure. The dam elements would essentially be the same and be similar in visual characteristics to the existing Dam, albeit slightly more contemporary in appearance.

Impacts include:

- temporary noise impacts on social amenity during construction
- temporary ambient air quality impacts during construction

- temporary disruption to the enjoyment of natural surroundings during construction
- temporary negative visual impacts during construction
- positive effect on landscape character post construction.

21.7.1.3 Community health and wellbeing

Project transport routes travel through the communities of Warragamba, Silverdale and Wallacia. The Project would generate an estimated 180 heavy vehicle movements and 250 light vehicle movements per day along these routes over the four to five-year construction period. Construction traffic would pose an increased level of risk for road users and pedestrians in sensitive localities. There is the potential for increased safety risks for vehicles accessing heavy vehicle routes, particularly in residential areas and commercial areas where existing heavy vehicle movements are low.

A potential impact associated with increased traffic is the increased risk of traffic accidents, especially as the Southern route would pass The Oaks Public School, Picton Public School, Picton High School, Tahmoor Public School, and the commercial centres of The Oaks, Picton and Tahmoor.

At peak times, the number of heavy vehicles needing to use local roads to access the construction site may have a negative impact on current levels of accessibility. Residents are not used to high traffic volumes and may not feel comfortable sharing local roads with heavy vehicles. Affected residents may become frustrated at ongoing accessibility impediments over the construction period. Feeling unsafe can influence levels of anxiety and can be a barrier to community participation and accessing services.

The presence of a large construction workforce (up to 500 construction workers) in the local area would result in more people utilising community services and facilities. This could result in increased demand on the limited medical services available in the towns of Warragamba and Silverdale.

Services and facilities in the Warragamba commercial area include retail trade, food services, and police, fire and ambulance stations. It is not anticipated that the presence of the construction workforce would place additional pressure of these amenities in such a way that may affect availability for residents in the local area.

Impacts include:

- temporary increased risks to road safety due to construction traffic movements
- temporary increased anxiety relating to community safety due to additional construction traffic movements
- temporary pressure on existing medical and emergency services due to influx of construction workforce.

21.7.1.4 Culture and heritage

The construction area covers approximately 100 hectares, of which about 33 hectares would be temporarily disturbed during the construction. During the construction, the development of surface infrastructure would be wholly within the Project footprint and would not cause direct harm to any Aboriginal objects or areas of cultural value located within the footprint. An assessment on impacts to Aboriginal objects and Aboriginal places was undertaken (refer to Chapter 18 of the EIS). Proposed surface infrastructure avoids all rock shelters, grinding grooves and natural landscape features, such as geology and soil landscapes. Therefore, there would be no potential surface disturbance impacts to any of these site types or any sites with moderate or high scientific significance.

Within and adjacent to the construction area, there are several listed non-Aboriginal heritage items, including the Dam itself, Haviland Park and Warragamba Emergency Supply Scheme (refer to Chapter 17 of the EIS on non-Aboriginal heritage assessment). The Project would result in a range of physical and visual impacts to Haviland Park due to realignment of a section of Production Avenue. In addition, the use of a large portion of land within Haviland Park would require removal of vegetation and ground excavations. Further, the crest crane on the crest road would need to be removed. It is noted that there would be a need to relocate plaques and memorials on the crest roadway, including the memorial with brass plaques commemorating the works and those who lost their lives building the Dam. The proposed works include several activities with the potential to impact on archaeological remains associated with the original Warragamba Dam construction camp, including vegetation clearance, demolition, levelling and construction works.

The construction phase of the Project could result in direct and indirect impacts to biodiversity within the construction area (refer to Chapter 10 of the EIS with regard to Construction Area Biodiversity Assessment). Direct impacts on biodiversity values are caused by vegetation clearing while indirect impacts on biodiversity values are caused when

Project-related activities affect threatened species, threatened species habitat, populations or ecological communities in a manner other than direct impacts. Impacts would include:

- loss or fragmentation of native vegetation due to the clearance of 22.42 hectares of native vegetation
- loss or degradation of ecologically important habitat
- loss of threatened flora and fauna species
- potential fauna mortality
- potential changes to natural fire regimes
- potential weed and feral animal invasion.

The Construction Area Biodiversity Assessment states that there is certainty that native vegetation would be cleared, which would result in the loss of ecological habitat and threatened species. This creates a High impact because of the local degradation of sensitive habitat.

Impacts include:

- temporary and permanent disturbance of non-Aboriginal heritage items
- temporary and potentially permanent impacts on natural heritage, such as local parkland and native bushland flora and fauna.

21.7.1.5 Way of life

The construction phase would generate employment opportunities for people in local communities of Warragamba and Silverdale and for people across the broader region. The Project would require up to 300 workers for site establishment works and up to 500 workers at the peak of construction. The construction workforce for the Project would generally be provided by contractors and subcontractors. Increased spending in the local area due to the Project would also stimulate additional indirect employment opportunities in local communities.

During the construction phase, the Project would involve the procurement of a broad range of goods and services. This would provide some commercial opportunities for businesses in Warragamba, Silverdale, Wallacia and the broader region.

The potential temporary closure of the Visitor Centre and the closure of Haviland Park along with increased heavy vehicle movements and construction related activities may deter some tourists from visiting the Dam throughout the construction period. Reduced tourist numbers may have a flow-on effect on local businesses and the overall economic vitality of the town.

During the construction phase, the Project may also have a positive effect on tourism as people come to witness the construction process which would be able to be viewed from the Eighteenth Street Lookout. The Eighteenth Street Lookout has the potential to have increased visitors due to its excellent view of the construction activities on the Dam itself, possibly leading to increased tourists to Warragamba.

Once operational, it is likely that the 'engineering significance' of the Dam would increase and therefore may attract additional tourists. The Visitor Centre would be reopened when construction work is finished, and the surrounding area restored.

The presence of a large construction workforce (up to 500 construction workers) may impact on community sentiment and cohesion. Most of the construction workforce would be sourced from outside the local area, driving in and out on a daily basis. As non-resident workers would be only present while on roster, there would be limited opportunities for integration with local community. In addition, there may be differences between residents and non-resident workers in terms of aspirations, values and behaviour. Therefore, impacts associated with behaviour of workers and poor integration of workers into local communities may occur.

Impacts include:

- temporary generation of employment opportunities
- temporary generation of commercial opportunities for businesses
- perceived temporary negative effects on tourism industry
- a post construction increase in visitation numbers to the Dam
- temporary impacts on community sentiment and cohesion.

Table 21-11 summarises the socio-economic impacts the Project's local communities' study area.

Table 21-11. Summary of socio-economic impacts and their significance rating for the Project's local communities' study area

No.	Impact	Positive/negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Property and land use						
1	Construction - Temporary disruption of tourism and recreation uses due to the potential closure of the Warragamba Dam Visitor Centre and Haviland Park	Negative	Tourists and locals	Almost Certain	Moderate	A3 - Extreme
2	Construction-Delayed travel time in accessing properties due to increased construction traffic	Negative	Communities living along the construction traffic movements	Almost Certain	Minor	A2 - High
Environment						
3	Construction – Temporary negative visual impacts	Negative	Tourists, locals, and dam operation staff working on site	Likely	Moderate	B3 - High
4	Post construction - Positive landscape character	Positive	Tourists, locals, and tourism bodies	Likely	Moderate	B3 - High
5	Construction – Temporary noise impacts on social amenity	Negative	Warragamba community living in the proximity to the Project construction site	Likely	Moderate	B3 - High
6	Construction – Temporary air quality impacts	Negative	Warragamba and Silverdale communities living in the proximity to the Project construction site	Possible	Minor	C2 - Moderate
7	Construction – Temporary disruption to the enjoyment of natural surroundings	Negative	Tourists and locals	Likely	Moderate	B3 - High
Community Health and wellbeing						
8	Construction – Temporary risks to road safety due to construction traffic movements	Negative	Communities living along the construction traffic routes	Possible	Catastrophic	C5 - Extreme
9	Construction – Temporary anxiety relating to community safety due to additional construction traffic movements	Negative	Communities living along the construction traffic movements	Possible	Minor	C2 - Moderate
10	Construction – Temporary pressure on existing medical and emergency services due to influx of construction workforce	Negative	Warragamba and Silverdale communities and existing medical and emergency services	Possible	Minor	C2 - Moderate

No.	Impact	Positive/ negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Culture and heritage						
11	Construction – Temporary and permanent disturbance of non-Aboriginal heritage items	Negative	Tourists and locals	Almost Certain	Moderate	A3 - Extreme
12	Construction – Temporary impacts on natural heritage (such as local parkland and native bushland flora and fauna)	Negative	Tourists, locals and environmental advocacy groups	Almost certain	Moderate	A3 - Extreme
Way of life						
13	Construction – Temporary generation of employment opportunities	Positive	Project region jobseekers	Likely	Minor	B2- High
14	Construction – Temporary Generation of commercial opportunities for businesses	Positive	Project region business and industries	Likely	Minor	B2- High
15	Construction – Perceived temporary negative effects on Tourism industry	Negative	Tourists, locals, tourism bodies, and tourism businesses	Likely	Moderate	B3 - High
16	Post construction – Increase in visitation numbers to the Dam	Positive	Tourists, locals, tourism bodies, and tourism businesses	Possible	Minor	C2 - Moderate
17	Construction – Temporary impacts on community sentiment, cohesion, and resentment	Negative	Warragamba, Silverdale and Wallacia communities	Possible	Moderate	C3 – High

21.7.2 Upstream communities' study area

21.7.2.1 Property and land use

The upstream community has voiced a high level of concern as to the effects of the Project on World Heritage listed areas and National Park listed areas. While the additional total area that would be temporarily inundated for the PMF would be relatively small (590 hectares which accounts for 0.06 percent of the total area), community and stakeholder interest groups have expressed opposition to any impacts to the GBMWH and other protected lands as it erodes the value provided by World Heritage List status.

While most of the lands upstream potentially affected by the Project are designated for environmental conservation and water catchment protection, there are two privately owned lots (owned by the same owner) which would be temporarily affected by inundation in the event of temporarily holding back inflows associated with a major flood event. There are some additional properties which are impacted by existing flooding but would experience no change in flooding due to the Project.

Holding back inflows in the FMZ would result in impacts in access to Yerranderie Private Town from the east. However, this is not a public access route. The main access route to Yerranderie via the Colong Oberon Stock Route would not be affected by the Project. As only six trips per year are permitted to access Yerranderie via the eastern route, the consequence associated with changed access is considered to be low.

Impacts include:

- community concern regarding effects on World Heritage and National Parks listed lands
- direct effects on two private properties due to temporary and partial inundation of land
- changed access to properties at Yerranderie.

21.7.2.2 Environment

Concerns were raised by community stakeholders that views from lookouts such as Echo Point and Burratorang may be negatively affected. Views of Lake Burratorang from helicopter tours and other airborne travel may also be negatively affected. There are popular walking, mountain bike and four-wheel drive (4WD) trails throughout the area surrounding Lake Burratorang with some passing close to areas which would be temporarily inundated. Viewpoints from such trails could be negatively affected; however, the trails are typically closed during and following major rainfall events.

The Upstream Biodiversity Assessment found that the Project's operational impact would result in increased temporary inundation effects (refer to Chapter 8 of the EIS). These impacts would involve changes to current temporary inundation extents, depths and durations, and rates of rising and receding flows. There would be subsequent direct and indirect impacts on biodiversity values in the upstream communities' study area. Direct impacts on biodiversity values are caused by loss of vegetation with associated indirect impacts on species habitat, populations or ecological communities.

Direct impacts on biodiversity values in the upstream communities' study area include: loss of native vegetation, loss of threatened ecological communities, and loss of flora and fauna species and their habitats. Indirect impacts on biodiversity values include loss or fragmentation of native vegetation, degradation, changes to terrestrial habitats and associated fauna mortality. As outlined in Section 0 (SEIA baseline) and Section 21.6 (Stakeholder engagement), the residents of the Blue Mountains and Wollondilly LGAs highly value the opportunity to enjoy natural areas and the native flora and fauna. The ability to enjoy native flora and fauna may be affected by the loss or displacement of valued species due to alteration of habitat.

Impacts include:

- alteration to popular tourist viewsheds
- alterations to viewpoints from some walking, mountain bike and 4WD trails
- disruption to enjoyment of native flora and fauna.

21.7.2.3 Community health and wellbeing

Members of the upstream community have demonstrated opposition to the Project. Opposition to major projects, particularly when there would be resultant environmental change and when people feel that events are occurring beyond their control, can cause stress and anxiety. Members of the community feel anxious and threatened by the loss of World Heritage and environmental values. In particular, members of the Aboriginal community feel anxious and threatened by the potential loss of cultural heritage. This may trigger further deeper feelings of disempowerment associated with loss of access to and ability to manage their country.

Impact include health effects associated with heightened anxiety.

21.7.2.4 Culture and heritage

A key concern raised by community and stakeholder interest groups is the impact which the Project would have upon Aboriginal cultural heritage. The Project would lead to the temporary inundation of areas which have social, aesthetic, historical and archaeological significance. As identified in the ACHA (refer to Chapter 18 of the EIS), a total of 334 new and AHIMS (Aboriginal Heritage Information Management System) registered Aboriginal cultural heritage sites were identified.

The study area for the ACHA included Lake Burratorang and its tributaries, upstream catchment areas and the dam construction precinct. Of 334 identified sites, 64 sites already experience regular and prolonged inundation as they are below the permanent maximum water level of the existing dam. In addition, 173 sites which are above the full storage level and below the existing PMF level are already potentially impacted by flood events. However, the Project would increase the duration of temporary flooding by holding back inflows in the FMZ. There are 34 sites which are not impacted by existing flooding but would be inundated following development of the Project. Sixty-three sites which are outside the Project study area would not be impacted by temporary flooding. Of the 334 identified sites, 40 are predicted to experience a high level of impact, 22 a medium level of impact and 272 a low level of impact.

All non-Aboriginal heritage was either relocated or destroyed prior to the completion of the Warragamba Dam and the inundation of Lake Burratorang. Subsequently, heritage is limited to natural heritage (refer to Chapter 17 of the EIS). The National Heritage List (NHL) was established under the *Environment Protection and Biodiversity Conservation Act 1999* and provides a legal framework to protect and manage nationally and internationally important flora, fauna

and ecological communities, and heritage places. There are two places within the upstream area on the NHL, which includes one listed place and one nominated place. Although the nominated places have not yet been added to the NHL, they should be managed in accordance with the values set out in their nomination until a decision on whether to list the places is made.

Impacts include:

- effects on Aboriginal cultural heritage
- effects on natural heritage.

21.7.2.5 Way of life

Concerns were raised that the potential environmental impacts of the Project (including World Heritage listing) would detract from the desirability of the Blue Mountains as a key destination for international and domestic tourism. As a key element of the local economy of the Blue Mountains, a downturn in tourist numbers would affect a broad array of tourism-related businesses with potential flow effects to other businesses.

Nature-based recreation such as hiking, mountain biking and birdwatching are popular activities in the upstream area. There are many businesses in the region which either directly (such as guided walks and tours) or indirectly (for example, accommodation, food and beverage) provide goods and services to those partaking in nature-based recreation. Concerns were raised that the perceived environmental effects of the Project may detract from the desirability of the region as a centre for nature-based recreation, with subsequent negative commercial effects on businesses.

The residents of the Blue Mountains LGAs highly value the environmental and cultural attributes of the area in which they live. There has been considerable opposition registered against the Project due to perceived environmental and cultural impacts. If the Project were to proceed, those who hold strong environmental and cultural values may feel powerless, disenfranchised and lacking capacity and power to influence decisions that affect them. They may feel as though their ability to enjoy their values has been diminished.

A further factor influencing cohesion is the potential polarisation of community sentiment. There has been a campaign ('Give a Dam') mobilised in opposition to the Project, centring on the upstream communities. A campaign of such a scale can have a negative effect on community cohesion. This campaign can lead to polarisation of opinion which can have lasting effects on community relationships as a 'either you are with us or against us' mentality pervades. While in some sectors of the community, there may be almost universal opposition to the Project, which may also have a positive effect on community capacity and involvement.

In other sectors, stakeholders may be undecided regarding whether they support or oppose to the Project. Fracturing of public opinion can have a negative effect on community relationships and networks and resultant erosion of community cohesion.

Impacts include:

- reduced tourism visitation due to perceived environmental impacts
- reduction in revenue for nature-based recreation businesses due to perceived environmental impacts
- diminished enjoyment of community values
- polarisation of community sentiment resulting in reduced community cohesion.

Table 21-12 summarises the socio-economic impacts the Project's upstream communities' study area.

Table 21-12. Summary of socio-economic impacts and their significance rating for the Project's upstream communities' study area

No.	Impact	Positive/negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Property and Land Use						
1	Operation – Community concern regarding effects on World Heritage listed areas	Negative	Upstream communities, broader community, and environmental advocacy groups	Likely	Moderate	B3 – High
2	Operation – Community concern regarding effects on National Parks	Negative	Upstream communities, broader community, and environmental advocacy groups	Likely	Minor	B2 – High
3	Operation – Direct effects on two private properties due to temporary and partial inundation of land	Negative	Affected property owners	Almost Certain	Minor	A2 – High
4	Operation – Changed access to properties at Yerranderie	Negative	Yerranderie residents living along access routes	Unlikely	Minor	D2 – Low
Environment						
5	Operation – Alteration to upstream iconic viewsheds	Negative	Tourists and locals	Unlikely	Major	D4 – High
6	Operation – Alterations to viewpoints from walking, mountain bike and 4WD trails	Negative	Tourists, locals, pedestrians, and cyclists	Rare	Minor	E2 – Low
7	Operation – Disruption to enjoyment of native flora and fauna	Negative	Upstream communities, tourists, and environmental conservation community groups	Likely	Moderate	B3 – High
Community Health and wellbeing						
8	Operation – Health effects associated with heightened anxiety	Negative	Upstream communities and members of environmental advocacy groups	Unlikely	Moderate	D3 – Moderate
Culture and heritage						
9	Operation – Effects on Aboriginal cultural heritage	Negative	Aboriginal people and members of the broader community who value Aboriginal heritage	Likely	Moderate	B3 – High

No.	Impact	Positive/negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
10	Operation – Effects on natural heritage	Negative	Upstream communities and environmental advocacy groups	Possible	Moderate	C3 – High
Way of life						
11	Operation – Reduced tourism visitation due to perceived environmental impacts	Negative	Tourism-related businesses and other relevant businesses	Possible	Minor	C2 – Moderate
12	Operation – Reduction in revenue for nature-based recreation businesses due to perceived environmental impacts	Negative	Nature-based recreation businesses	Unlikely	Moderate	D3 – Moderate
13	Operation – Diminished enjoyment of community values	Negative	Members of environmental advocacy groups and locals	Possible	Moderate	C3 – High
14	Operation – Polarisation of community sentiment resulting in reduced community cohesion	Negative	The Blue Mountains and Wollondilly communities	Possible	Moderate	C3 – High

21.7.3 Downstream communities

21.7.3.1 Property and land use

Overall, the Project would result in a reduction in the impacts of flooding within the downstream communities' study area. Table 21-13 presents the modelled flood effects on residential properties as per current state and compared against the 'with Project' scenario.

Table 21-13 Residential properties affected by flooding, existing risk compared to Project

Flood size	Number of (2018) existing residential properties affected by flooding		Existing risk (2018) reduction with raised Dam compared to existing Dam
	Existing risk (2018) with existing Warragamba Dam	Existing risk (2018) with raised Dam	
1 in 5	160	110	31%
1 in 10	370	170	54%
1 in 20	1,000	280	72%
1 in 50	3,100	480	85%
1 in 100	5,900	820	86%
1 in 200	8,200	1,800	78%
1 in 500	13,700	4,200	69%
1 in 1,000	17,700	7,800	56%
1 in 2,000	21,700	13,300	39%
1 in 5,000	24,300	18,200	25%
PMF	34,800	30,900	11%

Table 21-14 presents the modelled flood effects on manufactured homes as per current state and compared against the 'with Project' scenario. Manufactured homes refer to semi-permanent styles of housing such as cabins and caravans.

Table 21-14. Manufactured homes affected by flooding, existing risk compared to Project

Flood size	Number of (2018) existing manufactured homes affected by flooding		Existing risk (2018) reduction with raised Dam compared to existing Dam
	Existing risk (2018) with existing Warragamba Dam	Existing risk (2018) with raised Dam	
1 in 5	570	260	54%
1 in 10	1300	650	50%
1 in 20	1,500	1,200	20%
1 in 50	1,700	1,500	12%
1 in 100	1,700	1,600	6%
1 in 200	1,800	1,700	6%
1 in 500	1,800	1,700	6%
1 in 1,000	1,900	1,800	5%
1 in 2,000	1,900	1,800	5%
1 in 5,000	1,900	1,900	0
PMF	1,900	1,900	0

Across the downstream communities' study area, 370 residential properties and 1,300 manufactured homes would be affected by flooding associated with 1 in 10 chance in a year event. Under the 'with Project' scenario, there would be an estimated 54 percent reduction in the number of residential properties and 50 per cent reduction in the number of manufactured homes affected. In a 1 in 100 chance in a year event an estimated 5,900 residential properties and 1,700 manufactured homes would currently be affected. With the project, there would be an estimated 86 percent reduction in the number of residential properties affected and a 6 percent reduction for manufactured homes. For a 1 in 500 chance in a year event, a large number of residential properties (13,700) and manufactured homes (1,800) would be affected by flooding. The Project would serve to reduce the number of residential properties affected by a 1 in 500 chance in a year event by 69 per cent to 4,200 residential properties and by 6 percent to 1,700 manufactured homes.

The economic cost to the community, business and the NSW Government includes damages to residential properties, public infrastructure, commercial properties, assets and other structures. Damage costs would mostly be due to flooding impacts on private residences however, commercial properties and public infrastructure would also be damaged and require repair. With the Project, the flood damage estimates would typically be reduced by approximately 74 to 80 percent for floods up to about the 1 in 200 chance in a year event, reducing to approximately 50 percent for a 1 in 2,000 year chance in a year event.

Predicted effects to residential properties across each of the LGAs of the downstream communities' study area is detailed in Appendix M to the EIS. Effects are predicted for the following key land uses:

- residential properties along with the number of permanent or semi-permanent manufactured homes
- commercial and industrial properties
- hectares of land supporting rural activities.

A summary of the predicted effects to residential properties, commercial and industrial buildings, and rural activities of each LGA is provided as follows:

- Liverpool LGA:
 - No residential properties affected by smaller flood events (1 in 50 change in a year and smaller) and fewer than 10 properties affected by a 1 in 100 chance in a year event. In a 1 in 2,000 chance in a year flood an estimated 30 residential properties would be affected. Under the 'with Project' scenario, the number of residential properties predicted to be affected would reduce by an estimated 70 percent. In a 1 in 5,000 chance in a year event, the Project would reduce the number of residential properties affected (50 properties) by an estimated 60 per cent.

- With regards to commercial and industrial buildings, it is predicted that approximately 20 would be affected by a 1 in 5,000 chance in a year event. With Project scenario, this would be reduced by 50 percent. It should be noted that the number of commercial and industrial properties potentially affected is likely to increase due to development activity stimulated by the Western Sydney Airport and the Western Sydney Aerotropolis projects.
- It is predicted that for a 1 in 100 chance in a year event there would be 310 hectares of land supporting rural activities affected under current state compared to 250 hectares with the Project, which represents a 19 percent reduction. For a 1 in 5,000 chance in a year event, the Project would result in an estimated 27 percent reduction in flooding of land supporting rural activities.
- Penrith LGA:
 - The number of residential properties affected by a 1 in 20 chance in a year event is currently estimated to be 70, which would reduce to fewer than 10 under the ‘with Project’ scenario. For a 1 in 100 chance in a year event there are currently an estimated 1,700 residential properties which would be affected. This number is predicted to reduce to 80 residential properties under the ‘with Project’ scenario, which represents a reduction of 95 percent. In a 1 in 1,000 chance in a year event, an estimated 7,200 residential properties would be affected and 150 manufactured homes. Under the ‘with Project’ scenario the number of residential properties affected in the Penrith LGA would be reduced by 65 percent, with the number of manufactured homes affected reducing from 150 to 70 homes.
 - For a 1 in 100 chance in a year event it is estimated that 70 commercial and industrial properties would currently be affected. Under the ‘with Project’ scenario, this number would reduce to zero.
 - The number of properties supporting rural activities currently affected by a 1 in 100 chance a year event is estimated to be 790, which would reduce to 200 under the ‘with Project’ scenario, a reduction of 75 percent.
- Blacktown LGA:
 - A relatively small number of residential properties (less than 10) would be affected by flooding associated with 1 in 5 and 1 in 10 chance in a year events. Under the ‘with Project’ scenario, these would avoid being affected by flooding. In a 1 in 100 chance in a year event an estimated 400 residential properties would currently be affected. With the Project, there would be an estimated 88 percent reduction in the number of residential properties affected. For as 1 in 1,000 chance in a year event, a large number of residential properties (1,400) would be affected by flooding. The Project would serve to reduce the number of residential properties affected by a 1 in 1,000 chance in a year event by 57 percent to 450 properties in total.
 - An estimated 790 hectares of land supporting rural activities would currently be affected by a 1 in 100 chance in a year event. The Project would result in a 39 percent reduction in the amount of rural land affected by flooding.
 - It is estimated that for a 1 in 100 chance in a year event there would currently be 50 commercial and industrial properties affected. Under a ‘with Project’ scenario, this number would reduce to less than 10 properties.
- Hawkesbury LGA:
 - Across the Hawkesbury LGA it is currently estimated that there would be 3,500 residential properties affected by a 1 in 100 chance in a year event, along with 610 manufactured homes. Under the ‘with Project’ scenario, the number of residential properties affected by a 1 in 100 chance in a year event would be reduced by 74 percent.
 - It is predicted that 3,810 hectares of property supporting rural activities would currently be affected by a 1 in 5 chance in a year event. Under the ‘with Project’ scenario it is predicted that there would be a 46 percent reduction in the area of land affected to a total of 2,080 hectares. The effect of the Project in reducing the extent of land inundated diminishes the larger the flood event. For instance, in a 1 in 100 chance in a year event, under the ‘with Project’ scenario there would be an estimated 15 percent reduction in the extent of land affected, while for a PMF the effect of the Project is only a two percent reduction.
 - It is estimated that currently 820 commercial and industrial properties would be affected by a 1 in 100 chance in a year event. Under the ‘with Project’ scenario, the number of properties affected would be reduced by 80 percent to a total of 160 commercial and industrial properties.

- The Hills LGA:
 - It is estimated that there are 100 residential properties which would currently be affected by a 1 in 100 chance in a year event. There are a relatively large number of manufactured homes located adjacent to the river which would be affected by even small flood events. An estimated 270 manufactured homes are predicted to be currently affected by a 1 in 5 chance in a year event, which rises to a total of 670 in a 1 in 10 chance in a year event and 850 manufactured homes in a 1 in 20 chance in a year event. Under the ‘with Project’ scenario it is predicted that there would be a 60 percent reduction in the number of residential and manufactured homes affected by a 1 in 5 event; a 43 percent reduction for a 1 in 10 chance in a year event and a 22 percent reduction for a 1 in 20 chance in a year event.
 - There are comparatively few commercial and industrial properties vulnerable to flooding in the Hills LGA. It is predicted that 144 hectares of land for rural activities would be affected by a 1 in 5 chance in a year event and 172 ha affected by a 1 in 10 chance in a year event. Under a ‘with Project’ scenario it is predicted there would be a 16 percent reduction to the amount of rural activity land affected by a 1 in 5 and 1 in 10 chance in a year event.

Flood related land use controls

A complex system of land use planning controls set and administer land use. Flooding is a key consideration in determining permissible land use and development. Currently, no residential development can be approved on land which is inundated by the existing 1 in 100 chance in a year event. While the 1 in 100 chance in a year event would change as a result of the Project, it is proposed that the existing flood planning levels would not change. However, over time as flood patterns become better understood and modelling is updated, it is reasonable to conclude that the effect of the Project, in terms of reduced flood risk in some areas, may have an influence upon future land use planning decisions. The NSW Government has clearly stated that the proposed dam raising would not lead to any further development beyond what is already permitted.

While the Project would reduce the frequency, extent and severity of flood events, the release of water would lead to more prolonged (lower level) flood conditions. As a result, access to some properties may be affected for a longer period. For example, in the 1 in 100 per year flood event, water levels would return to typical levels about a week after the event commenced. However, with the Project, it would be about 11 days before water levels returned to typical levels due to the discharge of water from the FMZ in the 1 in 100 per year flood event. Generally, the flows would be within the banks of the Hawkesbury-Nepean River with the exception of some low-lying areas around Windsor and the Penrith Lakes area, which would experience extended low-level flooding. Some low-level river crossings would be closed for longer periods due to the discharge of the FMZ. River crossings that would be affected the most include Yarramundi Bridge, Cattai Road bridge over Cattai Creek and the Sackville car ferry.

Impacts include:

- reduction in the impacts of flooding in the LGA of Liverpool
- reduction in the impacts of flooding in the LGA of Penrith
- reduction in the impacts of flooding in the LGA of Blacktown
- reduction in the impacts of flooding in the LGA of Hawkesbury
- reduction in the impacts of flooding in the LGA of The Hills
- loss of flood mitigation benefits due to lack of land use planning controls
- decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge.

21.7.3.2 Environment

A landscape character and visual assessment was completed as part of the EIS and examined potential Project related effects at three key sites: Penrith Weir, Richmond Bridge and Windsor Bridge (refer to Chapter 25 and Appendix P to the EIS). Penrith Weir was rated as having a high level of sensitivity due to locals and tourists regularly visiting the scenic river, park reserve, historic weir and bridges. A low-moderate level of magnitude was assessed as being associated with increased water levels as a result of both minor and major flooding events. Richmond Bridge was rated as having a high level of sensitivity due to motorists, cyclists and pedestrians being transitory viewers of the river along with those engaging in recreational river-based activities and locals and tourists using the park facilities having views of the river. A low-moderate level of magnitude of impact was assessed with minor flood releases raising river water levels but the bridge remaining in operation. Windsor Bridge was rated as having high sensitivity. A moderate level of magnitude of impact was assessed. The bridge would be closed for all flood events under current

circumstances but remain open up to a 1 in 20 chance in a year event with the Project. These three sites are representative of the potential impact on visual amenity along the Hawkesbury-Nepean River. While it is not predicted that the Project would have any permanent effect on visual characteristics of the river and river bank, the extended duration of elevated flood waters would temporarily disturb views.

As a result of the Project, there would be reduced frequency in which flood events are experienced in downstream areas. By withholding peak flood inflows, the extent of flooding experienced in downstream areas would also be reduced. This would have a positive effect on visual amenity as areas that would currently be flooded, would avoid being flooded with the Project. The landscape character and visual assessment recognised that due to viewers having no context to compare to, the reduced flooding extent in the downstream communities' study area may not be perceptible. However, the damage to infrastructure, loss of vegetation, debris and other matters along riparian zones and deposited sediment would have visual impacts. Reducing flood flow and extent would reduce the flood damage and consequently, the Project would reduce visual impacts (refer Figure 21-7).

Figure 21-7. Debris on bridge during the February 2020 flood event



Source: Infrastructure NSW (Image: Adam Hollingworth).

Across the floodplain, many of the natural areas enjoyed by residents and visitors are located close or adjacent to the Hawkesbury-Nepean River and thereby are highly vulnerable to flood events. The Project would reduce the severity and frequency of such areas experiencing flooding. However, the changes to the flood regime may result in changes to flora and fauna enjoyed by residents and visitors. Fishing and birdwatching are both popular nature-based activities which would potentially be affected by alterations to the current flood regime, particularly along the river and in adjacent wetlands and nature reserves.

It should be noted that planned implementation of variable environmental flows from Warragamba Dam would change the nature of releases. Changes to visual amenity and 'enjoyment of natural area's related to the operation of the FMZ would happen within the context of this changed environmental flow regime.

Impacts include:

- alteration of visual amenity associated with release of water from the FMZ
- avoidance of altered visual amenity due to reduction in the extent of flood inundation associated with most flood events
- disruption to the enjoyment of natural areas and the flora and fauna.

21.7.3.3 Community health and wellbeing

Flood events present a significant risk to community safety on the Hawkesbury-Nepean Valley, which is considered to have the highest single flood exposure in New South Wales. Population growth pressures along with historically deficient planning controls have resulted in residential areas which are highly exposed to flood risk. There are an estimated 5,000 homes which would currently be inundated in a 1 in 100 chance in a year event. By reducing the extent, frequency and severity of flood events, the Project would enhance the safety of residential areas. Five thousand houses currently located in areas would be inundated in a 1 in 100 chance in a year event, with the Project, this number is reduced to 1,000. This equates to approximately 10,000 people whose personal safety is currently threatened no longer being directly at risk due to their homes being inundated. The Project would further enhance community safety by reducing the risk of water-borne, vector-borne and soil-borne disease from flooding through reducing the frequency of flood events.

In addition, by reducing the frequency of smaller flood events (including 1 in 5, 1 in 10 and 1 in 20 chance in a year events), the Project would reduce the exposure of homeless persons and people living (both permanently or temporarily) in vulnerable forms of housing, such as caravan parks.

Evacuation is critical to avoid risks to human life in flood events. It is currently estimated that 43,100 people would need to be evacuated from the Hawkesbury-Nepean floodplain in the event of a 1 in 100 chance in a year event and an estimated 61,200 people needing to evacuate in a 1 in 500 chance in a year event. The Project would substantially reduce the frequency of flood events, avoiding evacuation routes being cut from McGraths Hill, Pitt Town and Windsor. For large flood events, the evacuation routes would also remain open longer. This would substantially reduce the risk of loss of life in a major flood event.

Across the downstream communities' study area, there are numerous semi-permanent styles of housing such as cabins and caravan parks. Caravan parks are typically located on the banks of the river, taking advantage of highly scenic amenity and ready access to recreational opportunities. As such, they are in a highly hazardous location in terms of floods. Added to this is the vulnerability of occupants – both short-term tourists and long-term residents. Tourists tend to lack awareness of the risk and numbers also swell dramatically during holiday periods. Residents of caravan parks include relatively short-stay occupants, who also may lack awareness of the risk. Longer-term residents are often elderly or are suffering from a form of disability. Those in the workforce tend to be employed in low-paying jobs, and a relatively-high proportion are unemployed. These characteristics point to the likelihood of difficult emergency evacuation and reduced capacities to recover after floods by repairing or relocating (low savings and income levels). People in social housing are considered a key community of concern in the floodplain due to a high concentration of social and physical vulnerability. There are approximately 1,600 social housing properties at risk of flooding across the Hawkesbury- Nepean floodplain. The reduction of flood flow and extent as provided by the Project would reduce the risk to vulnerable people living in social housing.

People experiencing homelessness are also highly vulnerable. There are an estimated 14,000 homeless persons in Western Sydney, and there has been a substantial increase in the recorded number of homeless persons between 2011 and 2016, such as in Penrith (45 percent increase), in Hawkesbury (166 percent increase) and in Dural-Wisemans Ferry (77 percent increase) (Lawton 2018). By reducing the frequency of smaller flood events (including 1 in 5, 1 in 10 and 1 in 20 chance in a year events), the Project would reduce the exposure of homeless persons and people living (both permanently or temporarily) in vulnerable forms of housing such as caravan parks.

Research conducted by SMEC (SEIA surveys and EIS consultations) and Newgate Research (INSW Flood Strategy) confirmed that levels of flood risk consciousness held by the broader public are low across the floodplain, particularly in higher growth areas such as the LGAs of Penrith and Blacktown. Levels of awareness and planning for flood disaster events are accordingly low. There is a risk that the Project would further exacerbate an attitude of complacency regarding flood risk if members of the community (falsely) interpret that the Project would deliver complete flood immunity under all flood events.

A primary reason why there is a general lack of awareness of flood risk at the time of the research, is that a majority of community had not experienced a major flood event. Community awareness on flood risk might have changed after the March 2021 major flooding event. A major flood event would result in considerable damage to or loss of property and potential loss of life. This would be a cause of anguish and despair for those affected. Recent studies have found that exposure to weather-related hazards such as floods adversely affects mental health (Graham *et al.* 2019). The Project would serve to reduce the risk to persons and properties associated with flood events. Accordingly, the Project would reduce adverse effects on mental health due to reduced exposure to flood risk.

Research indicates that natural disasters in Australia generate substantial economic and social costs in relation to mental health impacts. The economic costs of the social impact of natural disasters report undertaken by Deloitte Access Economics found that ‘the social costs of natural disasters in 2015 were at least equal to the physical costs – if not greater’ (Deloitte Access Economics, 2016: 2). The report included a case study on the 2010-2011 Queensland floods and found that mental health issues were the largest impact of the floods. It concluded that ‘the lifetime cost of mental health issues resulting from the floods is estimated at around \$5.9 billion (net present value in 2015 dollars)’, with the total intangible social impacts being \$7.4 billion and tangible impacts totalling \$6.7 billion (Deloitte Access Economics, 2016: 34, 36). As such, the Project has the potential to reduce economic costs related to mental health issues associated with flooding, through reducing the frequency and extent of flood events.

There are a broad range of services and facilities across the floodplain which are vulnerable to major flood events. These include both utilities which are relied upon to maintain standards of living, such as power, water and sewerage and major health facilities including public and private hospitals. In a 1 in 100 chance in year event, both the McGraths Hill Sewage Works and the Richmond Sewerage Treatment Plant would currently be affected while with the Project, both these facilities would not be impacted. The national transmission sub-station located in South Windsor would currently be affected by a 1 in 100 chance in a year event, however it would not be affected with the Project. While health facilities such as the Nepean Hospital are not affected by flood events, the Hawkesbury District Health Service and Windsor Specialist Medical Centre would currently be impacted by a 1 in 100 chance in a year event but would not be affected with the Project.

As a result of the discharge of the water in the FMZ following a major flood event, there would be some roads and access points between residential areas and health facilities which would remain closed for a longer duration. For very large flood events such as a 1 in 500 chance in a year event to the PMF, flood islands, including McGraths Hill and Bligh Park, may remain cut from support services for a longer duration with the Project compared to the current situation. As per the Traffic and Transport Assessment (refer to Chapter 24 of the EIS), key access points were assessed in terms of effects associated with the release of the FMZ. It found that the Cattai Creek Bridge and the Yarramundi Bridge would be closed for two to three times longer due to the release of the FMZ following a major flood event. There would be negligible changes due to the Project on the Jim Anderson Bridge, Richmond Bridge and Windsor Bridge. The Project would result in the Sackville Ferry being offline for up to three times longer – currently, offline for 139 hours in a 1 in 100 chance in a year event, compared to 305 hours with the Project.

Release of the FMZ waters would generally occur at a relatively consistent rate. For example, following a 1 in 100 chance in a year event, the release of water would be 100 GL per day over 11 days. Elevated flow rates over an extended period of several days may attract thrill seeking recreational behaviour such as rafting and surfing. Such activities may place participants at risk of personal injury or death.

Releases from the FMZ could affect water quality (and supply), particularly with increased turbidity in river water supplying the North Richmond Water Filtration Plant. In addition, ingesting water as a result of recreational activities during high flow times following a flood event may place people at risk. However, the outcome of the water quality assessment (refer to Chapter 27 of the EIS) indicates that no significant, long-term and adverse impacts on water quality in the downstream communities’ study area are predicted due to releases from the FMZ.

Impacts include:

- enhanced safety of residential areas due to reduced extent and frequency of floods, including reducing risk of post-flooding infectious disease
- enhanced safety due to improved ability to evacuate communities
- reduced risk to people living in highly vulnerable forms of housing
- reduced risk to vulnerable people living in social housing at risk of flooding
- reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency
- improved access to key services, and health facilities
- occasional reduced access to services and health facilities during discharge of water from the FMZ
- health risk relating to temporary reduction in water quality
- reduced adverse effects on mental health due to reduced experience of severe flood events
- reduced economic costs related to mental health issues associated with flooding.

21.7.3.4 Culture and heritage

Modelling assessment undertaken as part of the Aboriginal cultural heritage assessment (ACHA) indicates that the Project would not result in any negative impacts to sites of Aboriginal cultural heritage downstream of Warragamba Dam (refer to Chapter 18 of the EIS).

The Non-Aboriginal cultural heritage assessment found that there was a total of 856 listed heritage items across the downstream communities' study area (refer to Chapter 17 of the EIS). This comprised three Commonwealth listings, 129 listings under the NSW Heritage Act and 724 sites listed under Local Government Local Environment Plans (425 of which were in the LGA of Hawkesbury). It was found that the Project would generally have a positive effect upon cultural heritage listings through reducing the reduction of the severity, extent and frequency of flood events.

The Non-Aboriginal cultural heritage assessment investigated heritage listings located in areas affected by the release of the FMZ following major flood events. It was found that while no Commonwealth heritage listings would be affected by FMZ discharges, there were 29 State heritage registered listings and 270 listings registered on local environment plans which may be affected by FMZ related flows. Whether such flows are likely to result in any damage to individual listed items is not clear.

Impacts include:

- enhanced protection of non-Aboriginal cultural heritage
- potential effects on listed cultural heritage due to release of the FMZ.

21.7.3.5 Way of life

By reducing the extent, severity and frequency of flood events, the Project would avoid damage to property. It is estimated that the economic cost to the community, business and the NSW Government for a 1 in 100 chance in a year event under current circumstances in the Hawkesbury-Nepean Valley would be \$2.1 billion. For a PMF, this would increase to \$29.2 billion.

The Project would reduce the annual projected cost of flood damages from over \$90 million per year (current circumstances) to \$22 million per year (with Project) (INSW 2015). Such a level of savings to the public and private cost potentially has broader positive economic implications, such as the ability to fund further flood risk management solutions and investment in social and community infrastructure.

In March 2016, the Australian Business Roundtable for Disaster Resilience and Safer Communities released 'The Economic Cost of The Social Impact of Natural Disasters'. The report looked at the costs and long-term social impacts of natural disasters in Australia and found the social costs of natural disasters in 2015 were at least equal to the physical costs.

The 2010-11 floods in South East Queensland were 1 of the case studies in the report undertaken by Deloitte Access Economics. It found that lifetime mental health costs alone, at an estimated \$5.9 billion, were approaching the cost of direct impacts on infrastructure of \$7.4 billion.

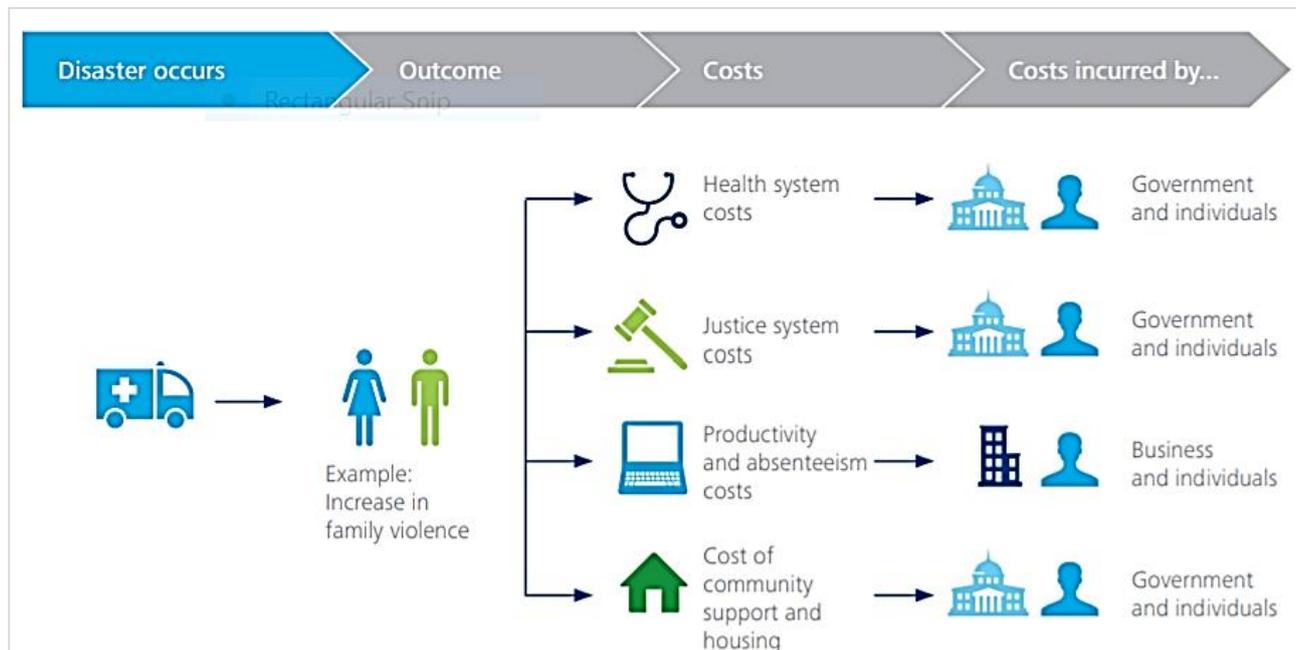
The report found that intangible costs arising from the floods related to a range of issues impacting on individuals including:

- injuries and death
- mental health problems
- risky or high-risk alcohol consumption
- family violence
- chronic and non-communicable diseases
- short-term unemployment.

Deloitte (2016) is undertaking similar analysis of the 2019 North Queensland floods for the Queensland Reconstruction Authority. That flood had around a likelihood of around a 1 in 1000 chance per year and resulted in widespread damages across urban and regional areas. At the time of writing, Deloitte noted that many of the impacts would take months to years to recover from, and that 'There is also anticipation of a high and lasting social cost, with some consequences for people's health and wellbeing expected to persist for the rest of their lives. These include intangible impacts on physical and mental health, family and community cohesion. By the end of March 2019, more than 60,000 people had accessed psychological first aid and more than 100,000 people had applied for personal hardship assistance grants. The human and community impact of this event is already substantial.'

Figure 21-8 from the Deloitte Access Economics report shows how outcomes from natural disasters map to costs incurred by individuals, businesses and the government.

Figure 21-8. Natural disasters map to costs incurred by individuals, businesses and the government



Source: Deloitte Access Economics, *The Economic Cost of The Social Impact of Natural Disasters* (2016)

In the event of a major flood, a large number of people would need to be evacuated from their homes or places of work. It is estimated that 43,100 people would need to be considered in evacuation planning if a 1 in 100 chance in a year event were to occur. It is estimated that a total of 19,800 residents would need to be evacuated and 23,400 residents would be isolated in dwellings (flood islands).

Some of those residents in flooded areas may be homeless for a prolonged period due to access roads being cut; loss of utilities such as power, water and sewerage; and damage to houses caused by flood inundation. Some people's homes may be completely destroyed – it is estimated that 7,600 homes would be affected by flooding in a 1 in 100 chance in a year event.

The Project would reduce the extent, frequency and severity of major floods, for instance, the number of residential properties affected in a 1 in 1,000 chance in a year event would be reduced by 56 percent with the Project. Note however, that under a PMF, the effect of the Project is not as significant, reducing the number of residential properties affected by only 10 percent. The number of houses predicted to be inundated in a 1 in 100 per year event falls to 900. There would also be less damage to road infrastructure and utilities, which allow people to return to their homes sooner.

While a key finding of social surveys undertaken by INSW (*Hawkesbury-Nepean Valley Flood Risk Management Strategy*) and WaterNSW (SEIA surveys and EIS consultation) was that overall public awareness of flood risk is low, it is likely that the extra level of flood protection afforded by the Project would have a positive effect in terms of confidence in the housing market. Improved buyer confidence in the housing market would commercially benefit both investors and existing home owners. A related benefit is the potential for a reduction in flood insurance premiums. Across many locations in the downstream communities' study area, flood insurance is prohibitively expensive. Preliminary analysis undertaken by the Insurance Council of Australia found that due to a substantial reduction in average annual damages, the Project could result in reduced insurance premiums for property owners who are currently exposed (Department of Primary Industries (DPI) 2014a).

The Hawkesbury floodplain is a highly fertile and productive area supporting a wide range of agriculture and agriculture-related businesses. Key agricultural industries on the floodplain include turf farming, fruit and vegetable production, beef and dairy cattle farming, and other forms of animal husbandry such as horse racing and polo. The estimated production value of these industries is in excess of \$900 million per annum, providing employment and livelihoods for several thousand residents and form a vital element of the local economy (DPE 2017a). They also provide key goods and services to the Greater Sydney region. In addition, the Hawkesbury River has traditionally

provided a key source of extractive materials such as sand and gravel and there remains a significant extractives industry.

A defining characteristic of these industries is that they are located in areas which are highly vulnerable to flooding — many incurring disruption even in relatively small flood events such as a 1 in 5 chance in a year event. By reducing the frequency of smaller flood events (including 1 in 5, 1 in 10 and 1 in 20 chance in a year events), the Project would reduce economic losses incurred as a result of flooding. The Project would also provide additional time for businesses to move stock and equipment in flood prone areas, which would further reduce flood-related economic losses.

As a result of the discharge of the water in the FMZ following a major flood event, low-lying areas would be inundated for a more prolonged period. This may have a negative effect on businesses which are wholly located on low-lying lands. More prolonged inundation of turf farms and market gardens may result in the loss of the crop or more extensive loss of top soil. Sands and gravel extraction localities would be inaccessible for a longer period and therefore prolonging loss of production. Horse racing and polo studs may be required to relocate stock for a longer period with consequential costs.

The scenic Hawkesbury River and surrounding areas provide popular recreational and tourism destinations. There are a large number of tourism and recreation-related businesses which rely upon the riverine environment. These include on river activities such as water skiing, riverboat cruises, houseboats, kayaking, fishing, sailing and rowing. Along the river, there are facilities and natural areas which supports tourism and leisure-based activities, such as the Great River Walk in Penrith and the Old Great North Road Heritage Walking Track in Hawkesbury. The estimated value of tourism and recreation on the Hawkesbury River is \$850 million per annum and is a key element of the local economy (The Stafford Group 2017).

As these activities and the businesses which support them are intimately tied to the river, they are highly vulnerable to flooding. Even in relatively small flood events, businesses which are either on river or adjacent to the river are disrupted. By reducing the frequency of smaller flood events (such as 1 in 5, 1 in 10 and 1 in 20 chance in a year event), the Project would reduce economic losses incurred as a result of flooding. The Project would also provide additional time for businesses to equipment and other assets out of harm way, which would further reduce flood related economic losses.

As a result of the discharge of the water held in the FMZ following a major flood event, periods of heightened river flows would be more prolonged. This may have a negative effect on tourism and recreation businesses which are reliant upon river-based activities, however the magnitude of effect would differ between respective businesses. For instance, water ski parks are very popular over the summer holiday period and during such time, they make a large proportion of annual income. If there were a flood event over this period which resulted in prolonged elevated flows preventing water skiing and related activities, the commercial loss for these businesses could be significant.

Flooding poses a major risk to downstream communities and is a key factor influencing the development pattern. Communities across the floodplain vary from urban centres to peri-urban and rural areas. Accordingly, the values and aspirations held by communities differ. The Project would provide greater ability to manage flood events and thereby avoid potential loss of life and property. This would serve to reduce community concerns and anxiety relating to floods. Over time, a greater level of understanding of flood dynamics and the role in which the Warragamba Dam plays in this process would be achieved. This would provide greater certainty in terms of community development and planning. As a result, the legibility, connectivity and therefore cohesion of the communities of the floodplain may be positively affected.

Further, the Project reduces the flood risk across the Hawkesbury-Nepean Valley by delaying and reducing the inflows from the Warragamba River, which makes up 80 percent of the catchment upstream of Penrith and 70 percent of the catchment upstream of Windsor. Across the 19,300 flood events modelled with combinations from all catchments under feasible regional rainfall events, the Project reduced the peak for all flood events above the 1 in 10 change per year level at Penrith, and all events greater than 1 in 15 chance per year level at Windsor.

Impacts include:

- positive economic effects due to reduced flood related damage to property
- reduced risk of people permanently and temporarily losing access to housing and accommodation
- improved confidence in housing market and potential reduction in insurance premiums
- reduction in flood related economic losses for agricultural and industrial businesses
- occasional additional economic losses for agricultural and industrial businesses due to release of FMZ

- reduction in flood-related economic losses for tourism and recreation related businesses
- occasional additional economic losses for tourism and recreation related businesses due to release of FMZ
- improved community cohesion due to improved ability to control flood related risk and plan communities accordingly.

Table 21-15 summarises the socio-economic impacts for the Project's downstream communities' study area.

Table 21-15. Summary of socio-economic impacts and their significance rating for the Project's downstream communities' study area

No.	Impact	Positive/negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Property and land use						
1	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Liverpool (primarily limited to Wallacia)	Positive	Property owners inundated by flooding in the LGA of Liverpool	Almost certain	Minor	A2 – High
2	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Penrith	Positive	Property owners inundated by flooding in the LGA of Penrith	Almost certain ⁶	Major	A4 – Extreme
3	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Blacktown	Positive	Property owners inundated by flooding in the LGA of Blacktown	Almost certain	Major	A4 – Extreme
4	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Hawkesbury	Positive	Property owners inundated by flooding in the LGA of Hawkesbury	Almost Certain ⁶	Major	A4 – Extreme
5	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of The Hills (primarily limited to Wisemans Ferry)	Positive	Property owners inundated by flooding in the LGA of The Hills	Almost Certain	Moderate	A3 – Extreme
6	Operation — Decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge	Negative	Affected property owners	Possible	Moderate	C3 – High

⁶ The Project reduces the peak for all modelled flood events above the 1 in 10 chance per year level at Penrith, and all events greater than 1 in 15 chance per level at Windsor.

No.	Impact	Positive/ negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Environment						
7	Alteration of visual amenity associated with release of the FMZ	Negative	Downstream communities and tourists	Possible	Minor	C2 – Moderate
8	Avoidance of altered visual amenity due to reduction in the extent of flood inundation associated with most flood events	Positive	Downstream communities and tourists	Likely	Minor	B2 – High
9	Operation — Disruption to the enjoyment of natural areas and the flora and fauna	Negative	Downstream communities and tourists	Unlikely	Minor	D2 – Low
Community health and wellbeing						
10	Enhanced safety of residential areas due to reduced extent and frequency of floods, including reduced risk to disease	Positive	Downstream communities	Almost certain	Major	A4 – Extreme
11	Enhanced safety due to improved ability to evacuate communities	Positive	Downstream communities	Almost certain	Major	A4 – Extreme
12	Reduced risk to people living in highly vulnerable forms of housing.	Positive	Downstream communities	Almost certain	Major	A4 – Extreme
13	Reduced risk to vulnerable people living in social housing at risk of flooding	Positive	Downstream communities	Likely	Major	B4 – Extreme
14	Operation — Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency	Negative	Downstream communities	Possible	Minor	C2 – Moderate
15	Operation — Improved access to key services, and health facilities	Positive	Downstream communities	Possible	Moderate	C3 – High
16	Operation — Occasional reduced access to services and health facilities during discharge of water from the FMZ	Negative	Downstream communities	Possible	Minor	C2 – Moderate
17	Health risk relating to temporary reduction in water quality	Negative	Downstream communities	Unlikely	Minor	D2 – Low
18	Reduced adverse effects on mental health due to reduced experience of severe flood events	Positive	Downstream communities	Likely	Major	B4 – Extreme
19	Reduced economic costs related to mental health issues associated with flooding	Positive	NSW Government, downstream communities and downstream local government areas	Likely	Major	B4 - Extreme
20	Reduced health risk to water borne disease	Positive	Downstream communities	Likely	Major	B4 - Extreme
Culture and heritage						
21	Aboriginal cultural heritage	Negative	Aboriginal people and members of broader community	Unlikely	Minimal	D1 – Low

No.	Impact	Positive/ negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
			who value Aboriginal heritage			
22	Enhanced protection of non- Aboriginal cultural heritage	Positive	Downstream communities and environmental conservation groups	Possible	Moderate	C3 – High
23	Potential effects on listed cultural heritage due to release of the FMZ	Negative	Downstream communities and environmental conservation groups	Unlikely	Moderate	D3 – Moderate
Way of life						
24	Positive economic effects due to reduced flood related damage to property	Positive	NSW Government, downstream communities, and businesses	Almost Certain	Major	A4 – Extreme
25	Reduced risk of people permanently and temporarily losing access to housing and accommodation	Positive	Downstream communities and downstream local government areas	Almost Certain	Major	A4 – Extreme
26	Improved confidence in housing market and potential reduction in insurance premiums	Positive	Downstream property owners, investors, and house-related businesses	Possible	Moderate	C3 – High
27	Reduction in flood related economic losses for agricultural and industrial businesses	Positive	Downstream agricultural and industrial businesses	Almost Certain	Moderate	A3 – Extreme
28	Occasional additional economic losses for agricultural and industrial businesses	Negative	Downstream agricultural and industrial businesses	Possible	Moderate	C3 – High
29	Reduction in flood-related economic losses for tourism and recreation related businesses	Positive	Downstream tourism and recreation-related businesses	Almost Certain	Minor	A2 – High
30	Occasional additional economic losses for tourism and recreation related businesses	Negative	Downstream tourism and recreation-related businesses	Possible	Minor	C2 – Moderate
31	Improved community cohesion due to improved ability to control flood related risk and plan communities accordingly	Positive	Downstream communities and LGAs	Possible	Moderate	C3 – High

21.7.4 Estuary communities' study area

21.7.4.1 Property and land use

The overall effect of the Project on Estuary communities is predicted to be minimal. In the lower estuarine areas, tidal influences begin to dominate water levels which reduces potential downstream impacts until they become negligible. As per the Flooding and Hydrology Assessment (Chapter 15 of the EIS), it was concluded that the Project would not have any material effect on water quality downstream of Wisemans Ferry.

Whilst the overall level of impact is minimal, the Project may indirectly affect some properties and land use in the Hawkesbury Estuary. By holding back flood waters to reduce peak flood events and subsequently releasing waters over longer period, the nature of flood flow would be altered from the current state. As a result, there are potential effects on property and land uses in the Lower Hawkesbury Estuary.

In the Hornsby LGA, most of the land affected by flood events is zoned for environmental conservation. For a 1 in 50 chance in a year event it is estimated that 50 residential properties would be currently affected. Under a 'with Project' scenario this would be reduced by 10 properties, a 20 percent reduction. For larger flood events such as 1 in 500 chance in a year event, the estimated number of residential properties currently affected is 90 properties, which under a 'with Project' scenario would reduce by 22 percent to 70 residential properties. Under a PMF scenario it is predicted that the Project would result in a 21 percent reduction in the number of residential properties affected.

There are very few commercial and industrial properties in the Hornsby LGA which are currently affected by floods. There are no properties which would be affected by 1 in 5 and 1 in 10 chance in a year events and less than 10 properties affected by larger floods up to a PMF event. The Project would marginally reduce flood risk for these properties. There are no recorded rural activity areas in Hornsby LGA affected by flooding related to Warragamba Dam.

In the Central Coast LGA, there are residential properties and manufactured homes which are currently affected by flooding. For a 1 in 5 chance in a year event it is estimated that 50 residential properties and 140 manufactured homes would be affected. Under a 'with Project' scenario it is predicted that there would be a marginal (5 percent) reduction in the number of residential properties and manufactured homes affected. Similarly, for a 1 in 10 chance in a year event, under a 'with Project' scenario it is predicted there would be a 5 percent reduction in the number of residential properties and manufactured homes affected. For a 1 in 100 chance in a year event it is predicted that there would currently be 110 residential properties and 180 manufactured homes affected. Under the 'with Project' scenario, it is predicted that there would be a 7 percent reduction in the number of residential properties and manufactured homes affected by a 1 in 100 chance in a year event.

A unique feature of the Hawkesbury Estuary are small riverside pocket communities which are only accessible by boat. For example, in the community of Berowra Creek, there are approximately 150 houses, a restaurant and five short-term accommodation units. On Dangar Island, there are approximately 170 houses, a coffee shop, three accommodation providers and a bowling club. Following a flood event, water discharge from the FMZ may result in social and economic impacts as water levels and velocities downstream of the Dam would be higher for a longer period than the existing situation (refer to Chapter 15 of the EIS with regard to flooding and hydrology assessment). This would lead to more prolonged flood conditions. As a result, access to some properties may be inhibited for a longer period, however as tidal water flows would remain more significant than any additional flooding it is expected that there would be very little impact on accessibility.

There are no recorded rural activity areas or commercial or industrial properties in the Central Coast LGA affected by flooding related to the estuary.

Impacts include:

- small reduction in the number of properties inundated by flooding
- increased duration of inhibited access to and from property due to release of the FMZ.

21.7.4.2 Environment

A feature throughout the estuary communities' study area is the highly-appealing and sought-after viewpoints of steep gorges descending into a picturesque marine estuarine environment. There are many viewpoints throughout the estuary communities' study area, with the viewpoint from Brooklyn Bridge likely the most iconic due to the extent of road and rail-related viewers. The Project would result in more prolonged flood conditions being experienced following major flood events due to the discharge of the FMZ. This would potentially mean that views of the

Hawkesbury estuarine environment would be changed for a more prolonged period than currently occurs. While it is not predicted that the Project would have any permanent effect on visual characteristics of the river and river bank, the extended duration of elevated flood waters would prolong disturbance of viewsheds.

Throughout the estuary communities' study area, there are a multitude of natural areas enjoyed by residents and visitors. The Project would reduce the severity and frequency of such areas experiencing flooding. A key attraction throughout the Hawkesbury Estuary are picturesque areas for swimming and aquatic recreation. Release of the FMZ following a large flood event may result in such locations experiencing flood conditions for a more prolonged period. This may temporarily affect the desirability of some areas for swimming and recreational activities.

Impacts include:

- temporary alteration of visual amenity associated with release of the FMZ
- temporary disruption to the enjoyment of natural areas.

21.7.4.3 Community health and wellbeing

Across the estuary communities' study area, there are numerous semi-permanent styles of housing, such as cabins and caravan parks. Caravan parks are typically located on the banks of the river, taking advantage of highly scenic amenity and ready access to recreational opportunities. As such, they are likely to be affected by flooding. By reducing the frequency of smaller flood events (including 1 in 5, 1 in 10 and 1 in 20 chance in a year events), the Project would reduce the exposure of homeless persons and people living (both permanently or temporarily) in vulnerable forms of housing such as caravan parks. As a result of the gradual release of the water stored in the FMZ following a major flood event, some residential areas only accessible by boat or ferry may experience inhibited access to health facilities for a longer duration.

A key activity throughout the Hawkesbury Estuary is swimming and aquatic recreation. Release of the FMZ following a large flood event may result in such popular swimming and recreational locations experiencing flood conditions for a more prolonged period. This may temporarily affect water quality in some areas used for swimming and recreational activities.

Impacts include:

- reduced risk to people living in highly vulnerable forms of housing
- occasional reduced access to services and health facilities
- potential health risks relating to temporary reduction in water quality.

21.7.4.4 Culture and heritage

The Non-Aboriginal cultural heritage assessment (refer to Chapter 17 of the EIS) determined that there was a total of 71 heritage items currently listed in the estuary communities' study area. The outcome of this Assessment found that the Project would provide no flood mitigation for World Heritage Listed items and National Heritage Listed items in the estuary communities' study area. The Project may have a negative impact on these areas with increased inundation times due to the slow release of inflows, however this is considered unlikely. The assessment also determined that there would be no impact for any significant impact criteria on the Old Great Northern Road sites and Ku-ring-gai Chase National Park. The physical assessment for the Old Great North Road heritage site determined that there may be a minor impact.

Impacts include enhanced protection of sites of cultural heritage significance.

21.7.4.5 Way of Life

The Hawkesbury Estuary is integral to the local economy and any change to conditions of the estuary would have economic implications. The mooring and servicing of boats is a highly significant industry in the Hawkesbury Estuary. By alleviating potential for downstream flooding and thereby the risk of damage to boats and other infrastructure, the Project is expected to have a positive impact.

Fishing and marine aquaculture also make a key contribution to the local economy. Oyster aquaculture was reported to be worth \$437,664 for FY2016/2017 (DPI 2017b). This has increased significantly from FY2012/2013 where oyster aquaculture in the Hawkesbury River was valued at \$34,297 (NSW DPI 2017b). The oyster industry was decimated by the QX disease outbreak in 2004 with 90 percent of the oysters growing in the 245-hectare growing area dying. Further, in 2013, the Pacific Oyster Mortality Syndrome (POMS) virus devastated oyster farms within the Lower Hawkesbury Estuary. However, oyster farming in the Lower Hawkesbury Estuary is recovering.

Oyster aquaculture is highly susceptible to development and water quality alteration. Agriculture practices such as cropping, and grazing can increase the amount of sediment and pesticide runoff into waterways which would be detrimental to oyster aquaculture (DPI 2017b). With the Project retaining inflows and altering flow regime, this could affect the oyster aquaculture industry. Alleviating potential for flooding in the Hawkesbury Estuary may be beneficial for oyster production, however an increased duration of flooding may have a negative effect.

In the Hawkesbury Estuary, Brooklyn is a centre for commercial fishing and prawn industries. The outcome Water Quality Assessment (refer to Chapter 27 of the EIS) indicates that there is no significant, long-term and adverse impact on water quality predicted in the estuary communities' study area due to the release of water from the FMZ. Therefore, the Project would have no effect upon fish and prawns.

Impacts include:

- positive economic effects due to reduced flood related damage to property
- occasional, potential and additional economic losses for fishing and aquaculture-related businesses due to release of the FMZ.

Table 21-16 summarises the socio-economic impacts the Project's estuary communities' study area.

Table 21-16. Summary of socio-economic impacts and their significance rating for the Project's estuary communities' study area

No.	Impact	Positive/negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Property and land use						
1	Small reduction in the number of properties inundated by flooding	Positive	Estuary property owners inundated by flooding in a 1 in 100 chance in a year event	Possible	Minor	C2 – Moderate
2	Increased duration of inhibited access to and from property due to release of the FMZ	Negative	Estuary property owners affected due to release of the FMZ	Possible	Moderate	C3 – High
Environment						
3	Alteration of visual amenity associated with release of the FMZ	Negative	Estuary communities and tourists	Possible	Minor	C2 – Moderate
4	Disruption to the enjoyment of natural areas	Negative	Estuary communities and tourists	Unlikely	Minor	D2 – Low
Community health and wellbeing						
5	Reduced risk to people living in highly vulnerable forms of housing.	Positive	Estuary communities living in highly forms of housing	Likely	Major	B4 – Extreme
6	Occasional reduced access to services and health facilities	Negative	Estuary communities	Unlikely	Moderate	D3 – Moderate
7	Health risk relating to temporary reduction in water quality	Negative	Recreation users	Unlikely	Minor	D2 – Low
Culture and heritage						
8	Enhanced protection of non-Aboriginal cultural heritage	Positive	Estuary communities and tourists	Possible	Moderate	C3 – High

No.	Impact	Positive/ negative	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
				Likelihood	Consequence	
Way of life						
9	Positive economic effects due to reduced flood related damage to property for fishing, recreation and aquaculture-related businesses	Positive	Tourism and recreation-related businesses, relevant industries, recreational users, and estuary LGAs	Possible	Moderate	C3 – High
10	Occasional, potential and additional economic losses for fishing and aquaculture-related businesses	Negative	Fishing and aquaculture-related businesses and industries	Unlikely	Moderate	D3 – Moderate

21.8 Impact mitigation/enhancement and residual assessment

The following tables (Table 21-17 for the local communities' study area, Table 21-18 for the upstream communities' study area, Table 21-19 for the downstream communities' study area, and Table 21-20 for the estuary communities' study area) provide impact mitigation and residual assessment in each SEIA study area.

Table 21-17. Local communities' study area impact mitigation/enhancement and residual assessment

No	LOCAL COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Property and land use								
1	Construction — Temporary disruption of tourism and recreation uses due to the potential temporary closure of the Warragamba Dam Visitor Centre and Haviland Park	Almost Certain	Moderate	(-) A3 – Extreme	<p>Establish a new walking trail for the public.</p> <p>Local communities and visitors would be notified about construction activities, the temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Assess options to continue functions of the Visitor Centre at alternative locations to ensure public safety during construction.</p> <p>Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions to reduce disruption of areas surrounding the Project site.</p> <p>Consult with the local community to select a legacy project to be delivered upon construction completion:</p> <ul style="list-style-type: none"> ▪ Upgrade the viewing platform on Eighteenth Street with a shelter, interpretive signage and other enhancements. ▪ Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials. ▪ Provide alternative BBQ and picnic facilities within the Wollondilly Shire to offset the temporary closure of facilities within the construction area. 	Almost Certain	Minor	(-) A2 – High

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
2	Construction — Delayed travel time in accessing properties due to increased construction traffic	Almost Certain	Minor	(-) A2 – High	<p>Implement the Construction Traffic Management Plan developed as part of the Traffic and Transport Assessment (refer to Chapter 24 and Appendix O of the EIS).</p> <p>Installation of temporary traffic control measures and signage for safe movement of vehicles, pedestrians and cyclists accessing local community facilities, shopping centres and schools.</p> <p>Local communities would be notified about construction activities, the potential temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Possible	Minimal	(-) C1 – Low
Environment								
3	Construction — Temporary negative visual impacts	Likely	Moderate	(-) B3 – High	<p>Implement impact mitigation measures as outlined in Appendix P (Landscape and visual impact assessment.)</p> <p>Reduce visual impacts through appropriate landscaping and incorporation of other screening solutions where appropriate.</p> <p>Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials.</p>	Possible	Minor	(-) C2 – Moderate
4	Post construction — Positive landscape character	Likely	Moderate	(+) B3 – High	<p>Consult with the local community to select a legacy project to be delivered upon construction completion.</p> <p>Provide information regarding the Project to tourism related agencies to assist them promote the area as a tourism attraction.</p> <p>Rehabilitation and landscaping of the cleared and disturbed areas.</p>	Almost certain	Moderate	(+) A3 – Extreme

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
5	Construction — Temporary noise impacts on social amenity	Likely	Moderate	(-) B3 – High	<p>Develop and implement a construction noise and vibration management plan – which would include detailed mitigation measures such as enclosing noise plant and equipment, scheduling noisy works and management of traffic.</p> <p>Notify the community of construction activities in advance.</p> <p>Consideration of the program and timing of community events (such as Dam Fest) when developing the construction program and specific noisy activities which would detract from the amenity of such events.</p> <p>Develop and implement a construction Community and Stakeholder Engagement Plan (Construction CSEP) which includes a complaints management process and provision of timely information to communities.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Likely	Minor	(-) B2 – High
6	Construction — Temporary air quality impacts	Possible	Minor	(-) C2 – Moderate	<p>Develop and implement an Air Quality Management Plan which would include detailed mitigation measures such as enclosing dust generating activities, dust suppression and monitoring.</p> <p>Develop and implement a Construction CSEP which includes a complaints management process and provision of timely information to communities.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Possible	Minimal	(-) C1 – Low
7	Construction — Temporary disruption to the enjoyment of natural surroundings	Likely	Moderate	(-) B3 – High	<p>Clearing areas would be minimised during detailed design and construction.</p> <p>Rehabilitation and landscaping of the cleared and disturbed areas.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p> <p>Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions to reduce the disruption to the enjoyment of natural surroundings.</p>	Possible	Minor	(-) C2 – Moderate

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Community health and wellbeing								
8	Construction — Temporary risks to road safety due to construction traffic movements	Possible	Catastrophic	(-) C5 – Extreme	<p>Develop and implement a Construction Traffic Management Plan which includes mitigation measure such as driver code of conduct, traffic scheduling, nominated heavy vehicle routes and temporary traffic management measures.</p> <p>Implement road safety initiatives during construction.</p> <p>Delivery of driver and community education and awareness initiatives regarding traffic safety.</p> <p>Improve traffic signage at key impacted localities to increase community and visitor awareness.</p> <p>Notify the community of construction activities in advance.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p> <p>Ongoing consultations with relevant NSW Government agencies such as Emergency Services, Roads and Maritime and local government.</p> <p>Develop and implement a Construction CSEP which includes a complaints management process and provision of timely information to communities.</p>	Possible	Moderate	(-) C3 – High

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
9	Construction — Temporary anxiety relating to community safety due to additional construction traffic movements	Possible	Minor	(-) C2 – Moderate	<p>Develop and implement a Construction Traffic Management Plan which includes mitigation measures such as driver code of conduct, traffic scheduling, nominated heavy vehicle routes and temporary traffic management measures.</p> <p>Delivery of driver and community education and awareness initiatives regarding traffic safety.</p> <p>Improve traffic signage at key impacted localities to increase community and visitor awareness.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p> <p>Ongoing consultations with relevant NSW Government agencies such as Emergency Services, Roads and Maritime and local government.</p> <p>Develop and implement a Construction CSEP which includes a complaints management process and provision of timely information to communities.</p>	Possible	Minimal	(-) C1 – Low
10	Construction — Temporary pressure on existing medical and emergency services due to influx of construction workforce	Possible	Minor	(-) C2 – Moderate	<p>Engage with medical and emergency service providers as part of ongoing planning and Project development.</p> <p>Provision of appropriate onsite medical response facilities and personnel.</p> <p>Develop and implement safety protocols including an emergency response plan.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Unlikely	Minimal	(-) D1 – Low

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Culture and heritage								
11	Construction — Temporary and permanent disturbance of non-Aboriginal heritage items	Almost certain	Moderate	(-) A3 – Extreme	<p>Incorporation of heritage into the design such as through completion of a Heritage Interpretation Strategy.</p> <p>Photographic archival recording heritage items that may be damaged or destroyed by construction activities.</p> <p>Where feasible, retain and display significant heritage items as movable heritage.</p> <p>Development and implementation of a moveable heritage item strategy for items such as the Warragamba Supply scheme, including machinery, equipment, plaques, and memorials.</p> <p>Application of site remediation measures for the construction sites including Haviland Park.</p> <p>Preparation of an archaeological research design to identify the need for archaeological testing and monitoring.</p> <p>Documentation of the condition of existing heritage items prior to disturbance, removal or change.</p>	Almost certain	Minor	(-) A2 – High
12	Construction — Temporary impacts on natural heritage (such as local parkland and native bushland flora and fauna)	Almost certain	Moderate	(-) A3 – Extreme	<p>Ensure that environmental impacts are offset, where possible, through implementation of the Biodiversity Offset Strategy.</p> <p>Clearing of vegetation would be minimised during detailed design and construction.</p> <p>Rehabilitation and landscaping of the cleared and disturbed areas.</p>	Almost certain	Minor	(-) A2 – High

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Way of life								
13	Construction — Temporary generation of employment opportunities	Likely	Minor	(+) B2 – High	<p>Provide a clear and efficient process for people to access information about employment and provide an opportunity to register interest in the Project.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers.</p> <p>Develop a framework to increase the representation of young people, Aboriginal and Torres Strait Islander people and women in the construction industry by providing employment pathways, training and skills development.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Likely	Moderate	(+) B3 – High
14	Construction — Temporary generation of commercial opportunities for businesses	Likely	Minor	(+) B2 – High	<p>Develop a local procurement policy to encourage the Project's contactors, where possible, source their workforce and their suppliers for goods and services locally.</p> <p>Provide a process for local businesses to register interest in project-related supplier and service provider opportunities.</p> <p>Work with the local networks and local businesses to organise and plan for how to benefit from the incoming workforce.</p> <p>Work with government stakeholders to build businesses' capacity through business development and mentoring.</p> <p>Work with the local networks and local businesses to organise and plan for how to benefit from the Project.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Likely	Moderate	(+) B3 – High

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
15	Construction — Perceived temporary negative effects on Tourism industry	Likely	Moderate	(-) B3 – High	<p>Local communities and visitors to be notified about construction activities, the potential temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Assess options to continue functions of the Visitor Centre at alternative location/s while ensuring public safety during construction.</p> <p>Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions to reduce disruption of areas surrounding the Project site.</p> <p>Work with the local networks and local businesses to organise and plan for how to benefit from the Project.</p> <p>Consult with the local community to select a legacy project to be delivered upon construction completion.</p> <p>Upgrade the viewing platform on Eighteenth Street with a shelter, interpretive signage and other enhancements.</p> <p>Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials.</p> <p>Provide alternative BBQ and picnic facilities within the Wollondilly Shire to offset the potential temporary closure of facilities within the construction area.</p>	Likely	Minor	(-) B2 – High
16	Post construction — Increase in visitation numbers to the Dam	Possible	Minor	(+) C2 – Moderate	<p>Consult with the local community to select a legacy project to be delivered upon construction completion.</p> <p>Establish a new walking trail for the public.</p> <p>Provide information regarding the Project to tourism related agencies to assist them promote the area as a tourism attraction.</p> <p>After construction, add project information to the Visitor Centre display.</p>	Likely	Minor	(+) B2 – High

LOCAL COMMUNITIES' STUDY AREA								
No	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
17	Construction — Temporary impacts on community sentiment, cohesion, and resentment	Possible	Moderate	(-) C3 – High	<p>Work with the Dam Fest committee to support its ongoing success during the four-year construction phase.</p> <p>Workforce fundraising to contribute to local Warragamba initiatives as voted by the community.</p> <p>Development and implementation of a Code of Conduct for the workforce.</p> <p>Actively engage with local communities to understand concerns and expectations and identify mitigation measures.</p> <p>Provision of regular Project construction updates to the community.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers. Consult with the local community to select a legacy project to be delivered upon construction completion. Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials. Develop and implement a Local Industry Participation Plan for construction.</p> <p>Develop and implement a Construction CSEP which includes a complaints management process and provision of timely information to communities.</p> <p>On-site parking for all construction vehicles.</p>	Possible	Minor	(-) C2 – Moderate

Table 21-18. Upstream communities' study area impact mitigation/enhancement and residual assessment

No	UPSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Property and land use								
1	Operation — Community concern regarding effects on World Heritage listed areas	Likely	Moderate	(-) B3 – High	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy. Consultation with GBMWA Advisory Committee and State/Federal government agencies regarding impacts and mitigation measures. Implementation of environmental management plan (EMP) measures which also aid in maintaining the environmental condition of the GBMWA.	Possible	Minor	(-) C2 – Moderate
2	Operation — Community concern regarding effects on National Parks	Likely	Minor	(-) B2 – High	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy. Consultation with GBMWA Advisory Committee, NPWS and State/Federal government agencies regarding impacts and mitigation measures. Implementation of EMP measures which also aid in maintaining the environmental condition of the National Parks.	Possible	Minor	(-) C2 – Moderate
3	Operation — Direct effects on two private properties due to temporary and partial inundation of land	Almost Certain	Minor	(-) A2 – High	Regular engagement with the two impacted property owners (as per a Community and Stakeholder Engagement Plan) to explain actual impacts and benefits, understand concerns and identify mitigation measures.	Almost Certain	Minimal	(-) A1 – High

No	UPSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
4	Operation — Changed access to properties at Yerranderie	Unlikely	Minor	(-) D2 – Low	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Consultation with GBMWA Advisory Committee, NPWS, and Yerranderie Management Committee and State/Federal government agencies regarding impacts and mitigation measures.	Unlikely	Minimal	(-) D1 – Low
Environment								
5	Operation — Alteration to upstream iconic viewsheds	Unlikely	Major	(-) D4 – High	Implementation of EMP measures which include appropriate revegetation and management actions of impacted land.	Unlikely	Moderate	(-) D3 – Moderate
6	Operation — Alterations to viewpoints from walking, mountain bike and 4WD trails	Rare	Minor	(-) E2 – Low	Implementation of EMP measures which include appropriate revegetation and management actions of impacted land.	Rare	Minimal	(-) E1 – Low
7	Operation — Disruption to enjoyment of native flora and fauna	Likely	Moderate	(-) B3 – High	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy. Consultation with DPIE and State/Federal government agencies regarding impacts and mitigation measures. Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment.	Possible	Minor	(-) C2 – Moderate
Community health and wellbeing								
8	Operation — Health effects associated with heightened anxiety	Unlikely	Moderate	(-) D3 – Moderate	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures.	Unlikely	Minor	(-) D2 – Low

No	UPSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Culture and heritage								
9	Operation — Negative effects on Aboriginal cultural heritage	Likely	Moderate	(-) B3 – High	<p>Provide opportunities for the Aboriginal community to be involved in the management of cultural sites and the landscape.</p> <p>Highlight traditional and historical Aboriginal heritage of the Warragamba area through displays and interpretation at suitable locations such as the Warragamba Dam Visitor Centre and lookout and through establishing and facilitating educational sessions focusing on Aboriginal heritage for school students in Warragamba.</p> <p>Maintain and update a GIS database of Aboriginal heritage sites in the study areas.</p> <p>Conduct heritage awareness training which can be incorporated into the site inductions for both employees and sub-contractors involved in the operation of the Dam and activities in the catchment of Lake Burragorang.</p> <p>Ensure ongoing active engagement with traditional custodians, including through the Gundungurra Indigenous Land Use Agreement and other key stakeholder groups.</p>	Possible	Minor	(-) C2 – Moderate
10	Operation — Negative effects on natural heritage	Possible	Moderate	(-) C3 – High	<p>Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy.</p> <p>Create a dedicated offset fund to specifically address any impacts from the Project.</p>	Possible	Minor	(-) C2 – Moderate
Way of life								
11	Operation — Reduced tourism visitation due to perceived environmental impacts	Possible	Minor	(-) C2 – Moderate	<p>Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts and benefits, understand concerns and identify mitigation measures.</p> <p>Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy.</p> <p>Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment.</p>	Possible	Minimal	(-) C1 – Low

No	UPSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
12	Operation — Reduction in revenue for nature-based recreation businesses due to perceived environmental impacts	Unlikely	Moderate	(-) D3 – Moderate	Regular engagement with local communities, tourism businesses and groups (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy. Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment.	Unlikely	Minor	(-) D2 – Low
13	Operation — Diminished enjoyment of community values	Possible	Moderate	(-) C3 – High	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy. Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment.	Possible	Minor	(-) C2 – Moderate
14	Operation — Polarisation of community sentiment resulting in reduced community cohesion	Possible	Moderate	(-) C3 – High	Regular engagement with community leaders and the broader community throughout the construction and initial operational phases to build understanding of Project related effects and benefits. Provide timely and transparent information to communities whose lifestyle and amenity may be impacted by the Project as per the Project's Community and Stakeholder Engagement Plan.	Possible	Minor	(-) C2 – Moderate

Table 21-19. Downstream communities' study area impact mitigation/enhancement and residual assessment

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Property and land use								
1	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Liverpool (primarily limited to Wallacia)	Almost Certain	Minor	(+) A2 – High	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Almost Certain	Moderate	(+) A3 – Extreme
2	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Penrith	Almost Certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Almost Certain	Major	(+) A4 – Extreme
3	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Blacktown	Almost Certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Almost Certain	Major	(+) A4 – Extreme
4	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding)	Almost Certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts.	Almost Certain	Major	(+) A4 – Extreme

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
	and improved evacuation) in the LGA of Hawkesbury				Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.			
5	Operation — Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of The Hills (primarily limited to Wisemans Ferry)	Almost Certain	Moderate	(+) A3 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Almost Certain	Major	(+) A4 – Extreme
6	Operation — Decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge	Possible	Moderate	(-) C3 – High	Work with relevant agencies to develop and implement updated emergency evacuation plans. Inform stakeholders on the duration of inhibited access to and from properties due to release of the FMZ.	Possible	Minor	(-) C2 – Moderate
Environment								
7	Alteration of visual amenity associated with release of the FMZ	Possible	Minor	(-) C2 – Moderate	Not applicable	Possible	Minor	(-) C2 – Moderate
8	Avoidance of altered visual amenity due to reduction in the extent of flood inundation associated with most flood events	Likely	Minor	(+) B2 – High	Not applicable	Likely	Minor	(+) B2 – High

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
9	Operation — Disruption to the enjoyment of natural areas and the flora and fauna they support	Unlikely	Minor	(-) D2 – Low	Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy. Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions for the loss or displacement of native species.	Unlikely	Minimal	(-) D1 – Low
Community health and wellbeing								
10	Enhanced safety of residential areas due to reduced extent and frequency of floods, including reduced risk of post-flooding infectious disease	Almost certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Almost certain	Major	(+) A4 – Extreme
11	Enhanced safety due to improved ability to evacuate communities	Almost certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Almost certain	Major	(+) A4 – Extreme
12	Reduced risk to people living in highly vulnerable forms of housing	Almost certain	Major	(+) A4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts.	Almost certain	Major	(+) A4 – Extreme

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
					<p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>			
13	Reduced risk to vulnerable people living in social housing at risk of flooding	Likely	Major	(+) B4 – Extreme	<p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>Project's Community and Stakeholder Engagement Plan to include inclusive and participatory engagement modes, including consideration of different language needs.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Likely	Major	(+) B4 – Extreme
14	Operation — Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency	Possible	Minor	(-) C2 – Moderate	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p> <p>Work with relevant agencies to develop and implement updated Emergency Evacuation Plans.</p>	Possible	Minimal	(-) C1 – Low

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
15	Operation — Improved access to key services, and health facilities	Possible	Moderate	(+) C3 – High	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Possible	Moderate	(+) C3 – High
16	Operation — Occasional reduced access to services and health facilities during discharge of water from the FMZ	Possible	Minor	(-) C2 – Moderate	<p>Implement the impact mitigation measures as per transport and traffic assessment report.</p> <p>Work with relevant agencies to develop and implement updated emergency evacuation plans.</p> <p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Possible	Minimal	(-) C1 – Low
17	Health risk relating to temporary reduction in water quality	Unlikely	Minor	(-) D2 – Low	<p>Regular monitoring of water quality and application of corrective measures as required.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p>	Unlikely	Minimal	(-) D1 – Low
18	Reduced adverse effects on mental health due to	Likely	Major	(+) B4 – Extreme	<p>Provision of mental health support to those affected by flood events</p>	Likely	Major	(+) B4 – Extreme

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
	reduced experience of severe flood events							
19	Reduced economic costs related to mental health issues associated with flooding	Likely	Major	(+) B4 - Extreme	Provision of mental health support to those affected by flood events	Likely	Major	(+) B4 - Extreme
20	Reduced health risk to water borne disease	Likely	Major	(+) B4 - Extreme	awareness raising and provision of health assistance to those affected by water borne disease	Likely	Major	(+) B4 - Extreme
Culture and heritage								
21	Effects on Aboriginal cultural heritage	Unlikely	Minimal	(-) D1 – Low	Impact is assessed being negligible and no mitigation required.	Unlikely	Minimal	(-) D1 – Low
22	Enhanced protection of non-Aboriginal cultural heritage	Possible	Moderate	(+) C3 – High	Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with Aboriginal parties in the protection of Aboriginal heritage as per the findings of the ACHA. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Possible	Major	(+) C4 – Extreme
23	Potential effects on listed cultural heritage due to release of the FMZ	Unlikely	Moderate	(-) D3 – Moderate	Develop and adopt an owner's guide to deal with the effects of flooding and prolonged exposure for heritage items impacted by the discharge of the FMZ. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. During floods, WaterNSW will implement operating protocols to minimise downstream impacts. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Unlikely	Minor	(-) D2 – Low

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Way of life								
24	Positive economic effects due to reduced flood related damage to property	Almost certain	Major	(+) A4 – Extreme	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Almost certain	Major	(+) A4 – Extreme
25	Reduced risk of people permanently and temporarily losing access to housing and accommodation	Almost certain	Major	(+) A4 – Extreme	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Almost certain	Major	(+) A4 – Extreme
26	Improved confidence in housing market and potential reduction in insurance premiums	Possible	Moderate	(+) C3 – High	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p>	Almost certain	Moderate	(+) A3 – Extreme

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
					WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .			
27	Potential reduction in insurance premiums at individual properties	Possible	Moderate	(+) C3 – High	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Almost certain	Moderate	(+) A3 – Extreme
28	Reduction in flood related economic losses for agricultural and industrial businesses	Almost certain	Moderate	(+) A3 – Extreme	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Almost certain	Moderate	(+) A3 – Extreme
29	Occasional additional economic losses for agricultural and industrial businesses	Possible	Moderate	(-) C3 – High	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p>	Possible	Minor	(-) C2 – Moderate

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
					Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .			
30	Reduction in flood related economic losses for tourism and recreation related businesses	Almost certain	Minor	(+) A2 – High	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Almost certain	Minor	(+) A2 – High
31	Occasional additional economic losses for tourism and recreation related businesses	Possible	Minor	(-) C2 – Moderate	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Possible	Minimal	(-) C1 – Low
32	Improved community cohesion due to improved ability to	Possible	Moderate	(+) C3 – High	During floods, WaterNSW will implement operating protocols to minimise downstream impacts.	Possible	Moderate	(+) C3 – High

No.	DOWNSTREAM COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
	control flood related risk and plan communities accordingly				<p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>			

Table 21-20. Estuary communities impact mitigation/enhancement and residual assessment

No.	ESTUARY COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Property and land use								
1	Small reduction in the number of properties inundated by flooding	Possible	Minor	(+) C2 – Moderate	<p>During floods, WaterNSW will implement operating protocols to minimise downstream impacts.</p> <p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Possible	Moderate	(+) C3 – High
2	Increased duration of inhibited access to and from property due to release of the FMZ	Possible	Moderate	(-) C3 – High	<p>Collaborate with communities which are only accessible by boat to fully understand how flooding affects accessibility and integrating this into FMZ discharge planning.</p> <p>Inform property owners as to the predicted duration of inhibited access to and from properties due to release of the FMZ.</p> <p>WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Possible	Minor	(-) C2 – Moderate
Environment								
3	Alteration of visual amenity associated with release of the FMZ	Possible	Minor	(-) C2 – Moderate	Not applicable	Possible	Minor	(-) C2 – Moderate
4	Disruption to the enjoyment of natural areas	Unlikely	Minor	(-) D2 – Low	Not applicable	Unlikely	Minor	(-) D2 – Low

No.	ESTUARY COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Community health and wellbeing								
5	Reduced risk to people living in highly vulnerable forms of housing	Likely	Major	(+) B4 – Extreme	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Likely	Major	(+) B4 – Extreme
6	Occasional reduced access to services and health facilities	Unlikely	Moderate	(-) D3 – Moderate	Collaborate with communities which are only accessible by boat to fully understand how flooding affects accessibility and integrating this into FMZ discharge planning. Inform property owners as to the predicted duration of inhibited access to and from properties due to release of the FMZ. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Unlikely	Minimal	(-) D1 – Low
7	Health risk relating to temporary reduction in water quality	Unlikely	Minor	(-) D2 – Low	Regular monitoring of water quality and application of corrective measures as required.	Unlikely	Minimal	(-) D1 – Low
Culture and values								
8	Enhanced protection of non-Aboriginal cultural heritage	Possible	Moderate	(+) C3 – High	Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Possible	Moderate	(+) C3 – High

No.	ESTUARY COMMUNITIES' STUDY AREA							
	Impact	Impact assessment before mitigation/enhancement		Significance rating	Mitigation/enhancement measures	Impact assessment after mitigation/enhancement		Significance rating
		Likelihood	Consequence			Likelihood	Consequence	
Way of life								
9	Positive economic effects due to reduced flood related damage to property	Possible	Moderate	(+) C3 – High	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> . Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.	Possible	Moderate	(+) C3 – High
10	Occasional, potential and additional economic losses for fishing and aqua-culture businesses	Unlikely	Moderate	(-) D3 – Moderate	During floods, WaterNSW will implement operating protocols to minimise downstream impacts. WaterNSW will continue to work with the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .	Unlikely	Minor	(-) D2 – Low

21.9 Conclusions

Each of the study areas (including local communities, upstream communities, downstream communities and estuary communities) exhibit substantially different socio-economic characteristics and values and would experience very different impacts and benefits as a result of the Project. Ultimately it is the avoidance of loss of human life which is the single most significant social change provided by the Project. While the avoidance of even a single loss of life is an extreme positive social impact, the identified positive social benefits related to people's lives, homes, health and livelihoods assessed as having a residual significance rating of 'Extreme' would arise from the Project.

A summary of the anticipated socio-economic impacts and benefits associated with the Project in each of the SEIA study areas is provided as follows.

21.9.1 Local communities

Impacts relating to construction such as increased traffic, temporary closure of facilities, noise and air quality impacts would be experienced in the local communities' study area, primarily in the townships of Warragamba and Silverdale. These are relatively small and tight-knit communities in the Wollondilly Shire which are socially and inextricably linked to the Dam itself. Warragamba was established when the Dam was constructed, and the local economy remains dependent on the tourism which the Dam generates. These communities are highly familiar with the likely socio-economic effects associated with the Project, having experienced similar effects when the auxiliary spillway was built in 2006. They are concerned about prolonged exposure to noise, the dust generated by construction activities and the number of truck movements, particularly on Silverdale Road.

Warragamba has struggled economically to rebound from the effects of the closure of tourist attractions in the area such as the Bullen's African Safari Lion Park along with the bushfires in 2001-2002 in which numerous buildings in the town centre were lost. A further key factor influencing the economic vitality of the town is the changed nature of visitation. The Warragamba Dam was a very popular weekend destination for families from Sydney who would spend the best part of a day viewing the Dam, having a picnic and visiting some of the businesses in the town. Over the last 20 years, the typical duration of visitation has reduced to a couple of hours spent viewing the Dam and Visitor Centre and then moving on. Relatively few tourists visit the town itself - the general layout of which is not conducive to encouraging visitors to stop in.

The local economy has suffered as a result and a key concern of local residents is that the Project may further reduce tourism throughout the construction period with subsequent negative effects on local businesses which are already suffering. WaterNSW has recognised the potential vulnerability of local communities to such effects and has subsequently made numerous mitigation commitments including:

- work with the local community to select a legacy project to be delivered upon construction completion
- upgrade the viewing platform on Eighteenth Street with a shelter, interpretive signage and other enhancements
- develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials
- provide alternative BBQ and picnic facilities within the Wollondilly Shire to offset the temporary closure of facilities within the construction area
- establish a new walking trail for the public
- ensure that traffic impacts are managed through a comprehensive traffic management plan.

A summary of the socio-economic impacts predicted to occur in the local communities' study area is provided in Table 21-21.

Table 21-21. Summary of impacts – the local communities’ study area

Impact description	Impact nature	Residual significance rating
Post construction — Positive landscape character	Positive	Extreme
Construction — Temporary generation of employment opportunities	Positive	High
Construction — Temporary generation of commercial opportunities for businesses	Positive	High
Post construction — Increase in visitation numbers to the Dam	Positive	High
Construction — Temporary risks to road safety due to construction traffic movements	Negative	High
Construction — Temporary disruption of tourism and recreation uses due to the potential temporary closure of the Warragamba Dam Visitor Centre and Haviland Park	Negative	High
Construction — Temporary noise impacts on social amenity	Negative	High
Construction — Temporary and permanent disturbance of non-Aboriginal heritage items	Negative	High
Construction — Temporary impacts on natural heritage (such as local parkland and native bushland flora and fauna)	Negative	High
Construction — Perceived temporary negative effects on Tourism industry	Negative	High
Construction — Temporary negative visual impacts	Negative	Moderate
Construction — Temporary disruption to the enjoyment of natural surroundings	Negative	Moderate
Construction — Temporary impacts on community sentiment, cohesion, and resentment	Negative	Moderate
Construction — Delayed travel time in accessing properties due to increased construction traffic	Negative	Low
Construction — Temporary air quality impacts	Negative	Low
Construction — Temporary anxiety relating to community safety due to additional construction traffic movements	Negative	Low
Construction — Temporary pressure on existing medical and emergency services due to influx of construction workforce	Negative	Low

21.9.2 Upstream communities

Upstream communities are largely within the Blue Mountains LGA. Communities within the LGA have a unique character and identity. Community networks are very strong and there is a sense of pride attached with the natural, cultural and built heritage of the area. Values connected with environmental stewardship and sustainability are widespread and there is a sense of environmental responsibility associated with being in an area of natural beauty. The environmental values of the community are further reinforced by the economic importance of the tourism industry, which is based upon the enjoyment of the natural features of the region. Communities are relatively prosperous and increasingly sought after as a place to live and retire.

A defining feature of upstream communities are that they are within or adjacent to the Greater Blue Mountains World Heritage Area. The community values the world heritage listing and have expressed opposition to any action which is perceived to erode the values of world heritage and national park status. It is on this basis that there has been vocal

opposition to the Project, along with concerns regarding potential effects on Aboriginal cultural heritage as well as threatened and endangered flora and fauna.

There are no Project construction-related impacts likely to be experienced in upstream communities. The Project's operational impact would result in increased temporary inundation effects and changes to current temporary inundation extents, depths and durations, and rates of rising and receding flows. Direct effects are limited to two privately-owned lots which would be temporarily affected by inundation following a major flood event. In addition, while not a public access route, holding back inflows in the FMZ may result in impacts in access to Yerranderie Private Town from the east, a secondary access point only able to be utilised six times per year.

The Project would indirectly affect people who live in upstream communities, primarily through perceived impacts relating to world heritage and national park listed lands and effects on Aboriginal heritage and flora and fauna. Fervent opposition to major projects, particularly when there would be resultant environmental change and when people feel that events are occurring beyond their control, can cause high levels of stress and anxiety. Some members of the community feel threatened and anxious by perceived effects on environmental values. In particular, members of the Aboriginal community may feel disempowered by the potential impacts on cultural heritage. The organisation of campaigns against the Project may also fracture public opinions which can have a negative effect on community relationships and networks and resultant erosion of community cohesion.

WaterNSW has recognised the potential socio-economic effects which the Project may have upon people in the upstream communities and has subsequently made numerous mitigation commitments including:

- regularly engage community leaders and the broader community throughout the construction and initial operational phases to explain actual impacts and benefits to understand concerns and to identify mitigation measures
- ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy and creation of a dedicated fund to specifically address any impacts from the Project
- consult with GBMWA Advisory Committee and State and Federal government agencies regarding impacts and mitigation measures
- implement EMP measures which include appropriate revegetation and management actions of impacted land that would also aid in maintaining the environmental condition of the GBMWA
- provide opportunities for the Aboriginal community to be involved in the management of cultural sites and the landscape.

A summary of socio-economic impacts predicted to occur in the upstream communities' study area is provided in Table 21-22.

Table 21-22. Summary of impacts – the upstream communities' study area

Impact description	Impact nature	Residual significance rating
Operation — Direct effects on two private properties due to temporary and partial inundation of land	Negative	High
Operation — Negative effects on Aboriginal cultural heritage	Negative	Moderate
Operation — Negative effects on natural heritage	Negative	Moderate
Operation — Community concern regarding effects on World Heritage listed areas	Negative	Moderate
Operation — Community concern regarding effects on National Parks	Negative	Moderate
Operation — Alteration to upstream iconic viewsheds	Negative	Moderate
Operation — Disruption to enjoyment of native flora and fauna	Negative	Moderate
Operation — Diminished enjoyment of community values	Negative	Moderate
Operation — Polarisation of community sentiment resulting in reduced community cohesion	Negative	Moderate

Impact description	Impact nature	Residual significance rating
Operation — Changed access to properties at Yerranderie	Negative	Low
Operation — Health effects associated with heightened anxiety	Negative	Low
Operation — Alterations to viewpoints from walking, mountain bike and 4WD trails	Negative	Low
Operation — Reduced tourism visitation due to perceived environmental impacts	Negative	Low
Operation — Reduction in revenue for nature-based recreation businesses due to perceived environmental impacts	Negative	Low

21.9.3 Downstream communities

The downstream communities' study area encompasses the Hawkesbury-Nepean floodplain including areas within the LGAs of Liverpool, Penrith, Hawkesbury, Blacktown and The Hills. There is considerable diversity of socio-economic characteristics across such a broad area ranging from intensive urban and commercial centres in the Penrith and Blacktown LGAs, to peri-urban and rural land uses in Hawkesbury LGA with relatively small townships and hamlets.

Similarly, there is variation across the downstream communities' study area in terms of historical and predicted growth and development. The floodplain includes areas identified for permissible future development, including within the North West Priority Growth Area. While all new development must be above the 1 in 100 chance in a year event threshold, previous planning controls allowed residential development to occur on land which would be affected by a 1 in 100 chance in a year event. There are currently an estimated 5,000 residential lots which would be directly affected by a 1 in 100 chance in a year event.

A further feature of the Hawkesbury-Nepean floodplain is the 'bath-tub' effect which increases the depth of flooding which would occur in a major flood. Flood islands form in places such as McGraths Hill, Pitt Town and Bligh Park (refer Figure 21-9).

Figure 21-9 Looking east from Windsor to McGraths Hill during the February 2020 flood event



Source: Adam Hollingworth, provided by INSW (2021).

In a 1 in 100 chance in a year event it is estimated that 60,000 people would need to evacuate. This would place enormous pressure on evacuation routes and the capacity of emergency services. A further consideration is the extent of highly vulnerable forms of housing such as caravan and mobile home parks, many of which are located adjacent to the river on low lying land. The floodplain also includes approximately 1,600 social housing properties at risk of flooding in the valley. People in social housing are considered a key community of concern due to a high concentration of social and physical vulnerability and limited access to the means of evacuation.

Considering the nature of flooding on the Hawkesbury-Nepean floodplain and the number of people potentially affected, there is a very high risk that a major flood event would result in the loss of human life and catastrophic damage to infrastructure and property. The Project would reduce this risk as it would reduce the extent and severity of flood events and increase the certainty of time for evacuation. Avoiding the loss of human life is the most critical socio-economic benefit associated with the Project.

To maximise the benefits which the Project would deliver and mitigate potential socio-economic impacts, WaterNSW has made numerous commitments including:

- implement operating protocols to minimise downstream impacts during floods
- work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect the Project would have on flood risk
- work with relevant agencies to develop and implement updated Emergency Evacuation Plans
- inform stakeholders on the duration of inhibited access to and from properties due to release of the FMZ
- continue to work with the relevant NSW Government agencies to support the *Hawkesbury-Nepean Valley Flood Risk Management Strategy*
- develop and adopt an owner's guide to deal with the effects of flooding and prolonged exposure for heritage items impacted by the discharge of the FMZ.

A summary of socio-economic impacts predicted to occur in the downstream communities' study area is provided in Table 21-23.

Table 21-23. Summary of impacts – the downstream communities' study area

Impact description	Impact nature	Residual significance rating
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Liverpool	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Penrith	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Blacktown	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Hawkesbury	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of The Hills	Positive	Extreme
Enhanced safety of residential areas due to reduced extent and frequency of floods, including reduced risk of post-flooding infectious disease	Positive	Extreme
Enhanced safety due to improved ability to evacuate communities	Positive	Extreme
Reduced risk to people living in highly vulnerable forms of housing	Positive	Extreme

Impact description	Impact nature	Residual significance rating
Reduced risk to vulnerable people living in social housing at risk of flooding	Positive	Extreme
Enhanced protection of non-Aboriginal cultural heritage	Positive	Extreme
Positive economic effects due to reduced flood related damage to property	Positive	Extreme
Reduced risk of people permanently and temporarily losing access to housing and accommodation	Positive	Extreme
Improved confidence in housing market	Positive	Extreme
Potential reduction in insurance premiums at individual properties	Positive	Extreme
Reduced adverse effects on mental health due to reduced experience of severe flood events	Positive	Extreme
Reduced economic costs related to mental health issues associated with flooding	Positive	Extreme
Reduction in flood related economic losses for agricultural and industrial businesses	Positive	Extreme
Avoidance of altered visual amenity due to reduction in the extent of flood inundation associated with most flood events	Positive	High
Operation — Improved access to key services, and health facilities	Positive	High
Reduction in flood related economic losses for tourism and recreation related businesses	Positive	High
Improved community cohesion due to improved ability to control flood related risk and plan communities accordingly	Positive	High
Operation — Decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge	Negative	Moderate
Alteration of visual amenity associated with release of the FMZ	Negative	Moderate
Occasional additional economic losses for agricultural and industrial businesses	Negative	Moderate
Occasional additional economic losses for tourism and recreation related businesses	Negative	Low
Operation — Loss of flood mitigation benefits due to lack of land use planning controls	Negative	Low
Operation — Disruption to the enjoyment of natural areas and the flora and fauna they support	Negative	Low
Operation — Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency	Negative	Low
Operation — Occasional reduced access to services and health facilities during discharge of water from the FMZ	Negative	Low
Health risk relating to temporary reduction in water quality	Negative	Low
Effects on Aboriginal cultural heritage	Negative	Low
Potential effects on listed cultural heritage due to release of the FMZ	Negative	Low

21.9.4 Estuary communities

The estuary communities' study area encompasses the area from Wisemans Ferry to the Brooklyn Bridge. It comprises 24 suburbs across the LGAs of Hornsby, Northern Beaches and Central Coast. A key socio-economic characteristic is the relatively low population which lives in the estuary communities' study area, with the overall population being 9,368 people, across 2,596 households. Very few of these people live in areas adjacent to the estuary itself due to the high levels of restriction on residential development enforced by NSW Government agencies and local government. The dominant land use throughout is environmental conservation.

The Hawkesbury Estuary supports a variety of businesses and industries including oyster aquaculture, commercial fishing, agriculture, recreation, and tourism. Recreational boating and boat mooring are economically important industries, particularly in the lower reaches of the estuary where it is estimated that there are over 50,000 boats registered. NSW Fisheries estimates that approximately 150,000 recreational fishing outings occur in the Hawkesbury River each year.

The overall effect of the Project on socio-economic conditions in the estuary communities' study area is not considered to be substantial. By reducing the severity and extent of flood events, the Project would serve to reduce flood related risks to people living in vulnerable forms of housing such as caravan parks. It may also reduce the damage to boats incurred due to debris flowing downstream in major flood events. However, by increasing the duration of some flood events due to release of the FMZ, some businesses such as water ski parks may have a longer period in which they are unable to operate. Due to the minimal effect, which the Project would have upon water quality, it is not expected that the Project would have any effect upon the fin fish, oyster, and prawn industries.

To maximise the benefits which the Project would deliver and mitigate potential socio-economic impacts, WaterNSW has made commitments including:

- collaborate with communities which are only accessible by boat to fully understand how flooding affects accessibility and integrating this into FMZ discharge planning
- inform property owners as to the predicted duration of inhibited access to and from properties due to release of the FMZ
- implement operating protocols to minimise downstream impacts during floods
- monitor regularly water quality and apply corrective measures as required.

A summary of socio-economic impacts predicted to occur in the estuary communities' study area is provided in Table 21-24.

Table 21-24. Summary of impacts – the estuary communities' study area

Impact description	Impact nature	Residual significance rating
Reduced risk to people living in highly vulnerable forms of housing	Positive	Extreme
Small reduction in the number of properties inundated by flooding	Positive	High
Positive economic effects due to reduced flood related damage to property	Positive	High
Enhanced protection of non-Aboriginal cultural heritage	Positive	High
Increased duration of inhibited access to and from property due to release of the FMZ	Negative	Moderate
Alteration of visual amenity associated with release of the FMZ	Negative	Moderate
Disruption to the enjoyment of natural areas	Negative	Low
Health risk relating to temporary reduction in water quality	Negative	Low
Occasional reduced access to services and health facilities	Negative	Low
Occasional, potential and additional economic losses for fishing and aquaculture businesses	Negative	Low

21.10 Environmental management measures

Management measures discussed in Section 21.9 are summarised in Table 21-25, which have been developed to avoid, minimise or manage potential risks identified in Section 21.7. Management measures have been incorporated in the Environmental Management measures in Chapter 29 (EIS synthesis, Project justification and conclusion).

Table 21-25. Summary of mitigation and enhancement measures

Impact	ID	Mitigation management measure	Timing	Responsibility
Property and land use				
Construction — Temporary disruption of tourism and recreation uses due to the potential temporary closure of the Warragamba Dam Visitor Centre and Haviland Park.	SE1	<p>Local communities and visitors would be notified about construction activities, the temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Assess options to continue functions of the Visitor Centre at alternative locations to ensure public safety during construction.</p> <p>Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions to reduce disruption of areas surrounding the Project site.</p> <p>Consult with the local community to select a legacy project to be delivered upon construction completion:</p> <ul style="list-style-type: none"> ▪ Upgrade the viewing platform on Eighteenth Street with a shelter, interpretive signage and other enhancements. ▪ Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials. ▪ Provide alternative BBQ and picnic facilities within the Wollondilly Shire to offset the temporary closure of facilities within the construction area. 	Construction	WaterNSW
Construction — Delayed travel time in accessing properties due to increased construction traffic.	SE2	<p>Implement the Construction Traffic Management Plan developed as part of the Traffic and Transport Assessment (refer to Chapter 24 and Appendix O of the EIS).</p> <p>Installation of temporary traffic control measures and signage for safe movement of vehicles, pedestrians and cyclists accessing local community facilities, shopping centres and schools.</p> <p>Local communities would be notified about construction activities, the potential temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Construction	Construction contractor

Impact	ID	Mitigation management measure	Timing	Responsibility
Operation Upstream — Community concern regarding effects on World Heritage listed areas	SE3	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy. Consultation with GBMWHA Advisory Committee and State/Federal government agencies regarding impacts and mitigation measures. Implementation of environmental management plan (EMP) measures which also aid in maintaining the environmental condition of the GBMWHA.	Operation	WaterNSW
Operation Upstream — Community concern regarding effects on National Parks	SE4	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy. Consultation with GBMWHA Advisory Committee, NPWS and State/Federal government agencies regarding impacts and mitigation measures. Implementation of EMP measures which also aid in maintaining the environmental condition of the National Parks.	Operation	WaterNSW
Operation Upstream — Two private properties due to temporary and partial inundation of land	SE5	Regular engagement with the two impacted property owners (as per a Community and Stakeholder Engagement Plan) to explain actual impacts and benefits, understand concerns and identify mitigation measures.	Operation	WaterNSW
Operation Upstream — Changed access to properties at Yerranderie	SE6	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. Consultation with GBMWHA Advisory Committee, NPWS, and Yerranderie Management Committee and State/Federal government agencies regarding impacts and mitigation measures.	Operation	WaterNSW
Operation Downstream — Reduction in the impacts of flooding in the LGAs of Liverpool (primarily limited to Wallacia), Penrith, Blacktown, Hawkesbury, and The Hills (primarily limited to Wisemans Ferry)	SE7	WaterNSW will support the relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Operation	WaterNSW

Impact	ID	Mitigation management measure	Timing	Responsibility
Operation Downstream — Decreased frequency but increased duration of inhibited access to and from low lying property due to longer duration of the FMZ discharge	SE8	Work with relevant agencies to develop and implement updated emergency evacuation plans. Inform stakeholders on the duration of inhibited access to and from properties due to releases from the FMZ.	Operation	WaterNSW
Environment				
Construction — Temporary negative visual impacts	SE9	Implement impact mitigation measures as outlined in Appendix P (Landscape and visual impact assessment.) Reduce visual impacts through appropriate landscaping and incorporation of other screening solutions where appropriate. Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials.	Construction	WaterNSW
Post-Construction — Positive landscape character	SE10	Consult with the local community to select a legacy project to be delivered upon construction completion. Provide information regarding the Project to tourism related agencies to assist them promote the area as a tourism attraction. Rehabilitation and landscaping of the cleared and disturbed areas.	Post construction	WaterNSW
Community health and wellbeing				
Construction — Temporary pressure on existing medical and emergency services due to influx of construction workforce	SE11	Engage with medical and emergency service providers as part of ongoing planning and Project development. Provision of appropriate onsite medical response facilities and personnel. Develop and implement safety protocols including an emergency response plan. Provide support to Wollondilly Council to assist with project-related administration and enquiries.	Pre-construction and construction	WaterNSW
Operation Upstream — Health effects associated with heightened anxiety	SE12	Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures.	Operation	WaterNSW
Operation Downstream — <ul style="list-style-type: none"> ▪ Enhanced safety of residential areas due to reduced extent and frequency of floods, including 	SE13	WaterNSW will support the relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	Operation	WaterNSW

Impact	ID	Mitigation management measure	Timing	Responsibility
<p>reduced risk of post-flooding infectious disease</p> <ul style="list-style-type: none"> ▪ Enhanced safety due to improved ability to evacuate communities ▪ Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency ▪ Improved access to key services, and health facilities 		<p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p> <p>WaterNSW will support the relevant NSW Government agencies involved in the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>		
<p>Operation Downstream — Occasional reduced access to services and health facilities during discharge of water from the FMZ</p>	SE14	<p>Work with relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>WaterNSW will support the relevant NSW Government agencies involved in the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Operation	WaterNSW
<p>Operation Estuary — Occasional reduced access to services and health facilities</p>	SE15	<p>WaterNSW will support the relevant NSW Government agencies involved in the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p>	Operation	WaterNSW
Way of life				
<p>Construction — Temporary generation of employment opportunities</p>	SE16	<p>Provide a clear and efficient process for people to access information about employment and provide an opportunity to register interest in the Project.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers.</p> <p>Develop a framework to increase the representation of young people, Aboriginal and Torres Strait Islander people and women in the construction industry by providing employment pathways, training and skills development.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>	Construction	WaterNSW
<p>Construction — Temporary generation of commercial opportunities for businesses</p>	SE17	<p>Develop a local procurement policy to encourage the Project's contactors, where possible, source their workforce and their suppliers for goods and services locally.</p> <p>Provide a process for local businesses to register interest in project-related supplier and service provider opportunities.</p>	Construction	WaterNSW

Impact	ID	Mitigation management measure	Timing	Responsibility
		<p>Work with the local networks and local businesses to organise and plan for how to benefit from the incoming workforce.</p> <p>Work with government stakeholders to build businesses' capacity through business development and mentoring.</p> <p>Work with the local networks and local businesses to organise and plan for how to benefit from the Project.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers.</p> <p>Provide support to Wollondilly Council to assist with project-related administration and enquiries.</p>		
Construction — Perceived temporary negative effects on Tourism industry	SE18	<p>Local communities and visitors to be notified about construction activities, the potential temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.</p> <p>Assess options to continue functions of the Visitor Centre at alternative location/s while ensuring public safety during construction.</p> <p>Ongoing consultations with relevant NSW Government agencies and local government to identify and implement appropriate solutions to reduce disruption of areas surrounding the Project site.</p> <p>Work with the local networks and local businesses to organise and plan for how to benefit from the Project.</p> <p>Consult with the local community to select a legacy project to be delivered upon construction completion.</p> <p>Upgrade the viewing platform on Eighteenth Street with a shelter, interpretive signage and other enhancements.</p> <p>Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials.</p> <p>Provide alternative BBQ and picnic facilities within the Wollondilly Shire to offset the potential temporary closure of facilities within the construction area.</p>		WaterNSW
P-Construction — Increase in visitation numbers to the Dam	SE19	<p>Consult with the local community to select a legacy project to be delivered upon construction completion.</p> <p>Establish a new walking trail for the public.</p> <p>Provide information regarding the Project to tourism related agencies to assist them promote the area as a tourism attraction.</p> <p>After construction, add project information to the Visitor Centre display.</p>	Post construction	WaterNSW

Impact	ID	Mitigation management measure	Timing	Responsibility
Construction — Temporary impacts on community sentiment, cohesion, and resentment	SE20	<p>Work with the Dam Fest committee to support its ongoing success during the four-year construction phase.</p> <p>Workforce fundraising to contribute to local Warragamba initiatives as voted by the community.</p> <p>Development and implementation of a Code of Conduct for the workforce.</p> <p>Actively engage with local communities to understand concerns and expectations and identify mitigation measures.</p> <p>Provision of regular Project construction updates to the community.</p> <p>Liaise with local job network providers to provide information on employment opportunities to local job seekers. Consult with the local community to select a legacy project to be delivered upon construction completion. Develop options to deliver tourism to Warragamba during construction, such as viewpoints, tours or display materials. Develop and implement a Local Industry Participation Plan for construction.</p> <p>Develop and implement a Construction CSEP which includes a complaints management process and provision of timely information to communities.</p> <p>On-site parking for all construction vehicles.</p>	Construction	WaterNSW
Operation Upstream — <ul style="list-style-type: none"> ▪ Reduced tourism visitation due to perceived environmental impacts ▪ Reduction in revenue for nature-based recreation businesses due to perceived environmental impacts ▪ Diminished enjoyment of community values ▪ Polarisation of community sentiment resulting in reduced community cohesion 	SE21	<p>Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment.</p>	Operation	WaterNSW
Operation Downstream — <ul style="list-style-type: none"> ▪ Positive economic effects due to reduced flood related damage to property 	SE22	<p>WaterNSW will support the relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p>	Operation	WaterNSW

Impact	ID	Mitigation management measure	Timing	Responsibility
<ul style="list-style-type: none"> ▪ Reduced risk of people permanently and temporarily losing access to housing and accommodation ▪ Improved confidence in housing market and potential reduction in insurance premiums ▪ Potential reduction in insurance premiums at individual properties ▪ Reduction in flood related economic losses for agricultural and industrial businesses ▪ Occasional additional economic losses for agricultural and industrial businesses ▪ Reduction in flood related economic losses for tourism and recreation related businesses ▪ Occasional additional economic losses for tourism and recreation related businesses ▪ Improved community cohesion due to improved ability to control flood related risk and plan communities accordingly 		WaterNSW will support the relevant NSW Government agencies involved in the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i> .		
<p>Operation Estuary —</p> <ul style="list-style-type: none"> ▪ Positive economic effects due to reduced flood related damage to property ▪ Occasional potential and additional economic losses for fishing and aqua-culture businesses 	SE23	<p>WaterNSW will support the relevant NSW Government agencies to support the <i>Hawkesbury-Nepean Valley Flood Risk Management Strategy</i>.</p> <p>WaterNSW will support the relevant NSW Government agencies and local government to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.</p> <p>Publicly disclose the benefits of the Project to stakeholders via various appropriate communication channels as outlined in the Project's Community and Stakeholder Engagement Plan.</p>	Operation	WaterNSW

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